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ABSTRACTS
Bone Scintigraphy in the Surgical Staging of Skeletal Chondrosarcoma

Mr. Joshua D. Johnson¹, Mr. Michael Stuart¹, Mr. William Rainer¹, Mr. Franklin Sim¹, Mr. Peter Rose¹, Mr. Matthew Houdek¹
¹Mayo Clinic, Rochester, United States

Introduction:
Surgical staging is paramount prior to treatment of primary bone sarcomas. Traditionally, investigations included MRI to define local tumor extent, CT chest for pulmonary metastases, and bone scintigraphy for skeletal metastases. Available literature suggests skeletal metastases at diagnosis with chondrosarcoma are rare. Therefore, the purpose of this study was to assess the value of bone scintigraphy in surgical staging of chondrosarcoma.

Methods:
277 patients treated for chondrosarcoma from 1998-2017 were reviewed. Of these, 120 completed bone scintigraphy as part of surgical staging. There were 76 males and 44 females with mean age 53 years. Tumor location included pelvis/sacrum (n=45), femur (n=33), humerus (n=12), spine (n=10), scapula (n=8), sternum/ chest wall (n=8), radius (n=1), tibia (n=1), fibula (n=1), and calcaneus (n=1). Mean tumor size and volume were 9.7cm and 525.8cm³, respectively. Tumor grade/subtype included grade 1 (n=45), grade 2 (n=30), grade 3 (n=17), dedifferentiated (n=20), clear cell (n=6), and mesenchymal (n=2).

Results:
Eleven (9%) had bone scintigraphy concerning for metastases. Six proved benign after further investigation. The remaining five with biopsy proven skeletal metastases all had dedifferentiated histology. There was no correlation with patient demographics or other tumor factors. Of those who did not have bone scintigraphy, 19 had PET/CT. Two were positive for skeletal metastases and both had dedifferentiated histology. Of all patients who did not have staging bone scintigraphy, none subsequently developed skeletal metastases.

Conclusion:
Skeletal metastases at presentation in chondrosarcoma of bone are rare and have not been observed with low grade lesions. Furthermore, bone scintigraphy lacks specificity and may lead to unnecessary testing and delays in treatment. As such routine use of bone scintigraphy low grade lesions may not be necessary; however should be used for high grade or dedifferentiated tumors.
Comparison of the 7th and 8th version of the AJCC-classification for soft tissue sarcoma.

Marko Bergovec, Andrew Hayes, Andreas Leithner, Ms. Maria Anna Smolle, Joanna Szkandera, Per-Ulf Tunn, Michiel Van de Sande, Madeleine Willegger

1Medical University of Graz, Graz, Austria, 2Leiden University Medical Centre, Leiden, Netherlands, 3HELIOS Klinikum Berlin-Buch, Berlin, Germany, 4Royal Marsden Hospital London, London, United Kingdom, 5Medical University of Vienna, Vienna, Austria

Introduction:
The AJCC classification for soft tissue sarcomas (STS) has been updated in 2017. We aimed at comparing the prognostic power of the 7th and 8th-AJCC version in a large dataset from five experienced tumour centres.

Methods:
1106 consecutive patients (516 female [46.7%], mean age: 60.8±16.3 years) treated surgically for high-grade extremity STS at 5 tertiary tumour centres were retrospectively included (median follow-up: 3.1 years [IQR: 1.3-5.9 years]). Influence of staging systems on LR- and DM-free as well as overall-survival was assessed by using univariate Fine & Gray’s and Cox-regression models, respectively. Harrell’s C-index was used for prognostic power.

Results:
143 (12.9%) and 362 (32.7%) patients developed LR and DM, respectively, and 368 deaths were observed (33.3%). Neither 7th (overall-p=0.995) nor 8th (overall-p=0.949) version were significantly associated with development of LR (C-index 0.519 vs. 0.527). On the other hand, 7th (overall-p<0.001) and 8th (overall-p<0.0001) version showed a significant association with occurrence of DM, with comparable c-indices (0.613 vs. 0.627). Both versions (7th: overall-p<0.0001; 8th: overall-p<0.001) were significantly associated with OS. There was a statistically significant difference between all three stages examined for the 8th version (II vs. IIIA vs. IIIB p=0.008 vs. p<0.001) and stages IIIA and IIIB for the 7th version (p<0.0001). Between stages II and IIIA according to the 7th version there was no statistically significant difference (p=0.119), though. Nevertheless, the prognostic power regarding OS between the systems was comparable (7th vs. 8th: 0.614 vs. 0.613; Figure 1).

Conclusion:
Both the 7th and 8th version of the AJCC-classification show good predictions of DM-free and overall-survival, whilst they do not reliably predict LR-free survival. One advantage of the 8th version over the 7th version could be that tumour size plays a more important role in the newer classification, resulting in a better differentiation between stages IIA/IIB and II/IIIA, respectively.
Tenosynovial giant cell tumor in the foot and ankle (26 cases with the mean 73 months follow-up period)

Mr. Hüseyin Bilgehan Çevik¹, Ms. Sibel Kayahan², Mr. Engin Eceviz², Mr. Seyit Ali Gümüştaş²
¹Diskapi Yıldırım Beyazıt Training & Research Hospital, Ankara, Turkey, ²Kartal Dr. Lutfi Kirdar Training & Research Hospital, Istanbul, Turkey

Background:
Tenosynovial giant cell tumor (TSGCT) is the most common soft tissue tumor of the foot and ankle. It originates from the synovial cells of the tendon sheath. Due to the lack of clinical data and outcomes in literature about TSGCT in the foot and ankle, this study was aimed to clarify the epidemiological and clinical features, and surgical outcomes about TSGCT in behalf of our experience.

Methods:
The records of 79 lesions of the foot and ankle collected from the pathology records and the clinic files were reviewed. Following data were evaluated: age, gender, side, tumor subtype, local recurrence, and patient functional status among 26 cases of TSGCT were evaluated with the mean 73 months follow-up period.

Results:
TSGCT of foot and ankle were detected in 26 patients with a mean age of 40 years. Histopathologically, there were 15 localised TSGCT (80% in the forefoot) and 11 diffuse TSGCT (54,5% in the hindfoot dorsum). The recurrence rate in the diffuse and localised TSGCT was 27,3% (3/11) and 6,6% (1/15) of patients, respectfully.

Conclusion:
Considering that the most common tumor seen in the foot and ankle is TSGCT, the lesion in the hindfoot may be diffuse TSGCT and the lesion in the forefoot may be localized TSGCT. It should not be forgotten that TSGCT is benign soft tissue tumor. As in many tumoral lesions, excision with clear margins is an effective treatment. But it should be considered balance between clear surgical margins and the functional status of the foot and ankle.
Histological, epidemiological and anatomical analysis of 55 bone tumors of the fibula

Mr. Seyit Ali Gümüştaş1, Mr. Hüseyin Bilgehan Çevik1, Ms. Sibel Kayahan2
1Diskapi Yıldırım Beyazıt Training & Research Hospital, Ankara, Turkey, 2Kartal Dr. Lutfi Kirdar Training & Research Hospital, Istanbul, Turkey

Background:
This present study purposed to evaluate the frequency and distribution of bone tumors of the fibula as well as the histopathological and anatomical features of these rare lesions in a large case series.

Methods:
The records of all lesions of the fibula collected from 2007 to 2018 in pathology and orthopedic clinic archives were evaluated. During these 11 years, 82 cases were identified. Analysis included assessment of age, gender, location, clinical and histopathological presentations, imaging findings, management approach, recurrence, and treatment outcomes with the assignment of each lesion to one of the bone tumors according to the World Health Organization (WHO) classification of bone tumors.

Results:
Bone tumors of the fibula were found in 55 cases. Mean patient age was 25.9 years (8–73). Most of the lesions were of undefined neoplastic nature (25.5%). 31 bone tumors were benign (56.4%), 13 were intermediate (23.6%), and 11 were malignant (20%). Tumors were located in proximal fibula in 33 (60%) patients which 10 of them (30.3%) were malignant. Ten of 11 (91%) malignant tumors were located proximally. The most commonly found bone tumor was histiocytic fibroma (21.8%), followed by aneurysmal bone cyst (16.4%), intraosseous ganglion (9%), chondroblastic osteosarcoma, osteochondroma, grade I chondrosarcoma and osteoid osteoma.

Conclusion:
Evaluation of 55 bone tumors of the fibula showed a high incidence of benign lesions in this series. Increasing patient age was identified as a potential risk factor for the development of a malignant lesion of the fibula. Malignancy should be considered in proximal fibular tumors.
An unusual tumour in the thigh: Semimembranosus Calcific Tendonitis

Mr. Ismail Turkmen\textsuperscript{1}, Mr. Tarik Sari\textsuperscript{1}, Mr. Murat Demiroglu\textsuperscript{1}, Mr. Korhan Ozkan\textsuperscript{1}

\textsuperscript{1}Istanbul Medeniyet University, Istanbul, Turkey

Calcific tendonitis is a type of tendonitis in which calcium deposits, especially hydroxyapatite crystals, accumulate in any muscle or tendon of the body, causing inflammation and pain there. Most commonly seen in rotator cuff tendons; Achilles tendon, wrist, hip, thigh, knee, ankle and foot can be seen in various tendon and muscle groups of the body. A 35-year-old female patient presented to our clinic with a complaint of pain in the left thigh medial, which had been present for 1 year. The patient did not describe any history of trauma or infection related to that region. She had no known metabolic disease or cancer. Physical examination revealed a solid and immobile mass starting from the medial left knee to the thigh posteromedial. The patient had no neurological deficit or vascular pathology. The range of motion of the knee joint was limited.

Calcific tendonitis is more common in adults and women between the ages of 40 and 60 years compared to men. Some of the conditions that are thought to be related to the deposition of calcium deposits in muscles and tendons, although the etiology is not fully elucidated are: reduction, -genetic susceptibility, -thyroid gland diseases, -diabetic mellitus metabolic diseases, -free oxygen radicals and -tumor-like uncontrolled cell proliferation. There are three known stages of this calcification process: 1. Calcification stage: Calcium starts to accumulate in the target tissue by going out of the cells. During this phase, the body tries to repair by trying to reabsorb calcium deposits. It is known as the most painful period. 2. Postcalcification stage: Calcium deposits are eliminated and healthy tissue replaces calcium deposits. The disease does not always follow these three patterns.
Rosai-Dorfman disease with bone involvement in children

Mr. Korhan Ozkan¹, Mr. Tarik Sari¹, Mr. Murat Demiroglu¹, Mr. Ismail Turkmen¹
¹Istanbul Medeniyet University, Istanbul, Turkey

Rosai-Dorfman’s Disease, also known as Sinus Histiocytosis with Massive Lymphadenopathy, is a rare condition with uncontrolled proliferation of histiocytes. Although it can be seen in all age groups, it is more common among children and young people.

The disease may present with painless growth, high fever, increased ESR and weight loss in lymph nodes due to the accumulation of lymphocytes and histiocytes. The definitive diagnosis is made by histopathological examination of the biopsy material.

Most of the cases can be healed spontaneously, chemotherapy, radiotherapy, corticosteroids and so on. Agents have been tried and an effective treatment method has not been found yet.

In this case, after a 15-month-old male infant who presented to our clinic with limping and swelling of his left ankle, he had no additional disease.

In this report, we present a case diagnosed as Rosai-Dorfman Disease after pathology material was reported as a result of total excision of soft tissue mass causing loss of continuity and pathological fracture in the cortex affecting almost all of the talus.
Does the Duration of Primary and first Revision surgery influence the probability of first and subsequent megaprosthetic failures after extremity sarcoma resection?

Mr. Christoph Theil, Mr. Jan Schwarze, Mr. Georg Gosheger, Mr. Tom Schmidt-Braekling, Mr. Dominik Schorn, Mr. Kristian Nikolaus Schneider, Mr. Jendrik Hardes, Mr. Dimosthenis Andreou

University Hospital of Muenster, Muenster, Germany

Background:
Complications in megaprosthetic reconstruction following sarcoma resection are common. While several risk factors for failure, particularly infection, have been explored, there is a scarcity of studies that investigate the effect of the duration of surgery.

Methods:
We performed a retrospective study of 568 sarcoma patients that underwent megaprosthetic reconstruction with the MUTARSTM between 1993 and 2015. Differences in the length of surgery and in implant survival were assessed using the Mann-Whitney U-Test, the Kaplan-Meier method and log-rank test with a cut-off value derived from receiver operating curves analysis using Youden’s index.

Results:
225 patients developed a first and 112 patients a subsequent prosthetic failure. The median duration of the initial surgery (DS1 – resection and megaprosthetic reconstruction) was 210 minutes. Patients who developed a first failure had a longer DS1 (225 vs. 205 minutes, p = 0.0001). There were no differences in the probability of infection between patients with longer and shorter DS1 (12% vs. 13% at 5 years, p = 0.492), however the probability of mechanical failure was higher in patients with longer DS1 (38% vs. 23% at 5 years, p = 0.006). The median length of the revision surgery for the first megaprosthetic failure (DS2) was 101 minutes. Patients without a second implant failure had a longer DS2 than patients who developed subsequent failures (117 vs. 90 minutes, p = 0.014). The probability of a second failure after first revision was lower for patients with a longer DS2 (38.5% vs. 61% at 5 years, p = 0.004).

Conclusion:
A shorter DS1 appears beneficial; however the notion that longer operating time increases the risk of deep infection could not be reproduced in our study. In revision surgery, a longer operating time, possibly indicating a more thorough debridement, appears to be associated with a lower risk for subsequent complications.
Generation Y in Surgery – War for Talent in Times of Talent Shortage

Dimosthenis Andreou¹, Georg Gosheger¹, Sebastian Klingebiel¹, Lukas Lampe¹, M. Mathoff¹, B. Möllenbeck¹, C. Rickert¹, Julian Röder¹, Mr. Kristian Nikolaus Schneider¹, Dominik Schorn¹, Jan Schwarze¹, Christoph Theil¹, J. Zehrfeld²
¹University Hospital of Münster, Muenster, Germany, ²WWU Academics University of Münster, Muenster, Germany, ³Institute for Clinical Radiology University Hospital of Münster, Muenster, Germany, ⁴Sarcoma Center Helios Bad Saarow, Bad Saarow, Germany

Introduction:
Surgical disciplines are fighting with a critical and increasing shortage of recruits. Potential young professionals belong to the Generation Y that due to shifted personal interests is constantly challenging senior consultants and human resources departments. Aim of our study is the analysis of different measures of junior doctor acquisition with regard to obtained motivating factors of young medical students.

Methods:
We performed an online survey amongst medical students of the first and ninth semester of a medical school on individual motivating factors, aspired medical residency and so far acquired experience in surgery. SPSS Statistics 25 (IBM Corporation, Armonk/USA) was used to perform statistical analysis.

Results:
Results of 179 out of 269 medical students were available for analysis (66.5% response rate (RR)): 101 of 150 medical students of the first semester (67% RR) and 78 of 119 medical students of the ninth semester (66% RR). The interest in a residency in surgery was high in the first semester of medical school (21%) – but dropped noticeably until the ninth semester (13%). Medical students of the ninth semester, who favoured „professional advancement and appreciation“ over „flexible working hours“ showed a significantly higher interest in a residency in surgery (p=0.022). Gained surgical experience was valued with an average grade of 2+ (1 = best, 6 = worst).

Conclusion:
The high fundamental interest in a surgical residency during start of medical school is a competitive advantage of surgical disciplines. However current recruitment efforts mainly target students at a later stage of their medical training, at which point many of them appear to no longer seriously consider surgical disciplines for future residency programs. Timely hands-on courses in the surgical core workspace – the operating theatre – appear to play an important role in arousing and retaining the interest of medical students in surgical disciplines.
Gorham-Stout Disease – Diagnosis, Treatment and Quality of Life

Dimosthenis Andreou1,3, Georg Gosheger1, Sebastian Klingebiel1, Lukas Lampe1, Max Masthoff2, Julian Röder1, Mr. Kristian Nikolaus Schneider1, Dominik Schorn1, Tim Vogler1, M. Wildgruber2

1Department of Orthopaedics and Tumor Orthopaedics University Hospital of Münster, Muenster, Germany, 2Institute of Clinical Radiology University Hospital of Münster, Muenster, Germany, 3Sarcoma Center Helios Bad Saarow, Bad Saarow, Germany

Introduction:
The Gorham-Stout disease (GSD) is a rare mono- or polyostotic condition characterised by an idiopathic intraosseous proliferation of angiomatous structures resulting in the progressive destruction and resorption of bone. Several eponyms like vanishing or phantom bone disease are in use, but only few case series are reported in literature. Aim of this study was the analysis of diagnosis, treatment and Quality of Life (QoL) in affected patients.

Methods:
We performed a retrospective analysis of eight consecutive patients with an average age of 22 years (6 – 43) and a mean follow-up of 6 years (0 – 23) who were diagnosed with GSD at our department between 1995 and 2019. Data regarding diagnosis, clinical- and radiographic features, treatment as well as sequelae and their subsequent therapy were obtained from patients’ charts. QoL was determined using standardised scoring systems: Musculoskeletal Tumor Society Score (MSTS), the Toronto Extremity Salvage Score (TESS) and the Reintegration to Normal Living Index (RNL).

Results:
The average time from first symptoms until final diagnosis was 35 months (3 – 60). Five patients had a polyostotic and three patients a monoostotic disease. Using an off-label therapy with bisphosphonates, a stable disease was achieved in five of seven cases after an average of 20 months (8 – 42). Five of the eight patients required a total of ten surgeries due to sequelae. The average MSTS at last follow-up was 69% (23% - 97%), the average TESS 75% (43% - 97%) and the average RNL 71% (39% - 88%).

Conclusion:
Diagnosis and treatment of GSD remain a multidisciplinary challenge. Off-label treatment with bisphosphonates appears to lead to a stable disease in the majority of patients. QoL varies depending on the individual manifestations but good to excellent results are possible even in polyostotic cases with a history of possibly life-threatening sequelae.
Ischiopubic synchondrosis – Diagnosis and treatment of a challenging tumor orthopaedic differential diagnosis

Mr. Kristian Nikolaus Schneider¹, Mr. Max Masthoff², Mr. Georg Gosheger¹, Mr. Thomas Ackmann², Mr. Christoph Theil², Mr. Julian Röder³, Mr. Lukas Lampe¹, Mr. Sebastian Klingebiel¹, Mr. Dominik Schorn¹, Mr. Dimosthenis Andreou¹

¹Department of Orthopaedics and Tumororthopaedics - University Hospital of Münster, Münster, Germany, ²Institute of Clinical Radiology - University Hospital of Münster, Münster, Germany, ³Sarcoma Center Helios Bad Saarow, Bad Saarow, Germany

Introduction:
Ischiopubic synchondrosis (IPS) is a self-limiting skeletal phenomenon characterized by a uni- or bilateral atypical overgrowth of the pre-pubescent ischiopubic junction seen on radiographic imaging during skeletal maturation. Aim of this study was to analyze clinical and radiographic features of the condition, to evaluate the diagnostic pathway as well as to provide the first long-term follow-up data in a large patient cohort.

Methods:
Retrospective analysis of 21 consecutive patients (13 male, 8 female) with a median age at diagnosis of 10 years (range, 7 – 11) and a median follow-up of 5 years (range, 3 – 8) who were diagnosed in our department between 1995 and 2019.

Results:
17 patients presented with a uni- and 4 patients with a bilateral disease. In unilateral IPS, the non-dominant side was affected in 82% of all cases. Initial referral diagnoses into our specialized tumor orthopaedics outpatient clinic included primary bone tumors (9x), osteomyelitis (2x), acute fracture (1x), stress fracture (1x), pathologic fracture (1x) and bone metastasis (1x). Only in six of the 21 patients the suspected diagnosis was IPS.
Patients with unilateral IPS received a median of two conventional radiographs (in bilateral IPS: one) and a median of two MRI scans (in bilateral IPS: one). 8 patients with a unilateral IPS also underwent a CT scan prior to referral.
All 21 patients underwent a conservative treatment and reported a resolution of symptoms and return physical activity after a median time of four months (range, 1 – 12).

Conclusion:
The understanding of the IPS and its physiological process of fusion during skeletal maturation is essential to avoid unnecessary diagnostic and therapeutic measures and to minimize uncertainty and anxiety amongst affected patients, their respective families and treating physicians. A conservative treatment leads to a spontaneous relief of symptoms with excellent functional long-term results.
Are Plasma YKL-40 and IL-6 prognostic for survival after surgery for metastatic bone disease of the extremities?

Ms. Michala Skovlund Sørensen¹, Mr. Thomas Colding-Rasmussen¹, Mr. Peter Frederik Horstmann¹, Mr. Klaus Hindsø², Mr. Christian Dehlendorff², Mrs. Julia Johansen², Mr. Michael Mørk Petersen¹

¹Musculoskeletal Tumour Section, Department of Orthopaedic Surgery, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark, ²Paediatric section, Department of Orthopedic Surgery, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark, ³Unit of Statistics and Pharmacoepidemiology, Danish Cancer Society Research Center, Copenhagen, Denmark, ⁴Departments of Oncology and Medicine, Herlev and Gentofte Hospital, University of Copenhagen, Copenhagen, Denmark

Background:
YKL-40 is up-regulated in diseases characterized by inflammation, injury and remodeling. YKL-40 concentrations in patients with different cancer types are associated with short overall survival (OS). Interleukine-6 (IL-6) plays a role in inflammation. IL-6 is prognostic for short OS in different cancer types. The prognostic value for YKL-40 and IL-6 in patients undergoing surgery for metastatic bone disease (MBD) is unknown.

Aim of Study: Investigate
(1) if YKL-40 is associated with OS in patients undergoing surgery for MBD (2) if this association was independent of IL-6 levels.

Materials and Methods:
A prospective single center study including patients undergoing surgery for MBD in the extremities. In case of multiple surgeries during the inclusion period (May 2014-November 2018) blood samples from index surgery were included. Blood samples were collected preoperatively. YKL-40 and IL-6 concentrations were determined by ELISA. Two-hundred-thirty-two patients (median age 66 years, IQR 58-74; female 51%) were included.

Eighty-two percent of the patients had disseminated disease at time of surgery and 70% of lesions were fractured. Cox-regression analysis was performed to identify if YKL-40 and IL-6 was independent prognostic factors for OS. Spearmann’s test was used to adress correlation between YKL-40 and IL-6.

Results: IL-6 and YKL-40 were significantly correlated (p<0.001). In univariate analysis, both high IL-6 (HR=1.99, 95%CI: 1.47-2.68, p<0.001) and YKL-40 (age- adjusted) (HR=1.59, 95%CI: 1.10-2.32, p=0.014) were associated with short OS. In multivariable analysis, adjusted for known risk factors for survival, high IL-6 was prognostic for short OS (HR=2.21; 95%CI 1.41-3.19, p<0.001) but YKL-40 was not (HR=1.00, 95%CI: 0.64-1.56, p=0.99).

Conclusions:
IL-6 and YKL-40 were associated with short OS in patients undergoing surgery for MBD. After adjusting for known clinical risk factors for poor OS only IL-6 remained significantly associated with OS. We therefore advocate for adjusting for IL-6 in prognostic studies of OS in MBD disease.
Aneuploidy and aneuploid circulating tumor cells in soft-tissue sarcoma patients

Mr. Andrea Napolitano¹, Mr. Alessandro Minelli¹, Mr. Daniele Santini¹, Mr. Giuseppe Tonini¹, Mr. Bruno Vincenzi¹
¹University Campus Bio-Medico, Rome, Italy

Introduction:
Circulating tumor cells (CTCs) have been detected in soft-tissue sarcoma (STS) patients using both epithelial and mesenchymal cell-surface markers, whose expression is however heterogeneous and dynamic. On the contrary, DNA aneuploidy represents a solid hallmark of cancer.

Methods:
We analyzed in silico the association between aneuploidy and prognosis in the Tumor Cancer Genome Atlas STS cohort. Kaplan-Meier curves associated to log-rank test were used to compare progression-free and overall survival. We evaluated the presence of aneuploid CTCs in 4 metastatic STS patients and 4 healthy controls using fluorescence in situ hybridization (FISH) for the centromeric region of chromosomes 3, 7, 8, 17 and 20, and for p16 and hTERT. Image acquisition and analysis was performed using the Ikoniscope® robotic microscopy system and reviewed by a trained Pathologist.

Results:
TCGA patients with aneuploidy score higher than median value had significantly worse median progression-free survival (16.9 vs 40.6 months, P=0.013) and overall survival (54.2 vs 84.6 months, P=0.024). This trend was separately confirmed in the most common histological subtypes, i.e. leiomyosarcoma, dedifferentiated liposarcoma, and UPS. Aneuploid CTCs were detected in 4/4 (100%) of STS patients and in none of the healthy control cases. In STS patients, the median number of cells retrieved was 4 (range 3–6). We observed in all the cases polisomy of chromosomes 3, 7, and 17. Polisomy of chromosome 8 was observed in 2/4 (50%) of cases. No copy number variations were observed for chromosome 20 and for the p16 and hTERT loci.

Conclusions:
Here, we first showed in silico the association between DNA aneuploidy and worse prognosis in STS patients, irrespective of histology. We then used FISH to identify aneuploid CTCs in patients with metastatic STS. We hypothesize that aneuploid CTCs might represent a uniquely aggressive population, and studies to confirm this hypothesis are currently ongoing.
Intra-articular soft-tissue sarcoma of the knee — is extra-articular resection and tumor endoprosthetic reconstruction the solution? A retrospective report on eight cases

Mr. Markus Nottrott¹, Mr. Arne Streitbürger¹, Mr. Georg Gosheger², Mrs. Wiebke Guder¹, Mr. Gregor Hauschild³, Mr. Jendrik Hardes¹

¹University Hospital Essen, Essen, Germany, ²University Hospital Münster, Münster, Germany

Introduction:
Intra-articular sarcoma of the knee joint is a very rare condition. Extra-articular resection and reconstruction with a tumor prosthesis is usually performed. We describe the results with this rare surgical procedure.

Methods:
This retrospective study evaluated the clinical and functional results after extra-articular resection of the knee joint in eight patients with soft-tissue sarcomas of the knee that were reconstructed using a tumor endoprosthesis.

Results:
Six patients (75%) had no evidence of disease at the final follow-up examination. One patient died of disease (lung metastases) 97 months postoperatively. One patient is alive with disease 47 months postoperatively, with inguinal lymph-node metastases. With regard to local tumor control, none of the patients developed any local recurrences. A total of seven patients (87.5%) underwent at least one revision operation. Five of the eight patients (62.5%) ultimately had to undergo amputation, mainly due to periprosthetic infection. In addition, two patients experienced periprosthetic fractures. The mean Musculoskeletal Tumor Society score was 18 (range 10–22), as function was impaired due to a weak extensor mechanism.

Conclusions:
These results suggest that in patients with intra-articular soft-tissue sarcomas, limb salvage procedures with tumor prostheses after extra-articular resection are associated with very high complication rates. In most cases, long-term limb salvage was not possible. When limb salvage is successful, function is poor due to a weak extensor mechanism in the knee joint. The indication for this procedure should therefore be considered critically. It must also be critically noted that modern microprocessor-guided exoprostheses in patients with above-knee amputations provide very good functional results and would in all probability surpass the functional results achieved in the patients described here.
FAP-related desmoid tumors treated with low-dose chemotherapy: results from an international, multi-institutional, retrospective analysis

Mr. Andrea Napolitano1, Mr. Salvatore Provenzano2, Ms. Chiara Colombo2, Mr. Marco Vitellaro2, Mrs. Antonella Brunello1, Mr. Giuseppe Badalamenti1, Ms. Margherita Nannini8, Mr. Toni Ibrahim8, Mr. Peter Hohenberger7, Mr. Silvia Gasperoni8, Mr. Spyridon Gennatas9, Mr. Robin L Jones9, Mrs. Nadia Hindi10, Mr. Javier Martin Broto10, Mrs. Mariella Spalato Ceruso1, Ms. Marianna Silletta1, Mr Angelo Paolo Dei Tos11, Mr. Alessandro Gronchi2, Ms. Silvia Stacchiotti2, Mr. Daniele Santini1, Mr. Giuseppe Tonini1, Ms. Elena Palassini2, Mr. Bruno Vincenzi1

1University Campus Bio-Medico, Rome, Italy, 2Fondazione IRCCS Istituto Nazionale dei Tumori, Milan, Italy, 3Department of Oncology, Medical Oncology 1 Unit, Istituto Oncologico Veneto – IOV, IRCCS, Padua, Italy, 4Azienda Ospedaliera Universitaria Policlinico "Paolo Giaccone", Palermo, Italy, 5University of Bologna, Bologna, Italy, 6Oste Oncology and Rare Tumors Center, Istituto Scientifico Romagnolo per lo Studio e la Cura dei Tumori (IRST) IRCCS, Meldola, Italy, 7Div. of Surgical Oncology & Thoracic Surgery, Medical Faculty Mannheim - University of Heidelberg, Mannheim, Germany, 8Azienda Ospedaliero-Universitaria Careggi, Florence, Italy, 9Royal Marsden Hospital - Institute of Cancer Research, London, UK, 10Biomedicine Institute of Seville (IBIS), Sevilla, Spain, 11Treviso General Hospital, Treviso, Italy

Introduction:
Desmoid tumor (DT) is a locally aggressive fibroblastic proliferative disease representing the most common extra-intestinal manifestation of Familial Adenomatosis Polyposis (FAP). As data on the activity of chemotherapy in these patients are limited, we examined the outcomes of patients treated with low-dose methotrexate (MTX) + vinca alkaloids (vinorelbine or vinblastine).

Methods:
We retrospectively reviewed clinical and outcome data from all patients with confirmed FAP-associated DTs treated with weekly MTX + vinca alkaloids in 7 European sarcoma reference centers between January 2000 and December 2018. Radiological responses were assessed using RECIST v1.0 and 1.1. The Kaplan-Meier method associated to the logrank test was used to estimate and compare survival curves.

Results:
We identified 37 patients (median age 29 years, range 7-44). According to RECIST, 20/37 (54.1%) patients achieved partial response (PR), 15/37 (40.5%) patients had stable disease, and 2/37 (5.4%) had progressive disease as best response. Overall, the median PFS was 6.5 years (range 0.3-12.1 years). In the subset of patients achieving PR as best response, the median PFS was not reached. In a subset of 11 patients with progressive disease offered MTX + vinca alkaloids rechallenge (after chemotherapy withdrawal following prolonged disease control), the disease control rate was 100%, resulting in a median PFS after rechallenge of 5.8 years.

Conclusions:
This is the largest series on the activity of low-dose chemotherapy in FAP-related DT patients. In this population, MTX + vinca alkaloids is an active combination, as already reported in sporadic DT patients.
Endoprosthetics of ankle joint for tumors of the distal tibia

Mr. Volodymyr Protsenko¹, Mr. Yevhen Solonitsyn¹, Mr. Volodymyr Chornyi²
¹Institute of Traumatology And Orthopedics of The National Academy of Medical Sciences of Ukraine, Kiev, Ukraine, ²Bogomolets National Medical University of the Ministry of Health of Ukraine, Kiev, Ukraine

Introduction:
Tumors of the distal tibia account for 2% of all bone tumors. With this localization of the tumor, joint arthrodesis, amputation, or exarticulation of the limb were previously performed. With the development of chemotherapy, the improvement of surgical technique, the emergence of new designs of endoprostheses, individual endoprosthetics began to be used to replace bone defects after removal of the tumor.

Methods:
From 2009 to 2019, 13 patients underwent segmental resection of the distal tibia with a tumor and replacement of the defect with an ankle prosthesis. There were 8 women, 5 men; the average age of the patients was 45.2 years. Giant cell tumor of the bone was observed in 5 patients, osteosarcoma - 3, chondrosarcoma - 2, adamantinoma - 2, bone angiosarcoma - 1. Patients with osteosarcoma and angiosarcoma of the bone underwent courses of chemotherapy. During the endoprosthetics we used individual oncological endoprostheses of the ankle joint manufactured by Inmed (Ukraine).

Results:
The follow-up period after endoprosthetics ranged from 12 to 60 months. Complications in the postoperative period were not observed. In 3 (25%) patients with osteosarcoma, chondrosarcoma and adamantine bone, relapses of the tumor were detected, amputation of the limb was performed. The functional result of the ankle joint was evaluated according to the MSTS system and amounted to an average of 72.4%. The overall disease-free survival of patients was 72.5 ± 1.9%.

Conclusions:
To achieve good clinical and functional results in patients with tumors of the distal tibia, it is necessary to observe clear indications for ankle replacement, careful selection of patients, taking into account the effect of the preoperative treatment.
Bone adamantinoma cases

Mr. Volodymyr Protsenko¹, Mr. Yevhen Solonitsyn¹, Mr. Volodymyr Chornyi²

¹Institute of Traumatology & Orthopedics of the National Academy of Medical Sciences of Ukraine, Kiev, Ukraine, ²Bogomolets National Medical University of the Ministry of Health of Ukraine, Kiev, Ukraine

Introduction:
Adamantinoma is a rare tumor of bone of epithelial origin, in which structures resembling the enamel organ of the tooth's bookmark are formed. According to the literature, adamantinoma is 0.3-0.48% among malignant bone tumors. It is characterized by slow development from 1 to 5 years and more, but in 15-22% of cases the tumor can develop quickly with metastases in lymph nodes, other bones and lungs.

Methods:
In our study, there were 2 patients with tibial adamantinoma and 1 patient with femur adamantinoma. Patients in the preoperative period were performed an open bone biopsy to verify the process. After examination 1 patient underwent segmental resection of the proximal tibia and knee replacement by individual modular oncologic endoprosthesis, and in 2 cases resection of the distal tibia and endoprosthesis of the tibial modular joint. In the case of knee joint replacement, the “V. Link” (Germany), and at the endoprosthesis bath of the ankle joint, the endoprosthesis of “Inmed” (Ukraine).

Results:
No recurrence and metastases were detected in 2 patients within 3 years. In 1 patient 4 years after the organ-preserving operation, a tumor recurrence developed and he had an amputation of the lower extremity. After 6 months, the patient was diagnosed with lung metastases. The patient underwent 3 courses of intravenous polychemotherapy and performed metastasectomy in the lungs. After 3 months, new foci of metastatic lesion appeared in the lungs and, despite conducting polychemotherapy courses, the patient died after 4 months. Thus, despite the radical removal of the tumor, the end result of treatment of this nosological form of the tumor was unsatisfactory.

Conclusion:
Organ-saving surgical treatment of a patient with bone adamantinoma did not lead to a favorable end result of treatment, which indicates the need for comprehensive treatment of this category of patients.
The role of denosumab in the management of un-resectable Giant Cell Tumour of Bone (GCTB): A systematic review with an illustrative case report

Mr. Stephen Fahy, Mr Brian Lenehan

1Connolly Hospital Blanchardstown, Blanchardstown, Dublin 15, Republic Of Ireland, Blanchardstown, Ireland

Background:
Giant cell tumours of Bone (GCTB) are benign but locally aggressive tumours which have a predilection for the metaphyseoepiphyseal junction of long bones. GCTB represent approximately 20% of all benign bone tumours, and 5% of all bone tumours. The management of inoperable GCTB is challenging and controversial. Surgical revision remains the gold standard intervention, however some tumours are deemed unresectable. In recent years denosumab has emerged as a potential alternative in the management of patients deemed un-resectable. Early research suggests that denosumab has significant positive effects in the management of inoperable GCTB high quality research in this field is lacking. This systematic review aims to summarize the current research and highlight areas of interest to guide future work.

Methods:
A systematic review was carried out to study the effects of denosumab therapy on un-resectable GCTB (search performed on PubMed®, Scopus®, and ScienceDirect®). A total of 14 reports, corresponding to 7 clinical trials, were identified as meeting the pre-specified inclusion criteria. Full-text review was performed of the relevant research.

Results:
On average, 45% (24%-92%) of patients had observer-reported clinical benefit from denosumab therapy, defined as improvement in either pain, mobility, or function. Similarly the majority of patients commenced on denosumab therapy achieved radiographic evidence of disease stability. Denosumab was well tolerated, serious adverse events were rare, with grade III/IV adverse events were occurring in 16% of patients.

Conclusion:
Denosumab therapy appears to be a safe and efficacious treatment for the management of un-resectable GCTB. Rapid and sustained reductions in pain and disability are commonly observed. Disease stability is achieved in the majority of patients, and evidence of a rapid and sustained decrease in markers of bone metabolism is observed following treatment initiation. The quality of identified studies is low, as such further high quality research is needed in this field.
Treatment of carcinoma bone metastases using the O-ARM navigation system

Mr. Francesco Nicolosi

1Arnas Garibaldi Catania Ortopedia e Traumatologia ad indirizzo Oncologico e Pediatrico, Catania, Italy

Introduction:
In recent years, patients suffering from bone metastases from carcinoma have increased dramatically, mainly due to the increase in life expectancy, given the improvement in the chemotherapy treatment of primary tumors.

Method:
From here the need for improvement of surgical treatments using new techniques that allow an improvement in the quality of life through even minimally invasive systems, because sometimes we are faced with patients in poor physical conditions that do not allow a traditional surgical treatment.

Results:
In our department of Oncological Orthopedics for about Two years we have been treating patients with bone metastases of the pelvis from primary prostate cancer, lung, myeloma, colon, breast. Patients are treated by radiofrequency thermal ablation through Osteokull and then by the introduction of Cement. For this treatment we use a navigation system called O-Arm. The O-Arm technology allows you to simulate the surgical act just before it is performed, allowing you to verify the correct setting and increase its accuracy. This technology allows to have a diagnostic tool able to acquire images during the intervention; these are scans similar to the TC which are transferred to a navigation system and thus provide a simulation of what the surgeons are about to do. bone metastases, debilitated by chemotherapy treatments and the advanced state of the disease.

Conclusion:
This system is proving itself very useful in the treatment of these lesions with the reduction or disappearance of painful symptoms allowing an improvement in the quality of daily life.
Eosinophilic granuloma in adults; two case reports

Mr. Ahmet Nadir Aydemir¹, Mr. Korhan Ozkan²
¹Pamukkale University Medicine Faculty, Denizli, Turkey, ²Medeniyet University Medicine Faculty, Istanbul, Turkey

Introduction:
Langerhans cell histiocytosis is a spectrum of diseases of the reticuloendothelial system. Eosinophilic granuloma is an isolated bone involvement associated with abnormal proliferation of Langerhans cells. It is usually observed in children and young people under 20 years of age. Eosinophilic granulomas are rarely seen in the adult age group. We aimed to present two adult patients suffering from pain with the scapula and pelvic bone involvement.

Report of the cases:

Case 1
A 40-year-old male patient presented to our outpatient clinic with complaints of increased pain on his right shoulder for the last six months. After a radiological evaluation (direct X-ray and MRI), a lesion with contrast enhancement was detected in his right scapula just inferior to the glenoid. The patient was found to underwent a ct-guided biopsy and was diagnosed as an eosinophilic granuloma. Due to the presence of a symptomatic lesion, the surgery was planned and the mass was removed as en bloc. After two years of follow-up, no recurrence was detected.

Case 2
A 32-y-old male patient presented to our outpatient clinic with increasing groin pain for the last one year. After his physical examination, a lesion with contrast enhancement was detected at the right superior ramus pubis on mri. excisional biopsy was performed and biopsy material was diagnosed as an eosinophilic granuloma. After a year follow up, the patient was pain-free and no recurrence was detected.

Discussion:
Eosinophilic granuloma is generally characterized by painful bone lesions in children and adolescents. The skull, pelvis, vertebrae and the diaphysis of long bones are common sites. Undiagnosed lesions often require biopsy. Our cases with ages over 30 years old are unique for eosinophilic granuloma. The patients had no symptoms at the follow-ups. Although rare, eosinophilic granuloma should be included in the differential diagnosis of adult bone lesions.
Rhabdomyosarcoma with Fukuyama Congenital Muscular Dystrophy: A Case Report

Ms. Yoko Hagiwara
1Chiba Cancer Center, , Japan

Introduction:
Fukuyama congenital muscular dystrophy (FCMD) is a common type of congenital muscular dystrophy in Japan. Recently, because meticulous patient management has been provided at hospitals and homes, some patients have survived for 30 year-old or even longer. We report our experience with a 16-year-old girl with FCMD who developed rhabdomyosarcoma.

Case At 3-month-old, muscle biopsy was performed, she was diagnosed with heterogeneous FCMD. Six months before visiting our department, her mother had noted swelling of the patient’s right thigh. Magnetic resonance imaging revealed a tumor at the distal thigh, and a needle biopsy was performed, leading to a diagnosis of rhabdomyosarcoma. After discussions with her family, standard treatment was chosen despite the risks involved in treatments. Chemotherapy and surgery was performed.

Discussion:
Rhabdomyosarcoma with FCMD has not previously been reported. In FCMD, mutations in the fukutin gene cause abnormal glycosylation of α-dystroglycan and impair the laminin-binding capacity of α-dystroglycan; consequently, its affinity to the muscle basal lamina is reduced. Regarding pediatric solid tumors, Martin et al. reported that the expression of α-dystroglycan is significantly reduced in rhabdomyosarcoma and neuroblastoma. Furthermore, Vajaria et al. stated that altered glycosylation might be associated with tumorigenesis, progression, and metastasis and be a factor predicting outcomes. Long-term survivors with FCMD appear to be carefully followed if they develop sarcoma.
Bone Cancer in Ancient Egypt: the largest series

**Mr. Albert Isidro Llorens**, Mr. Miguel Botella, Ms. Agustina Rodriguez-Machado, Ms. Bibiana Agusti, Mr. Jesus Herrerin

1Bone & Soft Tumor Unit. Orthopedic Surgery Dpt. Hospital Universitari Sagrat Cor, Barcelona, Spain, 2Forensic Anthropology Dpt. Universidad de Granada, Granada, Spain, 3Museu d’Arqueologia de Catalunya, Girona, Spain, 4Physical Anthropology Dpt. Universidad Autonoma de Madrid, Madrid, Spain

The antiquity of cancer has always been one of the most interesting fields of research in Evolutionary Medicine. Why are skeletons diagnosed with malignant disease so scarce in old times? The absence of pollutants, the lack of domestication of fire (without heavy metals), the diet (low in fat and sugars) and, mainly, the shorter life span, have been inferred to explain this absence.

Ancient Egypt is, undoubtedly, a field of work in which this subject could be better assessed. The presence of a civilization that covered more than 4,000 years in the same geographical area is a very useful tool to infer the evolution of malignant diseases.

In 1924, Smith & Dawson diagnosed an osteosarcoma in a distal femur of the 5th dynasty. Almost 40 years later, this lesion was re-diagnosed as a benign bone tumor. This has been a constant in the lack of accuracy in the diagnosis of cancer in ancient remains.

Most cases of cancer in old times are case reports, along with reviews of literature and, in some cases, short series. After an accurate differential diagnosis that included field X-ray examination, we present the world’s largest series of malignant disease in individuals belonging to 5 different Spanish missions in Egypt. The series includes 14 cases: 2 cases from Middle Egypt (1 from Oxyrhynchus and 1 from Sharuna) and 12 cases from Upper Egypt (9 from West Thebes and 3 from Qubbet el-Hawa). It is worth noting that 7 correspond to metastasis, 1 to nasopharyngeal carcinoma, 1 Ewing’s sarcoma, 2 multiple myeloma, 1 acute leukemia, and 1 soft tissue sarcoma.
Bone marrow concentrate use in the treatment of bone cysts

Mr. Lorenzo Andreani, Mr. Fabio Cosseddu, Ms. Elisabetta Neri, Mr. Antonio D'Arienzo, Mr. Lorenzo Andreani, Mr. Rodolfo Capanna

Azienda Ospedaliera Universitaria Pisana, Pisa, Italy

Introduction:
Bone cysts are tumor-like lesions often incidentally found on radiographs performed for other reasons. Different treatment have been proposed including nonoperative, percutaneous injection and surgical curettage. A recent attractive option is the stimulation of intrinsic healing using mesenchymal stem cells. We performed a retrospective evaluation of the results obtained at our institution for bone cyst percutaneous treatment.

Methods:
The study group consisted of 43 patients of which 12 aneurysmal bone cyst (ABC) and 31 simple bone cyst (SBC). All of the lesions were injected percutaneously under fluoroscopic guide. During the procedure a specimen of the lesion was collected and sent for histopathological examination. The injected substances were: vitamin C, atossisclerol, methylprednisolone acetate. In 23 patients, autologous bone marrow concentrate (BMC) was associated too. The healing status was followed-up through a plain radiograph 45 days and 2 months after the procedure.

Results:
Of the patients treated with BMC 20 achieved healing only with injection; in the remaining 3 cases, one needed embolization, one curettage and the third underwent femoral head resection and total hip replacement. Of the patients treated without BMC, 14 achieved healing only with injection; in the remaining 6 cases, 3 presented already fractured and the other three had big lesions with a high risk for fracture so all of them needed curettage and fixation.

Conclusion:
Bone cysts are hardly standardisable lesions for their variability in presentation, location and dimension. In our experience, the cases needing more than one procedure or more invasive treatment were complex cases independently on the primary use of BMC. We can assert that the use of BMC however must be encouraged being harmless and having an unquestionable high osteogenic and healing potential in bone defects.
Conservatively managed cartilage tumors of the long bones- A ten year MRI follow up study

Mr. Moritz Dreier¹, Mrs. Magdalena Gilg¹, Mrs. Christine Wibmer¹, Mrs. Maria Anna Smolle¹, Mrs Jasminka Igrec², Mr Marko Bergovec¹, Mr. Michael Fuchsjäger², Mr Andreas Leithner¹

¹Department of Orthopaedics and Trauma, Graz, Austria, ²Division of General Radiological Diagnostics, Department of Radiology, Graz, Austria

Introduction:
The incidental finding of an enchondroma (EC) within a long bone is a common diagnosis for referral to a bone tumor unit. The reported risk of malignant transformation varies between 0-6%. Consensus on follow up of these tumors is lacking. The aim of this study was to analyze the long-term risk of malignant transformation of EC.

Methods:
We retrospectively identified 104 patients diagnosed with EC between 2006 and 2009 who were treated conservatively. Inclusion criteria were localization of EC in the long bones, a baseline MRI at initial diagnosis and a minimum follow up of ten years. 33 patients (32%) were lost to follow up. Of the remaining 71 patients, 24 (33%) agreed to have a follow-up MRI at our institution.

Results:
Mean follow up of the 24 patients (8 males, 16 females) was 11.7 years (range 10.0-14.0). Mean age at last follow up was 62 years (range 37-83). Mean size of EC at diagnosis was 24 mm (range 6-57mm). Mean increase in size of EC was 2 mm (range 0-18 mm). 10 EC (42%) increased more than 2 mm between initial and follow up MRI. Only one patient developed endosteal scalloping and cortical breach but edema was absent. No EC showed signs of malignant transformation, none of the patients underwent surgery and all of them were free of clinical symptoms at last follow up MRI.

Conclusion:
Although this is a small study sample it seems that the risk for malignant transformation of ECs has been overestimated in the past. In this study no patient has suffered from malignant transformation following ten years of initial diagnosis of EC. Thus, the indication for annually performed MRIs for clinically asymptomatic patients has to be discussed.
Reconstruction of the ankle after wide resection of distal fibula tumors: Case report and review of the literature

Mr. Mohammed Alrumaih1, Dr. Munzier Abbasher2, Dr. Osama Alshaya2, Dr. Hasan Sawan1
1Department of Orthopaedic Surgery, Prince Sultan Military Medical City, Riyadh, Saudi Arabia, 2Department of Orthopaedic Surgery, King Fahad Medical City, Riyadh, Saudi Arabia

Background:
Involvement of the distal part of the fibula by benign aggressive and malignant tumors remains to be a challenge for the treating surgeon. Due to rarity of the condition reconstruction techniques vary, with variable results. The fibula is affected in 2.4% of primary bone tumors, with the proximal third being more frequently involved than the distal segment. Malignancies of the distal third of the fibula carry a better prognosis than proximal lesions, although some authors have not observed such prognostic difference.

Case Presentation:
We report 2 cases, all of them having Ewing’s sarcoma in the distal fibula. We investigated them systemically and locally by doing X-ray, CT Scan, MRI and Bone scan. We did for them wide resection of tumor. The ruminant of tendons of the peroneus longus, peroneus brevis, and flexor hallucis longus were cut and they were used to reconstruct for the lateral aspect of the right and left ankle using suture anchors. K-wires were used to do temporary arthrodesis.

Outcome:
The last MRI was done. It showed there is altered signal intensity of the soft tissue with post-contrast enhancement. However, there is no evidence of soft tissue mass lesion. According to the last follow up after six months post-operative, it showed no valgus deviation, normal ankle motion, mobilizing full weight bearing with splint assistant during physical examination.

Conclusion:
Overall, the rarity of the condition makes it difficult to choose which technique to be advantageous over the other. A stepwise approach would limit and narrow your options and a decision based on several factors should be addressed such as type and nature of the tumor, site, age of patient, involvement of growth plate, invasion of surrounding soft tissues (e.g. peroneus tendons), and the need for post-operative radiotherapy and chemotherapy should be considered.
Intraoperative Brachytherapy using flab technique in the treatment of soft tissue sarcomas - mean follow up of 5 years

Mr. Dietmar Dammerer¹, Mr. Vincent Auinger¹, Mr. Martin Thaler¹
¹Medical University Innsbruck, Innsbruck, Austria

Introduction:
Adjuvant radiotherapy has been shown to improve local control in patients with soft tissue sarcomas. Applying additional brachytherapy represents an enhancement of therapeutic ratio over single external-beam irradiation. To best of our knowledge, there are spare data on intraoperative brachytherapy using flab applications in soft tissue sarcomas.

Methods:
Retrospective study design with a prospective follow-up was applied. We included between 2003 and 2016 117 patients. Mean age at surgery was 60 years. Mean postoperative follow up was 5 years. 13 different histological types of high-grade soft tissue sarcomas were included. The applied intraoperative brachytherapy dose using a flab technique was 15-20 Gray (Gy.) combined with postoperative external-beam radiation. The mean total radiation dose was 50-60 Gy.

Results:
No treatment/surgery related loss of limb or live was observed. Mean size of tumor-mass at surgery was 8x5x7 cm. No vascular or neurologic complications occurred. We detected 13% (n=12/89) local recurrence and 28% (n=25/89) metastasis in our patients. Mean period of appearance of local recurrence and metastasis was 2 years. The most common site of metastasis was the lung (n=18), followed by the liver (n=3), the lymphknotes (n=2) and the abdomen (n=2). 40 patients out of 89 (45%) patients had radiation related skin complications. 9 patients died during follow up and 3 patients are lost of follow up.

Conclusion:
Given to the current literature, our data are well in line with similar studies. The intraoperative brachytherapy method using a flab technique in combination with external beam radiation is an efficient treatment technique in high-grad soft tissue sarcomas and showed similar results than neoadjuvant or adjuvant radiation.
Secondary superficial high-grade chondrosarcoma of the clavicle: A case report

Mr. Shinichi Takenoshita\textsuperscript{1}, Mr. Naofumi Asano\textsuperscript{1}, Mr. Tomoki Kasahara\textsuperscript{1}, Mrs. Rumi Nakagawa\textsuperscript{1}, Mr. Toru Hirozane\textsuperscript{1}, Mrs. Sayaka Yamaguchi\textsuperscript{1}, Mr. Hajime Okita\textsuperscript{2}, Mr. Robert Nakayama\textsuperscript{1}, Mr. Masaya Nakamura\textsuperscript{1}, Mr. Morio Matsumoto\textsuperscript{1}

\textsuperscript{1}Department of Orthopedic Surgery, Keio University School Of Medicine, 35, Shinanomachi, Shinjuku-ku, Japan, \textsuperscript{2}Department of Pathology, Keio University School Of Medicine, 35, Shinanomachi, Shinjuku-ku, Japan

Background:
Secondary surficial chondrosarcoma is a rare malignancy occurring in approximately 1\% cases of solitary and 5\% cases of hereditary multiple osteochondroma and commonly develops in the pelvis and humerus. Here, we report an extremely rare case of superficial secondary chondrosarcoma arising from a solitary osteochondroma of the clavicle.

Case:
A 32-year-old male patient was referred to our hospital for an enlarged mass in the right chest wall for 8 months. His past medical history revealed a small bony protrusion at the right clavicle upon chest XP at the age of 20 years. Physical examination revealed a firm-to-hard mass. CT revealed a prominent lesion on the surface of the proximal clavicle with irregular calcification in the center and a low-absorption area around it. MRI revealed a large lobulated extraosseous mass (size: 8.6 cm), with decreased T1 and increased T2 signal intensity. After a pathological review of an open biopsy specimen obtained at the previous hospital, the diagnosis was made as high-grade chondrosarcoma. Given that no apparent metastasis was observed on PET/CT, definitive surgery was performed. Subclavian arteries and veins and the brachial plexus were carefully preserved; subtotal clavicle excision, including the tumor and surrounding muscles, was performed. The surgical margin was negative. No postoperative complications occurred; shoulder function returned to normal 3 months after the surgery. The patient was followed up for 6 months after the surgery, and there was no evidence of tumor recurrence.

Discussion:
Only three cases of superficial secondary chondrosarcoma of the clavicle have been reported, all of which originated from multiple osteochondromas. This is the first report of a superficial secondary chondrosarcoma arising from a solitary clavicular osteochondroma. Although extremely rare, the possibility of malignant transformation in a clavicular osteochondroma should be considered; early diagnosis via careful follow-up is important.
What is the chance for a new endoprosthesis for patients with tumors of the knee joint after two-stage revision?

Mr. Ilkin Mikailov¹, Mr Petr Grigorev¹, Mr Dmitrii Ptashnikov¹
¹Russian Research Institute Of Traumatology And Orthopedics Named After R.r.vreden, Saint-Petersburg, Russian Federation

Introduction:
Infections are the most frequent and one of the most dangerous complications of oncological endoprosthetic reconstructions. Now the gold standard of surgical treatment of patients with infectious complications after oncological knee replacement is a two-stage revision.

Purpose:
To evaluate the results of two-stage revisions in patients with tumor lesions of the knee joint on the experience of RNIITO. R. R. Vreden.

Methods:
A retrospective study of 44 patients underwent two-stage revision between 2010 and 2019 at our institution. The mean age of this cohort was 56.5(19-75), with 77.3% being females. The tumor was localized in the distal femur in 18 (41%) patients; in proximal tibia in 26 (59%) patients. The size of the resection from 7 to 24 cm (average 9 cm).
Nosology: osteosarcoma 5; chondrosarcoma 10; GCT 29. The mean clinical and radiographical follow-up was 36 (3-98) months.

Results:
We managed to save the limb in 40 (91%) patients, of which only in 33 (82.5%) cases recovered the supporting limb. The second stage is not possible due to massive bone defects, in seven patients with spacer, but still they refuse amputation. Effective endoprosthesis replacement was performed in 21 (47.7%) patients of which, the distal femur 16 (76%) cases; proximal tibia 5 (24%) cases. Functional outcome: MSTS for distal femur 73% - 86% (median 81%), MSTS for proximal tibia 56% - 73% (median 62%)

Conclusion:
We managed to perform endoprosthesis replacement after the two-stage revision, only in 48% of patients. Infections in patients with tumors of the proximal tibia are more common and more severe than in lesions of the distal femur. Endoprosthetics in patients with defect of the proximal tibia in most cases provides only support function, and poor or satisfactory functional result. Functional results after second stage in patients with femoral defects are comparable with primary endoprosthetics.
Titanium Silk VS Polymeric Tube. As soft tissue reconstruction option in patients with hip replacement after tumor resection.

Mr. Ilkin Mikailov¹, Mr Petr Grigorev¹, Mr Rashid Tihilov¹
¹Russian Research Institute Of Traumatology And Orthopedics Named After R.r. vreden, Saint-Petersburg, Russian Federation

In order to fix the remaining soft tissue after resection of the tumor, non-absorbable materials are used, such as polymer synthetic tubes, fixed to the femoral component. However, fixation of soft tissues to the components of the endoprosthesis does not always lead to satisfactory results. According to the results of the examination (ultrasound scan, CT), this group of patients had a volume accumulation of fluid in surgical area. According to the literature data, the formation of seroma (limited clusters of tissue fluid) is caused by the contact of mobile soft tissues with synthetic tissue. Taking into account our own negative experience of using polymeric means of fixing soft tissues to the endoprosthesis, as well as the data obtained during the analysis of the literature, for the implementation of this technical task we have adopted implants made from titanium silk.

Purpose:

to analyze the mid-term results of the use of titanium silk and polymer tubes.

Study Design & Methods:

54 patients operated in the department of bone oncology department RNIITO from 2013 to 2016. The average age was 46 years (21 - 67) 34 - 63% 20 - 37%. Metastatic lesions 28; Chondrosarcomas 14; GCT 7; Osteosarcomas 5. The acetabular component: double mobility. The size of the resection is 7 - 26 cm (15 cm). The complex analysis of the results in the period not less than 18 months after the operation. In 30 (55,5%) patients we used polymeric tubes in 24 (44,5%) patients, titanium silk.

Seroma was detected: polymeric tubes 3 cases 10%; titanium silk 0 cases.

Functional result:

Polymeric tubes MSTS 81,3% Harris scale 79,1%; titanium silk MSTS 83,3% Harris scale 81,5%.

Conclusions:

The mid-term results showed that titanium silk is an option that gives a good functional result and there was no a single case of seroma formation.
Core Needle Biopsy for Myxoid Soft Tissue Tumors: a Diagnostic Challenge?

Mr. Ilkyu Han¹, Mr. Himanshu Rohela¹, Mr. Han-Soo Kim¹
²Seoul National University Hospital, Seoul, South Korea

Background:
Despite the overall diagnostic utility of core needle biopsy (CNB) comparable to incisional biopsy, increased diagnostic errors have been suggested of CNB for myxoid soft tissue tumors. This study compared the diagnostic performance of CNB between myxoid and non-myxoid soft tissue tumors.

Methods:
369 patients who underwent ultrasound-guided CNB prior to resection for soft tissue tumors were classified into two groups according to resection pathology; myxoid group (n = 75) and non-myxoid group (n = 294). One-hundred and ninety-three patients were male and the median age of the patients was 40 years. Two-hundred and sixty-three tumors were malignant.

Results:
CNB correctly diagnosed malignancy in 84% (58 of 69) for the myxoid group and 95% (184 of 194) for the non-myxoid group. For diagnosing histologic grade of soft tissue sarcoma, CNB correctly identified high grade in 78% (18 of 23) for the myxoid group and 74% (94 of 128) for the non-myxoid group. The correct diagnosis rate of histological type was significantly lower in the myxoid group (63% [47 of 75] in the myxoid group and 83% [242 of 294] in the non-myxoid group, p < 0.013).

Conclusion:
Our study suggests that CNB is useful for myxoid soft tissue tumors of the extremity, with regard to diagnosing malignancy and histologic grade. However, CNB was less useful for identifying histologic subtype in myxoid tumors than in non-myxoid tumors.
Prognoses of superficial soft tissue sarcoma: The importance of fascia-tumor relationship on MRI

Mr. Ilkyu Han¹, Mr. Jeong Hyun Lee¹, Mr. Han-Soo Kim¹
¹Seoul National University Hospital, Seoul, South Korea

Background:
Superficial soft tissue sarcoma (S-STS) has been reported to have more favorable prognoses than deep-seated STS. However, for some patients, poor prognoses have been observed and there is a need for better prognostication. The deep peripheral fascia lies in the border of the S-STS and can be consistently detected using magnetic resonance imaging (MRI). The relationship of the subcutaneous tumor with the fascia on MRI scan was reported to be useful in classifying the tumor as benign or malignant; this in turn, may reflect the biological aggressiveness of STS. This study was performed to evaluate the oncologic outcomes and to identify the prognostic factors of S-STS by focusing on the relationship of S-STS with the underlying fascia on MRI.

Material and methods:
We retrospectively reviewed data on 253 patients who underwent resection of localized S-STS. Potential factors that might influence the oncologic outcomes were identified. The fascia-tumor relationship on MRI was classified into three groups: no fascial contact group (n = 46), fascial contact group (n = 77), and fascial invasion group (n = 84).

Results:
Overall, 39 patients (16.5%) died due to S-STS; the 5- and 10-year survival rates were 82.6 ± 2.9% and 73.2 ± 4.5%, respectively. Fascial invasion detected on MRI scans (OR = 2.190, p = 0.034) and advanced age (OR = 2.408, p = 0.034) were found to be independent factors for worse disease-specific survival. The fascia-tumor relationship on MRI scan was not associated with local recurrence of S-STS.

Conclusion: The fascia-tumor relationship on MRI scan reflects the biological aggressiveness of S-STS and can serve as a prognostic factor.
The outcome of Joint Sparing Endoprosthesis (JSE) as a reconstructive modality after resection of juxta articular bone sarcoma

Mr. Ahmad Shehadeh¹
¹King Hussein Cancer Center, Amman, Jordan

Introduction:
The outcome of endoprosthetic reconstruction after joint sparing resection is not well described in literature.

Objectives:
To investigate the outcome of using customized Joint Sparing Endoprosthesis (JSE) after juxta articular resection of bone tumors.

Materials and Methods:
Thirty two patients received JSE and 36 joints were spared. age 4-55 year, (median 13 Year), 25 patients received surgery for primary reconstruction and 7 patients for revision of failed bone allograft or modular implant, anatomical location was 27 joints spared in the lower limbs and 9 in the upper limbs.
Flat surface HA coated custom JSE was used to spare 17 joints, and short stemmed custom JSE was used to spare 19 joints. The length of remaining bone epiphysis for JSE anchorage from the knee and ankle joints, was 25-75 mm, median=45mm.

Results:
Operative time 2.5 - 4 hr.(Avg. 3 hr.) The bone resection surface fitted the prosthesis surface with < 2mm difference. Histological examination of all resected specimens show clear bone resection margins, 2 patients had positive soft tissue margins.
At mean follow up period of 3 years(6 mo-7yrs), 6 patients developed local and systemic recurrences, three of them had pathological fracture at time of diagnosis and 4 poor response to chemotherapy(P=0.016), all recurrences occurred in the soft tissue. Implant survival at 5 year was 89%, MSTS score was 93%(86-100%).

Conclusion:
This is the biggest series in literature for joint sparing surgery in which custom JSE was used .In our series, both implants designs that we used; survived well at 5 year follow up (89%), no increased incidence of local recurrence in comparison to joint sacrificing techniques . No increased need for revision surgery in comparison with joint sacrificing approach. the early results of using custom made JSE is encouraging and functional outcome is outstanding.
Soft tissue sarcoma abutting the bone, what is the adequate bone margin?

Mr. Ahmad Shehadeh¹
¹King Hussein Cancer Center, Jordan

Background:
The incidence, surgical treatment and effect on overall survival and recurrence of bone invading/abutting soft tissue sarcoma, still poorly described in the literature.

Objectives:
To present an institutional experience regarding; surgical treatment and outcome of soft tissue sarcoma abuts the bone.

Material / Methods:
From July 2006 - Dec. 2017, 252 patients with wide local/compartment resection, at KHCC. Fifty five patients (20%) the tumor were attached to the bone. Patients divided into 3 groups:
Group 1: bone abutment only (n=30)
Group 2: cortical invasion (n=13)
Group 3: either medullary canal invasion or total encasement of bone (n=12)
All patients with group 1 received subperiosteal resection of the tumor, group 2 received hemicortical resection, and group 3 received segmental bone resection of the involved bone.

Results:
At mean follow up of 56 month (16-78mo), 8 patients died of disease metastasis, 4 patients developed local recurrence at the soft tissue, all of them the pathology of the resection show negative margin, 2 from group 1, and 2 from group 2. Two patients had radiation related femur fracture. Six out of the 13 patients with bone invasion on MRI, found to have bone invasion in histopathology exam. 5 yr. EFS = 53% and 5 yr. OS = 76%

Conclusion:
This is a small group retrospective pilot study; the results show that STS abutting bone probably do not lead to worse outcome. Our proposed guideline for surgical management of different scenarios of soft tissue tumor with adjacent bone abutment/invasion can be the basis for objective mean to plan the management of this subtype of soft tissue sarcoma. Larger size study is needed to expand this guideline.
Osseointegration prosthetic limbs for rehabilitation of amputees, the outcome in sarcoma patients.

Mr. Ahmad Shehadeh

King Hussein Cancer Center, Jordan

Introduction:
Traditional socket prostheses are associated with high incidence of problems: discomfort and pain at the residual limb, problems with fitting, and skin problems in the stump, all of which will result in a negative impact on the quality of life and mobility of the patients.

Materials and Methods:
At Khcc, we performed Osseo-integration surgery in 4 patients with above knee amputation for cancer, one patient with osteosarcoma, two patients with soft tissue sarcoma, and the fourth one with germ cell tumor. In all 4 patients, surgery was done after 2-3 year history of fitting with traditional socket prosthesis, where the patient were extremely uncomfortable, with persistent pain and opioids pain medicine intake.

Results:
Three out of the 4 patients did well and rehabilitated successfully and walked with no assistive aid at 1 year follow up period and stopped using all kinds of pain medicine, average MSTS score was 86%. The fourth patient, unfortunately developed metastatic lesion at the contralateral knee which mandates contralateral above knee amputation and her rehabilitation was complicated, then she developed systemic recurrences.

Conclusion:
Our series, is small, we are the first center in the Middle East to use this technology, we obtained excellent results in 3/4 patients. One obstacle is the high cost of the implant, and difficulty to be afforded by uncovered patients.
Combined use of intramedullary nails and Harms titanium mesh cages for reconstruction of diaphyseal defects after resection of malignant bone tumors.

Mr. Ilkin Mikailov1, Mr Petr Grigorev1

1Russian Research Institute of Traumatology & Orthopedics named after R.R. Vreden, Saint-Petersburg, Russian Federation

Introduction:
Today there are several options for reconstruction of diaphyseal post resection bone defects: endoprosthesis with intramedullary fixation of components, various variants of osteosynthesis in combination with (auto, allo) bone grafting devitalized bone autotransplant, bone cement, 3D printing

Methods:
We analyzed the middle term outcome of 7 patients with long bone tumors in the tibia diaphysis, treated with a combination of intramedullary nails, Harms titanium meshes cage and bone cement. The age of the patients ranged from 45 to 67 years. The size of the defects varied between 9 and 20 cm (13cm). There were 3 renal cancers, 2 chondrosarcomas, 2 breast cancers. All patients received standard titanium tibial nails locked by screws; the meshes were filled with cement with antibiotic.
The follow up ranged from 2 to 5 years. All patients were contacted through regular follow up.

Results:
All patients were alive no cases of local relapse have been identified. No cases of infection and mechanical failure of the implant were detected. Functional outcome: MSTS score 80% - 86% (median 82,5%).

Conclusions:
The proposed variant of defect replacement provides: the preservation of the joint, good local control, the possibility of early full weight-bearing on the limb and a low probability of infections, good medium-term survival of implant. However, a small number of observations cannot allow make statistically significant conclusions.
Epiphysis sparing surgery is a safe and effective treatment for tumors of the distal tibia.

Mr. Andrea Sambri, Dr. Mattia Dalla Rosa, Dr. Claudio Giannini, Dr. Riccardo Zucchini, Dr Maurizio Scorianz, Dr Davide Guido, Prof Davide Maria Donati, Prof Domenico Andrea Campanacci, Dr Massimiliano De Paolis

1Istituto Ortopedico Rizzoli, Bologna, Italy, 2Azienda Ospedaliera Careggi, Firenze, Italy

Introduction:
The aim of this multi-institutional retrospective study was to compare intercalary tumor resection (ITR), with preservation of the epiphysis, with osteoarticular reconstruction (OA) and ankle arthrodesis (AA), either tibiotalar (TT) or a combined tibiotalar and subtalar fusion (TTC) fusion after distal tibia (DT) resection for primary bone tumors.

Material and methods:
73 patients (median age 19 years, range 7-74) were included. Reconstructions of the DT included ITR in 17 cases, OA in 11 and 45 AA (38 TT and 7 TTC).

Results:
A total of 8 (10.9%) patients developed a LR after a median 14 months (range, 7-43). A similar incidence of LR was observed in ITR group (11.8%) and in the other two groups. (11.1% in AA and 9.0% in OA).
Graft fracture was the most frequent complication which required revision surgery. All graft fracture occurred in those cases with only homologous graft. All patients (7) affected by 7 proximal osteotomy non-union healed after treatment with autologous bone grafting.
In the OA group, three patients developed severe arthritis but only one was symptomatic and required conversion into TTC AA.
At final follow-up (median 77 months, range, 10-225) a total of 54 patients alive with a reconstruction in site were available for functional evaluation. In the ITR group, both MSTS (median 29) and AOFAS (median 85) were higher than in OA (22 and 70), TT AA (24 and 76) and TTC AA (24 and 78).

Conclusions:
Epiphysis preservation in distal tibia tumor is a safe and effective limb-sparing treatment. It requires rigorous planning, including adjuvant chemotherapy and accurate imaging analysis. When it isn’t adequate, AA (either TT or TTC) should be preferred over OA.
Silver coated (PorAg®) endoprosthesis can be protective against reinfection in the treatment of tumour prostheses infection.

Mr. Andrea Sambri¹, Dr. Mattia Dalla Rosa¹, Dr. Claudio Giannini¹, Dr. Riccardo Zucchini¹, Prof Davide Maria Donati¹, Dr Massimiliano De Paolis¹

¹Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction:
Silver-coated implants showed encouraging results in reducing reinfection rate for the treatment of endoprosthesis (EPR) infection (PJI) around the knee. We aim to evaluate the use of silver (PorAg®) coated compared to titanium coated prosthesis in two-stage revision for knee EPR PJI.

Materials & Methods:
68 patients were included. Median age was 30 years (range 14-83). 29 patients were re-implanted with PorAg® prosthesis and 39 with titanium-coated prosthesis. All patients had PJI confirmed according to Musculoskeletal Infection Society (MSIS) criteria. In 10 cases, no microorganism was identified at the time of first stage revision, but all had a sinus communicating with the prosthesis. Successful eradication of the infection was defined by the absence of clinical/serologic evidence of infection at 6 months after the second stage or at latest follow-up. Infection was again defined according to the MSIS criteria.

Results:
At 3 years follow-up, estimated reinfection rate in the silver group was slightly lower than in non-coated EPR (10.3% vs 17.5%, p=0.104). Among re-infected patients, only one out of three patients (33%) in the silver group required an amputation compared to 80% in the non-silver group (p=0.047).

Conclusions:
Our results demonstrate the efficacy of PorAg® coating in the two-stage revision of knee EPR and may have possible advantages over this traditional strategy, in particular when applied to patients with a higher risk of re-infection. Moreover, it appears that even in the case of recurrent PJI, silver coating can result in a higher chance of limb salvage.
Pathological fracture does not affect prognosis in dedifferentiated chondrosarcoma of the limbs.

Mr. Andrea Sambri1, Dr. Gianmarco Tuzzato1, Dr. Debora Lana1, Prof. Davide Maria Donati1, Dr Giuseppe Bianchi1

1Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction:
The aim of this retrospective study is to improve the current understanding of the natural history and treatment outcomes of pathological fracture (PF) in Dedifferentiated chondrosarcoma (DdChS) of the limbs.

Methods:
We retrospectively 175 adult patients (>18 years) with primary Dd ChS of the limbs. Disease-specific survival (OS) and local recurrence (LR) were analyzed.

Results:
Median age at the time of surgery was 66 years (range, 29-91). Most DdChS (121, 69.1%) were localized in femur. Forty-nine (28.0%) had metastasis at diagnosis; 39 (22.3%) had a PF.
OS rate was significantly lower in patients with metastasis at diagnosis (8.6% Vs 41.0% at 10 years, p<0.001). Among patients with localized disease, a similar OS was observed in those with/without PF (p=0.638), with/without chemotherapy (p=0.543) and the type of surgery (resection/amputation) (p=0.877). A worse OS in patients who developed a LR (p=0.031).
A not enhanced risk of LR was observed in PF (p=0.443). Amputation reduced risk of LR (80.0% vs 63.1% at 5 years, p=0.039), in particular in PF group.

Conclusions:
Patients with metastases have a particularly poor prognosis in DdChS. Pathological fracture does not influence prognosis in terms of survival and local control. Initial curative resection is essential in order to reduce the chance of recurrence, as this reduce drastically the chance of survival. Amputation might be an option in patients with localized disease and a PF in order to reduce the risk of LR, thus potentially increasing the chance of survival.
Similar local recurrence rate but worse survival in primary, localized grade 3 myxofibrosarcoma of the extremities.

Mr. Andrea Sambri1, Dr. Debora Lana1, Dr. Gianmarco Tuzzato1, Dr. Alberto Righi1, Prof Davide Maria Donati1, Dr Giuseppe Bianchi1

1Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction:
Myxofibrosarcoma (MFS) is one of the most common soft tissue sarcomas (STS) in elderly patients and it primarily affects the extremities. The aim of this retrospective analysis is to understand the natural history of MFS, in particular whether prognosis is influenced by histologic grade.

Patients and methods:
We retrospectively reviewed 229 adult patients with primary MFS of the limbs. Disease-specific survival (OS) and local recurrence (LR) were analyzed.

Results:
Median age at the time of surgery was 70 years (range, 19-92); most MFS (163, 71.2%) were localized in the lower limb. Sixteen (7.0%) MFS were grade 1, 38 (16.6%) grade 2 and 175 (76.4%) grade 3. A significant worse OS was found in grade 3 MFS (73.1%) than in grade 2 and 1 (91.9% and 100%, respectively) at 5 years, p=0.031). A better OS was observed in superficial and in small MFS (p=0.005 and p=0.002). Locally recurred MFS had a worse OS (p=0.018).
A better LR-free rate (100% at 5 years) was observed in grade 1 MFS; however, a similar rate was observed between grade 2 and 3 tumors (77.1% and 80.0% at 5 years, respectively, p=0.412).

Discussion:
Grade 3 MFS are associated with the worst prognosis. On the other hand, patients affected by grade 1 MFS have the lowest risk of developing a local recurrence.
These data could help to identify a high-risk patients group, thus reserving a more careful follow up to higher risk patients. Also, since MFS mostly affects elderly population, it might be of paramount importance to reserve adjuvant treatments, such as radiotherapy and chemotherapy, only to higher-risk patients.
Overall Survival in case of oncologic resection of bone metastasis in thyroid cancer.

Mr. Vincent Crenn¹, Mr. Henri Fragnaud¹, Mr. Denis Waast¹, Mr. Gualter Vaz², Mr. Jean-Camille Mattei⁴, Mr. Richard Alexandre Rochwerger⁶, Mr. Yoann Varenné⁵, Mr. François Gouin², Mr. Louis-Romée Le Nail³, Mr. Philippe Rosset³, Mr. Mickael Ropars⁵

¹CHU Nantes, Nantes, France, ²Centre Léon Bérard, Lyon, France, ³CHU Tours, Tours, France, ⁴APHM, Marseille, France, ⁵CHU Rennes, Rennes, France

Introduction:
Impact on overall survival (OS) has not been clearly evaluated in bone resections of metastatic thyroid lesions. We propose a retrospective study of patients operated with a wide margin bone resection planned surgery. The aim of this study was to analyze 1-year, 5-years, 10-years and 15-years OS of these patients, and to identify factors influencing this survival.

Methods:
17 patients from 5 oncologic surgery hospitals (Tours, Rennes, Marseille, Lyon and Nantes) undergoing oncologic resection between 1992 and 2018 were included. Mean age at surgery was 56.6 ± 12.7 years, sex ratio was 0.42 (5 men for 12 women), mean follow-up at surgery was 65 ± 63 months. Resection margins were R0 for 11 cases (65%), R1 for 4 cases (24%), and R2 for 2 (12%). Chronologic metastatic bone presentation was synchronous (<6 months) for 7 cases (41%) and metachronous for 10 cases (59%). We observe 5 axial lesion (29%), 8 femoral lesions (47%), and 4 humeral lesions (24%).

Results:
Median OS after resection was 151 ± 93 months, OS at 1, 5, 10 and 15 years was 94%, 74%, 74% and 37%. Single or multiple metastasis resulted in a 10-year OS of 87.5% versus 0% (Log Rank, p = 0,07). IRA-therapy treatment was associated with better 5-year OS of 83% versus 0% (log-rank, p = 0,18). Non-axial metastatic localization was associated with better 5-year OS of 83% compared to axial localization with 55% (log-rank, p = 0,09). R0 resections were associated with a 77% 5-year OS versus 67% for R1 and R2 margins (log-rank, p =0,43).

Conclusion:
OS in our cohort is high in cases of oncologic resection in thyroid bone metastasis. Single metastasis, IRA-therapy associated treatment, and non-axial localization seem to have a better prognosis in this context.
Late metastasis in Ewing sarcoma

Andreas Leithner¹, Bernadette Liegl-Atzwanger⁴, Alfred Maier³, Maria Anna Smolle¹, Freyja-Maria Smolle-Jüttner³, Joanna Szkandera², Mr. Johannes Nikolaus Woltsche¹

¹Department of Orthopaedics and Trauma, Medical University of Graz, Graz, Austria, ²Division of Oncology, Department of Internal Medicine, Medical University of Graz, Graz, Austria, ³Division of Thoracic and Hyperbaric Surgery, Department of Surgery, Medical University of Graz, Graz, Austria, ⁴Institute of Pathology, Medical University of Graz, Graz, Austria

Introduction:
Ewing sarcoma (EWS) is the second most common malign bone tumor of adolescence and young adulthood. Despite improved tumor therapy, 30%-40% of patients suffering from a localized primary EWS sustain a relapse. The median time from initial tumor diagnosis to relapse is 1.3 to 2.3 years.

Case report:
Here, we report the case of a 50-year-old female patient, that was diagnosed a localized EWS of the right femur 29 years previously. The patient received efficient tumor therapy corresponding to the therapy approaches in CESS 86 and showed complete remission. This year a follow-up computer tomography lead to the incidental finding of a pulmonary lesion. Further investigations identified this lesion as a solitary, very late metastasis of an EWS. At the moment the patient receives induction chemotherapy. Wide local excision with partial thoracic wall resection is planned to be performed.

Conclusions:
This case illustrates the unique event of recurrence in EWS, 29 years after diagnosis of the primary tumor. To the best of our knowledge, there has not been described a longer time span between initial tumor diagnosis and relapse in literature up to now. Therefore, we wish to increase awareness, that EWS can show very late metastasis.
Recovery of Function after Arthrodesis Reversal to a Hinged TKA

Mr. Graham Albert¹, Chase Dean¹, Bennie Lindeque¹
¹University of Colorado, Aurora, United States

Introduction:
EE is a 65 year old male status post hinged TKA who presented with recurrent falls secondary to quadriceps weakness. In 2016, he underwent left knee arthrodesis with retention of the hinged TKA. After quadriceps strengthening, he underwent arthrodesis reversal. Since then he has gone on to recover complete function.

Methods:
For several years after his hinged TKA surgery he was ambulatory with assistance but his quadriceps weakness was causing recurrent falls. He underwent left knee arthrodesis with locking plates laterally and encasement of the hinged implant with bone cement. Three years later, he requested reversal to hinged TKA which was performed with a caveat that his quadriceps was strengthened greatly. He underwent successful removal of plates and cement with retention of hinged TKA.

Results:
Three weeks post-op, EE had improved left knee ROM – active full extension and active 90 degrees of flexion. More impressively, he was ambulating at home without a cane and walking several blocks at a time with a cane in case he lost his balance. Three months post-op, EE presented with improved left knee ROM – active full extension and active 110 degrees of flexion – and reported walking with a cane 5+ blocks per day.

Conclusion:
There is no current literature on changing a TKA to a knee arthrodesis for treatment of recurrent falls. This is true for tumor resections around the knee as well as knee infections. Furthermore, there is no literature supporting knee arthrodesis with retention of TKA implants or the reversal of knee arthrodesis and return to function of the TKA in treatment of tumors or infections. Performing a knee arthrodesis with retention of TKA implants is a feasible option for a patient who may opt for a mobile knee in the future.
High efficacy for TNF-Melphalan based isolated limb perfusion in the treatment of locally recurrent high-grade soft tissue sarcoma

Mr. Lars Erik Podleska¹, Mr. Jendrik Hardes¹, Mr. Arne Streitbürger¹, Mr. Hans-Ulrich Steinau², Mr. Georg Taeger¹, Mr. Farhad Farzaliyev²
¹Tumororthopaedics and Sarcoma Surgery, Essen University Hospital, Essen, Germany, ²Department of General-, Visceral- and Transplantation Surgery, Essen University Hospital, Essen, Germany

Introduction:
TNF-Melphalan based isolated limb perfusion (TM-ILP) is known to be an effective treatment option in high-grade soft tissue sarcoma (STS) of the extremities. However, until today there is no data on the efficacy of TM-ILP in cases of recurrent STS, which are often considerably more difficult to treat compared to primary STS. Thus, the aim of this study was to evaluate the effectiveness of TM-ILP followed by resection of the residual tumor (ILP-group) in comparison to patients treated by resection only (non-ILP-group).

Methods:
Both groups (ILP vs. non-ILP) were retrospectively compared for local recurrence free survival (LRFS) and distant metastasis free survival (DMFS). Variables with a possible influence on LRFS were analyzed using either the chi-square or the Mann-Whitney U test. Kaplan-Meier survival plots were calculated, and a proportional hazard regression model was developed.

Results:
Out of 448 patients with extraabdominal STS treated between August 2012 and December 2015, 52 cases involving 47 patients with recurrent STS were included. 28 patients were treated by TM-ILP prior to resection (ILP-group) and 24 were treated by standard therapy (non-ILP). The three-year LRFS in the ILP-group was estimated at 75% with a 95%-confidence interval (CI) of 71.5–78.5 and was significantly lower in the non-ILP-group: 43.4% (95%-CI: 38.7–48.1; p=0.009). Distant metastasis-free survival in the ILP-group was not significantly different from the non-ILP-group (ILP: 88.9% at 44-months, 95%-CI: 85.2–92.6%; non-ILP: 80.4% at 44-months; 95%-CI: 75.2–85.6%). Multivariable analysis revealed resection with negative margins, lower number of previous recurrences and TM-ILP as positive predictors for LRFS.

Conclusion:
TM-ILP in combination with subsequent resection of the residual tumor significantly improves LRFS for patients with a first local recurrence of high-grade STS.
Comprehensive Bioinformatic Analysis of Immune Composition and Genes for Survival Prediction in Sarcoma

Mr. Hongmin Chen

1Sun Yat-Sen University Cancer Center, Guangzhou, China

Introduction:
Sarcomas, a broad family of mesenchymal malignancies, exhibit remarkable histologic diversity. Previous study has reported that the infiltration of immune and stromal cells in tumor microenvironment contribute significantly to prognosis. ESTIMATE, an algorithm to calculate immune and stromal scores, predicts the infiltration of non-cancer components. TCGA database is available to grasp potential correlations between gene set prolifere and overall survival of malignancies. To better understand the proportions of immune cells in the tumor microenvironment, We used CIBERSORT and ssGSEA to infer the relative proportions of several distinct leukocyte cell types in the tumors from gene expression data of sarcoma patients. Moreover, we extracted a list of genes that predict poor outcomes in sarcoma patients.

Methods:
Gene expression profile and clinical data for sarcoma patients was obtained from the TCGA data portal. Immune scores and stromal scores were calculated by applying the ESTIMATE algorithm to the downloaded database. Batch adjusted data was subsequently analyzed using CIBERSORT and ssGSEA to resolve the immune composition. For validation, gene expression profiles for sarcoma patients were obtained from the Gene Expression Omnibus dataset GSE17679.

Results:
The immune and stromal score are associated with prognosis. The type 2 macrophages in sarcoma makes up the largest composition of all immune cells in the tumor microenvironment of sarcoma. From functional enrichment analysis of TCGA database applied by ESTIMATE algorithm-based immune scores, we extracted that NR1H3, VAMP5, GIMAP2, GBP2, HLA-E and CRIP1 are highly expressed in the immune microenvironment, predicting good outcomes in sarcoma patients.

Conclusion:
We extracted a list of tumor microenvironment related genes. These genes were validated in an independent sarcoma cohort and that may represent promising novel signatures for the diagnosis and prognosis prediction of sarcoma. The immune composition analysis could be useful for outlining the prognosis.
Results in the surgical treatment of aneurysmal bone cysts – a retrospective data analysis

Mr. Kevin Döring, Mr. Stephan Puchner, Mr. Klemens Vertesich, Mr. Philipp Theodor Funovics, Mr. Gerhard Martin Hobusch, Mrs Irene Sulzbacher, Mrs Catharina Chiari, Mr. Reinhard Windhager

Medical University of Vienna, Vienna, Austria

Introduction:
Aneurysmal bone cysts (ABC) are benign tumors mostly occurring in children and young adults. Different open and minimal invasive surgical approaches have been proposed for the treatment of ABCs. The aim of this study was to retrospectively review data of a large single center series of ABCs.

Methods:
By retrospective data analysis of the Vienna Bone and Soft Tissue Tumor Registry, we evaluated 90 patients who were treated for primary ABCs between 1986 and 2009. This included 50 males and 40 females with a mean age of 16 years. All of these patients were treated with either curettage, phenolization if appropriate and subsequent reconstruction with bone grafts, or with en-bloc resection. The mean follow up was 99 months.

Results:
Curettage was performed in 83 patients, while 45 patients received adjuvant phenolization. Local recurrence occurred in 28 patients after a mean time of 16 months, with a corresponding local recurrence free survival (RFS) of 83% after one year, 77% after 2 years and 66% after 5 years. The cysts were most commonly located in the femur (n=18), the humerus (n=15) and the fibula (n=14). ABC located in hands and feet showed a superior RFS (p=0.044). Younger patients (p=0.043) and ABC filling with allograft (p=0.022) displayed an inferior RFS.

Conclusion:
Even after extensive curettage, phenolization and filling of the cyst, the local recurrence rate of aneurysmal bone cysts remains rather high. In this context, regular postoperative monitoring of the young patients is absolutely necessary.
Lessons learned from recruitment patterns in the Prophylactic Antibiotic Regimens (PARITY) randomized controlled trial

Ms. Michelle Ghert1,2, Dr. Anthony Bozzo1,2, Ms. Patricia Schneider1, Ms. Victoria Giglio1, Dr. David Wilson2, Dr. Michelle Ghert1,2

1Centre for Evidence-Based Orthopaedics (CEO), McMaster University, Hamilton, Canada, 2Division of Orthopaedic Surgery, McMaster University, Hamilton, Canada

Introduction:
The PARITY trial was the first study to prospectively enroll and randomize orthopaedic oncology patients in multiple centers internationally. The objective of this study was to describe recruitment patterns, examine the differences in enrollment across different PARITY sites, and to identify variables associated with varying levels of recruitment.

Methods:
Data from this study was obtained from the PARITY trial Methods Centre and correspondence data. We performed descriptive statistics to demonstrate the recruitment patterns over time. We compared recruitment, time to set up, and time to enroll the first patient between North American and international sites, and sites that did and did not have dedicated research personnel.

Results:
A total of 602 patients from 36 North American and 12 international sites were recruited from 2013 to 2019. Average monthly enrollment increased each year of the study. North American sites were able to start up significantly faster than international sites (19.3 vs. 28.3 months p=0.037). However, international sites had a significantly higher recruitment rate once active (0.2 participants/month vs. 0.62 participants/month, p=0.018). Sites with research personnel were able to reach ‘enrolment ready’ status significantly faster than sites without (19.6 vs. 30.7 months, p=0.032), but there was no difference in recruitment once active (0.28 participants/month vs. 0.2 participants/month).

Conclusions:
As a collaborative group, the PARITY investigators increased the pace of recruitment throughout the trial. The longer time to start-up at international sites is likely due to the complex governing regulations of pharmaceutical trials. Nevertheless, international sites should be considered essential as they recruited significantly more patients per month once active. The absence of research support personnel should not preclude a site from participation. The Surveillance After Extremity Tumor Surgery (SAFETY) trial has begun recruitment in Canada and the results of the current study will guide participation in SAFETY and in future trials.
Novel prognostic scale for patients with spinal metastases

Mr. Aslan Valiev¹, Mr. Elmar Musaev¹, Mr. Valerii Burliaev¹, Mr. Mamed Aliev²
¹Federal State Budgetary Institution «N.N. Blokhin National Medical Research Center of Oncology» of the Ministry of Health, Moscow, Russian Federation, ²Federal State Budgetary Institution National Medical Research Radiological Center of the Ministry of Health of the Russian Federation, Moscow, Russian Federation

Introduction:
The high relevance of determining the prognosis of life in patients with metastatic spinal lesions is currently in no doubt. The existing prognostic scales are either dedicated to a single nosological form with a sufficiently high reliability, or universal prognostic scales with moderate reliability.

Materials and methods:
Prospective and retrospective material from 1999 to 2016. 460 patients with metastatic spinal lesions (16 nosological forms). There was no special nosological selection of patients by tumor type during enrollment. A prognostic scale has been created to determine the prognosis and surgical approach for patients with spinal metastases. Out of more than 80 prognostic factors, based on the regression analysis, the most effective and reliable oncological prognosis factors were selected that were not previously taken into account at the present time. Also, individualized nosological prognostic factors for the most common types of tumors (such as breast, renal, prostate, and lung cancer) are included in the prognosis. The reliability of the prognostic scale is 84%.

Conclusion:
This prognostic scale is, in our opinion, a universal tool that is quite simple in clinical management and allows using it in determining the prognosis of life of cancer patients with spinal metastases, taking into account modern individualized nosological prognosis factors.
Ankle Valgus Deformity in Skeletally Immature Hereditary Multiple Exostoses

Mr. Osman Emre Aycan, Mr. Muhammet Coskun Arslan, Mr. Yavuz Arıkan, Mr Devrim Ozer

Baltalimani Bone Diseases Training & Research Hospital, Istanbul, Turkey

Introduction:
Ankle valgus is the most common deformity in Hereditary Multiple Exostoses (HME) which may develop by tapering of the lateral aspect of the distal tibial epiphysis and fibular shortening or compensatory to pre-existing proximally located deformities. We sought to evaluate the effect of pre-existing deformities, localization of osteochondroma and timing of resection in skeletally immature patients.

Methods:
We conducted a retrospective review of HME patients treated at a single institution from 1996-2018. 78 skeletally immature HME patients with follow-up orthoroentgenographic views of minimum 5 years were included. Apart from epidemiological data, the number of exostoses at lower extremities (hip, knee, ankle), tibiofibular interosseous exostoses, existing deformities, limb length discrepancies and brachymetatarsia were evaluated. Femoral neck/shaft angle, femorotibial angle, anterior/lateral distal tibial angle(ADTA/LDTA), intrinsic obliquity of talus, distal tibial lateral surface displasia and position of tibia and fibula at ankle were measured.

Results:
Mean age at the time of diagnosis was 6.4±3.8 with a mean follow-up of 12.4±6.1 years. Ankle valgus was the only deformity encountered in our series. 51 patients inevitably developed ankle valgus deformity within the follow-up time. The number of interosseous osteochondroma was significantly related with the presence of valgus deformity.(p=0.002) No significant relation was found between the number of osteochondroma around the hip or knee and presence of ankle deformity. Brachymetatarsia is determined as one of the early signs of increased number of osteochondromas, limb length discrepancy and ankle deformity. 25 ankles of 18 patients were operated due to interosseous osteochondroma at distal tibiofibular region. Ankle valgus deformity was absent in 16 patients within follow-up time. Correction of the ankle valgus deformity was significantly correlated with age at diagnosis.(p = 0.001)

Conclusion:
The resection of emerging interosseous osteochondroma at ankle region of skeletally immature HME patients, seems to be an effective strategy for correcting ankle valgus.
Nursing aspects to improve the quality of life - ensuring optimal inpatient and post-hospital care

Ms. Andrea Fink¹, Mrs. Romana Matz¹, Mrs. Marlene Kraner¹, Mrs. Katharina Tschiggerl¹, Mrs. Eva Maria Rosenberger²
¹Medical University Clinic Graz, Orthopaedics and Trauma, Graz, Austria, ²Medical University Clinic Graz, Ward Manager of surgical Department, Graz, Austria

Introduction and purpose:
Patient-oriented care is important during as well as after hospitalization for optimal recovery after surgery. This is ensured in inpatient care through the introduction of the intervention program "primary nursing" since January 2019 and by means of a multi-professional pain management. Patients in primary nursing are accompanied by a qualified health and nursing team throughout their inpatient care. Conversations and the help with any concerns is of major importance here. The planning of a needs-oriented, post-inpatient care is now also initiated at inpatient admission. The aim of this procedure is to determine how many inpatients had a conversation about their discharge at the day of admission. Furthermore, it is assessed how many patients used the nursing intervention program and multi-professional pain management.

Methods:
Twelve patients (1 female, 11 males, mean age 52 years), who were surgically treated at our tertiary tumour centre between January and August 2019 for a soft tissue sarcoma of the extremities, were included in this retrospective survey.

Results:
All patients (100%) held a conversation in preparation of their discharge. One third (33.3%) was cared for by primary nursing. Three (25%) patients used multi-professional pain management. All patients gave positive verbal feedback regarding our intervention programs.

Conclusion:
To further primary nursing and pain management, there is a need for well-trained health and nursing staff, as well as good collaboration among the multi-professional team to ensure the long-term care and care of patients, both inpatient and post-hospital.
Advanced Epithelioid Haemangioendothelioma: fever, pain and pleural effusion predict a worse outcome

**Mr. Andrea Napolitano**, **Mr. Bruno Vincenzi**, Ms. Anna Maria Frezza, Ms. Antonella Brunello, Mr. Lorenzo D’Ambrosio, Mr. Giacomo Giulio Baldi, Mr. Giuseppe Badalamenti, Mr. Giovanni Grignani, Mr. Sergio Valeri, Mr. Luca Impota, Mrs. Mariella Spalato Ceruso, Mr. Angelo Paolo Dei Tos, Mr. Alessandro Gronchi, Ms. Silvia Stacchiotti

1 University Campus Bio-medico, Rome, Italy, 2 Istituto Nazionale Tumori, Milan, Italy, 3 Istituto Oncologico Veneto, Padova, Italy, 4 Istituto di Candiolo, Candiolo, Italy, 5 Nuovo Ospedale Santo Stefano, Prato, Italy, 6 Policlinico P. Giaccone, Palermo, Italy, 7 University of Padova, Padova, Italy

**Introduction:**
Epithelioid hemangioendothelioma (EHE) is an exceedingly rare soft tissue sarcoma subtype. EHE clinical behavior is highly unpredictable, with indolent as well as very aggressive forms. A common choice in advanced patients is active surveillance (AS). We report on a retrospective study aimed at identifying clinical features associated with an aggressive behavior.

**Methods:**
Patients affected by advanced EHE in AS followed in 6 centers of the Italian Rare Cancer Network were retrospectively reviewed. Diagnosis was confirmed by a sarcoma pathologist and molecular analysis was performed. Baseline clinical features were evaluated, including the presence of systemic symptoms (fever, weight loss, anorexia) and tumor related pain, number of organs involved, mitotic index. Response and progression were defined according to RECIST 1.1. Survival functions were estimated by Kaplan-Meier method.

**Results:**
52 patients were identified. All patients had metastatic disease; 20 showed involvement of one organ, while 32 had multiorgan disease. At the time of initial diagnosis, all patients were naive from any systemic therapy and underwent exclusive AS. With a median FU of 28 months, 31 (63%) patients progressed while 22 (37%) remained stable. No spontaneous regressions were observed. Median PFS was 29 months. Median OS was 52 months. Fever correlated with shorter m-PFS (8 vs 43 months), as well as pain (10 vs 41 months) and the presence of pleural effusion (5 vs 44 months). In addition, fever and pleural effusion correlated with a shorter m-OS. Similarly, the presence of pain corresponded to a not significant worse m-OS.

**Conclusions:**
This retrospective study suggests that in advanced EHE patients the presence of fever and/or tumor related pain and/or of pleural effusion can be associated with a more aggressive clinical behavior. Pleural effusion seemed to be a clinical feature associated with the worst outcome, with a m-OS of 12 months.
Growth disturbance in the tibia after expandable distal femur reconstruction in skeletal immature patients.

Mr. Ahmad Shehadeh

King Hussein Cancer Center, Amman, Jordan

Introduction:
Expandable distal femur endoprosthesis (EDFE) are commonly used to compensate for the sacrificed femoral physis in distal femur resection in skeletal immature children. However, the effect of the passive tibial component on tibia growth is not well studied in literature.

Methods:
Twenty patients who received expandable distal femur replacement, between 2009-2017, followed for 30 months at least, tibial length, rotation deformity, medial proximal tibia angle (MPTA), posterior tibia slope angle (PTSA), and whole extremity length were measured. The diameter of the proximal part of tibia tray which penetrates the physis was 12-16 mm. Two types of implants were used, JTS noninvasive prosthesis (Stanmore Implants Worldwide) in 13 patients, and MUTARS® Xpand Growing Prostheses, in 7 patients.

Results:
No patients had evidence of tibia physis injury at time of surgery, at average of 3 years follow up, 8 patients had normal growth pattern (40%), 12 patients had growth disturbance, of those: rotation deformity (n=1), varus deformity; MPTA < 85°, (n=5), sagittal deformity; PTSA < 40°, (n=2) and 8/12 patients had 2-3 cm tibia length discrepancy, 4 of them received over elongation of the expandable distal femur 1-2 cm. At last follow up at skeletal maturity of before death, 4 patients has LLD of 1.5-2.5 cm, none received further surgery, all were managed by shoe lift.

Conclusion:
Almost half of the patients with expandable distal femur prosthesis will suffer from disturbed tibia growth and deformity, however, in our series, none of them required a subsequent surgery to correct the resulting LLD or deformity, and all were managed conservatively successfully making EDFE is a good reconstruction modality for maintaining limb length. A multicenter collaborative study is needed to recruit a larger population of patients to draw a statistically significant conclusions.
Soft tissue sarcomas: Wound complications dictate treatment selection - A new approach

Mr. Bennie Lindeque¹, Mr. BGS Lindeque², Mr. Benjamin Harnke³
¹University of Colorado, Aurora, United States, ²University of Cape Town, Cape Town, South Africa

Introduction:
It is well known that local control and local recurrence per se does not influence overall survival. Also, pre-op radiation to lesions in proximity of 3mm to the skin carries a high severe wound complication rate. Also, wound reconstruction with free flaps have up to 40% complication rate, which is similar to primary closure in pre-op radiation. A post-radiation wound complication classification based on length of treatment, morbidity, and cost does not exist. The morbidity is much higher than portrayed in the literature. Modern image modalities can detect a local recurrence much sooner and Image Intensified Radiotherapy reduces the radiation dosage administered.

Materials:
5,443 publication abstracts were read on soft tissue sarcomas. We extracted 28 publications that discuss pre-operative wound complications and 14 publications that report on post-operative wound complications.

Results:
No publication exists compiling severity and length of wound treatment systematically. Also, no publications assess wound complication cost. Recurrent classification of wound complications into minor and major complications is unsatisfactory.

Conclusion:
1. Surgery without neoadjuvant or adjuvant radiotherapy is the preferred treatment of STS if a 2 cm margin can be achieved.
2. Post-operative RT is the preferred adjuvant if the wound bed is not larger than 7 cm and joints could be spared.
3. Pre-operative RT is the preferred adjuvant if the tumor is larger than 7 cm, close to neurovascular bundle or a joint.
4. MRI in follow up should be done every 3 months for 2 years, then 6 monthly for up to 5 years, then yearly for up to 10 years.
5. Radiation used should be of Intensity-Modulated Radiotherapy to minimize collateral damage.
Vascularized Bone Graft Reconstruction following Bone Tumor Resection: An Outcome Analysis of a Multidisciplinary Center for Bone and Soft Tissue Sarcoma

Mrs. Sabina Gorski¹,², Mr. Martin Haug¹,³, Mr. Andreas H. Krieg²,³
¹Department of Plastic, Reconstructive, Aesthetic and Hand Surgery, University Hospital Basel, Basel, Switzerland, ²Paediatric Orthopaedic Department, University Children’s Hospital Basel (UKBB), Basel, Switzerland, ³Bone and Soft Tissue Tumour Centre of the University of Basel (KWUB), Basel, Switzerland

Limb-sparing procedures are continuously evolving to enhance patient outcomes. The use of vascularized bone grafts has achieved significant improvement in both functional satisfaction and oncologic safety. As few studies have assessed the results of the various bone graft options, this study highlights clinical outcomes following bone tumor resection combined with fibular, iliac crest or medial femoral condyle (MFC) reconstructions.

Twenty-seven vascularized bone grafts (Eighteen fibulas, six iliac crests and three MFCs) have been assessed with respect to consolidation and hypertrophy, functional as well as oncologic outcomes and local complication rates. There were fifteen males and twelve females (mean age at index-surgery 17.9 years) with a mean follow-up of 5.1 years. Mean bony defect after resection was 11.9 cm.

80 percent of fibular grafts healed primarily at the proximal osteotomy sites after a median time of 5 months, compared to 6 months at the distal sites. 83.3 percent of patients following iliac crest reconstruction achieved primary union at both osteotomy sites after a median of 5 months. In two of the MFC grafts bony union occurred after a median time of 4 months. Significant hypertrophy was observed in thirteen patients and ranged from 24.4 to 100 percent.

We identified six groups of complications based on their clinical presentation and the highest rates occurred in the fibular group. Despite complication risks, functional results were highly satisfied with a mean MSTS score of 87.3 percent and 84.4 percent, respectively.

Vascularized bone grafts have offered reconstructive prospects maintaining long-term functionality and aesthetic satisfaction without compromising tumor recurrence outcomes. In this study, we demonstrate that vascularized bone grafting is feasible with the concomitant use of chemotherapy and radiation therapy. While the vascularized fibula is a suitable graft in extensive defects, the iliac crest and MFC grafts offer both structural support and lower complication rates.
Complications and survivorship of megaprostheses after the resection of bone metastases

Mr. Christoph Theil¹, Ms. Maria Anna Smolle², Mr. Georg Gosheger¹, Mr. Kristian Nikolaus Schneider¹, Mr. Marcel-Philipp Henrichs³, Mr. Tom Schmidt-Braekling¹, Mr. Jendrik Hardes¹, Mr. Dimosthenis Andreou¹,²

¹University Hospital Muenster, Münster, Germany, ²University Hospital Graz, Graz, Austria, ³Paracelsus Hospital Osnabrueck, Osnabrück, Germany, ⁴University Hospital Essen, Essen, Germany, ⁵Sarcoma Center Berlin-Brandenburg, Helios Hospital Bad Saarow, Bad Saarow, Germany

Introduction:
Resection followed by megaprosthetic reconstruction can be indicated in patients with bone metastases particularly in oligometastatic disease or following pathological fractures. We aimed at investigating implant survivorship and potential failure mechanisms using a competing-risk model.

Methods:
We retrospectively identified 234 patients with bone metastases treated at a single center between 1993 and 2017 using a single design modular implant system. Implant failures were classified using the system proposed by Henderson et al. Implant survivorship and associated risk factors were analyzed using competing-risk analysis including death as a competing event reporting hazard ratios (HR) and 95% confidence intervals (CI). Median follow-up amounted to 16 months (IQR 7-34) for all patients and 25 months (IQR 13 – 51) for surviving patients.

Results:
The most frequent complications were wound healing problems in 9% (21/234) of the patients followed by infections in 3% (6/234). 5% of the patients (13/234) had to undergo major revision with implant removal and 1% (2/234) had to undergo amputation. The one- and three-year risk of a prosthetic complication was 11% and 14%, respectively, while the risk of infection for the same periods was 2% and 3%, respectively. The overall survival probability was 42% (95% CI 36-49%) two years after surgery and 16% (95% CI 11 – 21) after five years. Proximal tibial replacements (HR: 8.300; 95%CI: 3.134-21.948; p<0.001), total humerus and femoral replacements (HR: 6.397; 95%CI: 1.896-21.586; p=0.003) had a significantly higher risk for implant complications. Patients with previous surgeries (HR: 1.996; 95%CI: 0.999-3.989; p=0.050), and a higher BMI (HR: 1.089; 95%CI: 1.028-1.153; p=0.004), had a significantly poorer complication-free survival.

Neither preoperative nor postoperative local radiation treatment was significantly associated with overall complications or infections.

Conclusion:
Megaprosthetic reconstruction following the resection of bone metastases is a durable and low-complication treatment option, even in combination with local radiotherapy.
Sacral nerve roots and ischial nerve as organs at risk in definitive carbon ion irradiation of sacral sarcoma.

Mr. Piero Fossati1, Mrs. Petra Georg1, Ms. Joanna Gora1, Mrs. Giovanna Martino1, Mr Markus Stock1, Mr Eugen Hug1
1MedAustron Ion Therapy Center, , Austria

Introduction:
Radical surgery of pelvic sarcoma is technically challenging and can be mutilating. Carbon ion radiotherapy has been successfully employed in the definitive treatment of non-operated sacral chordoma [1], chondrosarcoma [2] and osteosarcoma [3,4]. Peripheral nerves neuropathy is a late unwanted side effect of high dose radiotherapy whose real incidence and pathophysiology are not yet completely understood [5,6]. Most probably direct nerve damage and demyelination, microvascular damage and fibrosis play a synergistic role. In proton and carbon ion series peripheral nerves toxicity is reported when dose to the cauda equine and/or nerve roots, and/or ischial nerve exceeds 70 Gy RBE [1,7] and when a long stretch of nerve ( > 10 cm) is irradiated.

Methods:
We defined an internal protocol for peripheral nerve sparing in high dose carbon ion radiotherapy of pelvic sarcoma. Individual nerve roots are contoured on axial CT slices as they exit the sacral foramina. Ischial nerve is contoured dorsal to piriform muscle and ventral to gluteus maximus. Coronal reconstructions are employed to interpolate the contours in dubious slices.

Prescription doses used for definitive carbon ion irradiation of pelvic sarcoma at MedAustron range from 76.8 Gy RBE in 16 fractions of 4.6 Gy RBE to 73.6 Gy RBE in 16 fractions of 4.8 Gy RBE.
Dose constraints for peripheral nerves are set at 70 Gy RBE over 5 cm length and at 74 Gy RBE in a 0.01cc volume.

Results:
Thanks to the favorable physical properties of carbon ions (small spot size and sharp lateral penumbra) it is possible to selectively spare peripheral nerve and maintain adequate target coverage.

Conclusion:
We have implemented a nerve sparing high dose carbon ion radiotherapy concept for pelvic sarcoma. Long term follow up is needed to confirm the efficacy of this approach in reducing clinically relevant radiation induced neuropathy.
Tibial PEComa - An extremely rare case report

Mr. Tiago Amorim-Barbosa

Introduction:
Perivascular Epithelioid Cell tumor (PEComa) is an extremely rare mesenchymal tumor, mainly reported in the abdominopelvic and retroperitoneal viscera, being the primary bone even rarer with only 11 cases described worldwide.

Methods-Results:
A 63-year-old female-patient with no relevant history, observed by General Practitioner with an insidious right ankle pain and normal ankle radiograph. Nine-months later, a magnetic resonance imaging revealed a destructive bone lesion involving the calcaneus, navicular and cuneiform with circumferential soft tissue component and extension to tibial shaft. A percutaneous biopsy revealed a malignant neoplasia with melanocytic markers expression. Analysis for V600-mutations of BRAF gene and 22q12-translocations of EWSAR1 gene were negative, supporting PEComa. Without evidence of metastasis, she underwent transfemoral amputation. The pathological anatomy of the surgical specimen confirmed the diagnosis of PEComa, with positive TFE3 expression. No adjuvant therapy was performed. At 5-months follow-up, she had 12/30 on the MSTS score and a lytic lesion of 5 cm in the right ischopubic ramus, suggesting secondary lesion, was confirmed by Positron Emitting Tomography, further revealing another lesion in the left femoral condyle and right humeral head. The patient initiated Temsirolimus, a mTOR inhibitor. Due disease progression, she started pazopanib, an antiangiogenic-tyrosine-kinase-inhibitor. Given the clinical worsening, she started letrozole, 3 months later, an aromatase-inhibitor, with regression of the lesions. Due lumbosacral metastasis with endocanalar invasion, she developed an equine tail syndrome, performing high-dose of corticosteroid therapy and radiotherapy. The patient died 2 years and 9 months after the onset of symptoms.

Conclusion:
The case reports an extremely rare disease with a challenging diagnostic and therapeutic approach, necessarily multidisciplinary.
Brown-Séquard Syndrome by Dorsal Hemangioma of Aggressive Behavior

Mr. Tiago Amorim-Barbosa

Introduction:
Hemangioma is a mesenchymal neoplasm of vascular origin that often affects the skin and subcutaneous cellular tissue. However it may involve any bone, including the spine.

Methods- Results:
Female patient, 65 years-old, with one year paroxysmal dorsalgia, without other associated symptoms. Magnetic resonance imaging (MRI) showed multiple dorsolumbar spine lesions suggesting hemangiomas, being the largest in D5 with slight bulging of the posterior vertebral-wall and right pedicular and laminar extension, without signs of spinal compression. After two-years follow-up, she started persistent back pain with progressive gait difficulty and bilateral lower limb paresthesias. She underwent vertebral-biopsy confirming hemangioma diagnostic and a posterior pedicular spinal instrumentation at D4, D6 and D8 was perfomed. She was discharged from hospital with progressive recovery of complaints. Two-months later, she started gait difficulty, with less lower limb muscle strength, worse on the right (grade 3-4), pain sensitivity preserved until D12 on the right and preserved until D3 on the left; decreased propriocetivity in the right hallux, with bilateral Hoffman and Babinski signs. The MRI showed lesions progression with epidural invasion in D5, with right predominance, with signs of myelopathy. The patient repeated bone biopsy of D5, confirming hemangioma. She underwent spinal decompression and additional instrumentation at levels D3 and D9. After 3 months of follow-up, it has shown a favorable evolution with progressive recovery of sensitivity and motor deficits.

Conclusion:
This case report highlights the non-infrequent aggressive behavior of hemangiomas, which, due to the reaching of the dorsal spine with neurological compression, caused a right Brown-Séquard Syndrome (ASIA D), requiring surgical treatment.
Functional outcome of giant cell tumor of distal radius treated with ulnar translocation and wrist arthrodesis

Mr. Tiago Amorim-Barbosa¹, Ms. Ana Ribau¹, Mr. João Vale¹, Ms. Vania Oliveira¹, Mr. Pedro Cardoso¹, Mr. Alexandre Pereira¹
¹Centro Hospitalar do Porto, Porto, Portugal

Introduction:
Distal radius is the third most common site of giant cell tumor (GCT) of bone. The local aggressive invasion of this rare neoplasm requires reconstructive solutions after wide excision. The authors propose to analyze the functional outcomes of two patients with a GCT of distal radius surgically treated and its comparison with results found in the literature.

Materials and Methods:
The authors present two patients (male with 36 years old and female with 24 years old) with a GCT of distal radius, characterized by a lesion without well-defined limits, with involvement of the surrounding soft tissue. (Campanacci 3). The patients were treated with ulnar translocation and wrist arthrodesis with a Locking Compression Plate, after neoadjuvant treatment with denosumab.

Results:
The follow-up was 12 months, with no clinical or imaging signs of local recurrence and radiographs showed bone fusion at both ends of the ulna. The patient presented an excellent range of pronation and supination. Both patients had an improvement in the modified Musculoskeletal Tumor Society score (MSTS) and Quick - Disabilities of the Arm, Shoulder and Hand.

Discussion and Conclusion:
Distal radius is third most common site for occurrence of GCT of bone. Campanacci grade 3 are best managed by resection of distal radius as recurrence rates are high after curettage. Modalities of reconstruction after resection of distal radius tumours vary, being the most frequent the ulnar centralisation or translocation, reconstruction with autologous fibular grafts or wrist arthroplasty. Despite a loss of wrist motion, reconstruction of distal end of radius using ulnar translocation and wrist arthrodesis provides excellent functional outcomes with preservation of rotational movement of forearm and hand function.
DELAY IN DIAGNOSIS OF PRIMARY OSTEOSARCOMA OF BONE IN CHILDREN: HAVE WE IMPROVED IN THE LAST 15 YEARS AND WHAT IS THE IMPACT OF DELAY ON DIAGNOSIS?

Mr. Shinichirou Yoshida¹ ², Mr. James Celaire³, Ms. Chloe Pace⁴, Mr. Charles Taylor⁴, Mr. Yoichi Kaneuchi⁴, Mr. Adesegun Abudu⁴

¹The Royal Orthopaedic Hospital, Birmingham, United Kingdom, ²Department of Orthopaedic Surgery Tohoku University Graduate School of Medicine, Sendai, Japan

Introduction:
Delay in diagnosing primary osteosarcoma in children remains a problem and may be associated with poor prognosis.

Aims:
Examine: (1) if length of symptoms of children with high grade osteosarcoma has improved in the last 15 years (2) Is delay in diagnosis related to presence of metastases at presentation? (3) The impact of delay in diagnosis on prognosis.

Materials and Methods:
250 consecutive patients with diagnosis of high-grade primary osteosarcoma of bone treated at a national bone tumour treatment centre between 2004 and 2018 were studied. Three groups comprising those diagnosed over a five-year period (Group 1: 2004 – 2008, Group 2: 2009 – 2013; Group 3: 2014 – 2018) were studied.

Results:
There were 126 males and 124 females with mean age 12.2 years (4 - 16). The median length of symptoms before diagnosis was eight weeks with no differences in the group. There was no difference in the proportion with metastases at the time of diagnosis in the three group. There were no differences in the length of symptoms of those with or without metastases at diagnosis. However, there has been gradual improvement in overall survival as shown in the table.

Conclusions:
There has not been any improvement in the length of symptoms or proportion of patients with metastases at the time of diagnosis in the last 15 years but the 5-year overall survival has improved during the same period. This is most probably due to increased intensity of treatment.
PREDICTION OF EFFECTIVENESS OF PREOPERATIVE RADIOTHERAPY IN SOFT TISSUE SARCOMA AND IMPACT ON PROGNOSIS

Mr. Shinichirou Yoshida1,2, Mr. Yoichi Kaneuchi2, Mr. Jonathan Stevenson1, Mr. Guy Morris1, Mr. Scott Evans1, Mr. Adesegun Abudu1

1The Royal Orthopaedic Hospital, Birmingham, United Kingdom, 2Department of Orthopaedic Surgery Tohoku University Graduate School of Medicine, Sendai, Japan

Aims:
To identify if the radiotherapy (RT) served the purpose that was intended in patients with soft tissue sarcoma (STS), assess response to the RT according to histology and prognosis based on response.

Methods:
Patients with STS treated with preoperative radiotherapy between January 2008 and December 2018 were studied. The treatment decision was made by an experienced supra-regional multi-disciplinary team.

Results:
One hundred fourteen patients were studied. The mean age at diagnosis and mean follow-up were 54.8 years (10-88) and 28.9 months (4 – 108) respectively. Histological grade was high in 110 and low in four patients. Indication for preoperative RT was (1) due specific tumour histology such as myxoid liposarcoma or Ewing’s sarcoma in 46 patients (42%), (2) proximity to critical structures such as neurovascular bundle in 58 patients (51%) and (3) extensive peritumoral oedema in 10 patients (7%). Tumour shrinkage was observed in 61 patients (53%), no volume change in 16 (14%) and enlargement in 36 patients (32%). Tumour shrinkage was more common in Ewing’s sarcoma (100%) and myxoid liposarcoma (83%). No volume change was observed in 27% of myxoid liposarcoma, 12.5% of spindle cell sarcoma and 28.6% of myxofibrosarcoma. Tumour enlargement was more common in spindle cell sarcoma (87.5%), undifferentiated pleomorphic sarcoma (71%) and myxofibrosarcoma (71.4%).

Surgical treatment was limb preserving in 106 patients (93%) and amputation in eight (7%). Excision margins were wide or radical in 23 patients (20%), marginal in 79 (69%) and intralesional margin in 12 patients (11%). Local recurrence and distant metastasis occurred in seven (6%) and 26 (23%) patients respectively. Significant prognostic factors for development of local recurrence included enlargement of tumour despite RT and proximal upper limb location of tumour.

Conclusions:
Preoperative RT is usually ineffective in spindle cell and undifferentiated pleomorphic sarcoma. Patients with tumour enlargement have poorer prognosis.
Giant Periosteal Aneurysmal Bone Cysts. Clinicopathological description of two tumours larger than 20 cms.

L.C. Gomez-Mier, Mr. Manuel Ricardo Medellin Rincon, T. Quinonez-Yepes, C. Soto-Montoya

Instituto Nacional de Cancerologia, Bogota, Colombia

Introduction:
Aneurysmal bone cysts are one of the most frequent bone pseudotumoral lesions and are a common cause of consultation in orthopedic oncology. Due to their active or aggressive nature, they can become confused with malignant tumoral pathology. In these lesions, the periosteal location in the long bones and giant presentation with sizes bigger than 20 centimeters are infrequent and for this reason not usually reported in the literature.

Methods:
By retrospective analysis of a prospective database, two patients with a diagnosis of aneurysmal bone cyst who presented tumors that started in a periosteal location of long bones were identified and selected for description. In these two cases, the lesions were larger than 20 centimeters.

Results:
The first case corresponds to a 15-year-old female patient with increased leg volume. An aneurysmatic lesion measuring 22 centimeters was documented and confirmed as an aneurysmal bone cyst after the histopathological study. She was successfully managed with serial embolization achieving adequate pain control, reduction in the volume and consolidation of the tumor. The second case corresponded to a 34 years-old male patient, in whom a tumor that initially started in the periosteum grew to a 21 centimeters lesion that was later recognized in x-ray images. After the curettage biopsy of the tumor, an involution of the cyst was observed with reduction in the size and peripheral consolidation.

Conclusions:
The periosteal and giant presentation in aneurysmal bone cyst constitutes a diagnostic and therapeutic challenge. It is necessary to rule out associated malignant pathology and therefore the histopathological study is imperative. Treatment in these situations may require different interventions ranging from curettage biopsy to radiotherapy. It is therefore necessary for the attending physician to know the characteristics of this type of lesions and their presentation to establish the best possible treatment.
Histiocytic sarcoma arising in a femur with a long-standing chronic osteomyelitis.

L.C. Gomez-Mier¹, Mr. Manuel Ricardo Medellin Rincon¹, M.A. Melo-Uribe¹, C. Soto-Montoya¹
¹Instituto Nacional de Cancerologia, Bogota, Colombia

Introduction:
Histiocytic sarcomas are rare, malignant neoplasms. This tumor usually presents as solitary masses in extra nodal sites, and B systemic symptoms are recorded at diagnosis. The bone location of this tumor is not often reported, and the association with a chronic osteomyelitis has not been described before.

Methods:
Case report and literature review.

Results:
A 56 years-old male with a history of long standing osteomyelitis in the femur after a gunshot injury attended our institution. In the clinical exam, a fungating lesion in the thigh was observed. X-rays of the femur showed posttraumatic changes, and a lytic lesion in the distal third, with a permeative pattern of destruction, associated to a pathological fracture. On MRI, a mass around the fracture was observed. Biopsy of the bone confirmed the diagnosis of Histiocitic Sarcoma. The patient was treated with hip disarticulation as there was no safe reconstructive options due to the margins and the fungating lesion. After the surgical management, the wound progressed in a regular fashion and the patient received adjuvant chemotherapy to control the systemic process.

Conclusions:
Histiocytic sarcomas are tumors with a poorly understood etiology, and no definitive standard of care established. Although in the literature the relationship between lymphomas and chronic osteomyelitis has been presented, to the extent of our knowledge, this is the first description of a primary Histiocytic sarcoma developing after a long standing bone infection.
As suggested by other authors, the repeated antigenic stimulation may result in hyperplasia and, eventually, in neoplastic transformation. Therefore, chronic osteomyelitis may represent a precursor condition for development of some lympho-hematopoietic cancers. The additional pathogenic mechanism involved in this cases should be further investigated.
Evolution in the using of Implantcast growing endoprosthesis - Experience of the Warsaw Center - Institute of Mother & Child

Wojciech Jasica¹, Iwona Malesza², Bartosz Pachuta², Magdalena Rychlowska-Pruszynska³, Mr. Andrzej Szafranski³, Tomasz Walenta²

¹The Children’s Memorial Health Institute - Department of Oncology of Children and Adolescents, , Poland, ²Institute Of Mother & Child, Department of Oncology & Oncological Surgery, , Poland

Introduction:
Metaanalysis of the patients treated in the Institute of Mother and Child in last 18 years.

Methods:
From 2006 to 2018 230 Implantcast growing endoprosthesis were implanted. The age of the patient was from 4 to 25 years old. Median was 13 yrs. old. The treatment was begun from neoadjuvant chemotherapy. After achievement the regression or stabilization of primary lesion, the patients were qualified to surgery procedures. It was excision of the tumor and reconstruction by the using of the growing endoprosthesis in spite of young age of the patients.

Results:
2006 - 2007: age of trial and errors related to learning
2008 - 2017: an era of analysis and drawing conclusions
2018 - 2019: an era of practical knowledge and innovation
2006 - 2007: endoprosthesis - problematic lengthening 8/25 32.0%
2008 - 2017: endoprosthesis - problematic lengthening 13/146 9,0%
2018 - 2019: endoprosthesis - problematic lengthening 2/61 3,3%
total without mechanical problem 207/230 90%

Conclusions:
Indications for using growing endoprosthesis in children and adolescents
• Predicted range of growth more than 2 cm in resected area of the bone. If less than 2 cm it is possible to use modular system.
• Resection of growth plate in children patients is indication to implantation of growing endoprosthesis. Without resection (when tumor is located in the middle part of the diaphysis of a long bone) you can use non growing solution.
• Each patient should be consulted by anthropologist with forecast of estimated length of bone growth.
• The choice of right type of growing endoprosthesis depends on the result of anthropological consultation.
• To appropriate working of electric motor in growing endoprosthesis the total body weight of patient should not exceed 75 kg (165 lbs.).
New technical know how in reconstruction of bone defects in children and youth with primary malignant bone tumors - own experiences

Bartosz Pachuta, Magdalena Rychlowska-Pruszynska, Mr. Andrzej Szafranski

1The Children’s Memorial Health Institute -Department of Oncology of Children and Adolescents, , Poland, 2Institute Of Mother & Child, Department of Oncology & Oncological Surgery, , Poland

Purposes:
to improve the results of reconstruction after pelvic malignant bone tumours surgery.

Methods:
To resolve the problem of reconstruction after resection the primary bone tumors in inconvenience localization or the big mass of the tumor we can to take advantage of new concept of using existing solutions or Innovation technology for replacement of massive bone defects after excision of primary bone tumor. Originally Lumic endoprosthesis was dedicated for hemipelvectomy type II and II+III by Ennekings classification. In specific situation we can using lumic for reconstruction i.e. after hemipelvectomy type I, II and III by Enneking classification. In another situation we need Innovation technology for replacement of massive bone defects after excision of primary bone tumor, for example Stratos system to reconstruction in the cases with thorax bone tumor localization. Complete new technology is 3D printer. We can produce the implants of any localization, any shape. We need only a good CT scan and computer software to produce the needed replacement for young patients.

Results and Conclusions: (by the clinical experience):
Chance for reconstruction of bone defects in children and youth with primary malignant bone tumors depends on: localization and extent of the tumor, tumor reaction on neo-adjuvant chemotherapy, patients determination, surgeon determination in using of new concept of existing technology or in using of new technology.
Custom made endoprosthesis is very useful in the case of atypical tumor localization and it is possible to implant it after good response for naoadjuvant chemotherapy. Personal experience of operating surgeon and being faithful to success is of more importance for successful results.
Surgical Anatomy, Techniques and Biomechanical Analysis of Aortic Percutaneous Stabilization of Periacetabular Osteolytic Lesions and Biomechanical Analysis

Mr. Francis Lee¹, Mr. Devin Conway¹, Mr. Morris Montana¹, Mr. Alex Moushey¹, Mr. Kareme Alder¹, Mr. Fancheng Chen², Mr. Steven Tommasini¹

¹Yale University, New Haven, United States

Introduction:
To provide biomechanical evidence with respect to the most effective reconstruction technique for massive tumor-induced bone loss in the peri-acetabular region and to determine the most easily accessible and strongest entry point for periacetabular screws.

Materials:
Four cohorts of hemipelvis composite bone model uniform periacetabular defects were created by robot-arm cutting. Four groups of hemipelves with no defect (ND), hemipelvis with defect (DO), hemipelvis with defect filled with cement (DC), and hemipelvis with defect filled with cement and stabilized with iliac screws (DCS) underwent impact testing to maximal load causing fractures (N=5/group) as well as cyclic loading (N=3-4/group) at 800N biomechanically simulating partial weight bearing. Load to failure, toughness, stress relaxation, and fracture comminutions were examined. A student’s heteroscedastic T-test was used to assess significance. In addition, on 20 CT scan of patients with pelvis metastasis, screw paths reaching to the superior-medial weight-bearing dome was determined.

Results:
The screws inserted from the abductor tubercle of the iliac crest provided the longest screw path with most bone support in supine position. In the load to failure analysis, comparison of the DC, DCS, and ND cohorts with the DO cohort demonstrated a statistically significant higher load to failure between each of the three other cohorts and the DO group (p<0.01). There was no statistically significant difference in the load to failure (p = 0.99) or cyclic loading testing (p = 0.54) between DCS and ND. In cyclic loading, the DO group failed immediately. Cyclic loading failed to show a significant difference between the DC and DCS group after 1000 cycles. Energy absorption to fracture toughness was higher in DCS than DC (p<0.01).

Conclusion:
Augmentation with screws starting from the anterior iliac crest during acetabular cementoplasty increases toughness for the prevention of catastrophic acetabular pathologic fractures as shown in representative clinical cases.
Functional Ambulation and Pain Outcomes of Same-Day Percutaneous Ablation-Osteoplasty-Reinforcement-Internal Fixation (Aorif) Reconstruction of Massive Periacetabular Osteolytic Defects and Pathological Fractures

Mr. Francis Lee¹, Ms. Courtney Toombs¹, Mr. Igor Latich¹, Mr. Dieter Lindskog¹, Mr. Gary Friedlaender¹

¹Yale University, New Haven, United States

Introduction:
Pelvic osteolytic lesions frequently result in debilitating pain and pathological fractures. Open surgical management of acetabular lesions is associated with complications that delay potentially lifesaving treatments.

Methods:
Outcomes of AORIF were assessed via a single center prospective cohort investigation of 44 patients with osteolytic periacetabular skeletal metastases and follow-up to 36 months (mean 11.3 ± 9.7 months). Surgical indications included discomfort, pain, limping, functional impairment, fractures, and subchondral bone defects in the periacetabular regions alongside sufficient iliac crest bone stock. Contraindications were severe mental status deterioration and lack of medical clearance. Primary outcomes evaluated were postoperative pain and functional improvement. Combined pain and ambulatory function (PAF) scores and Musculoskeletal Tumor Society (MSTS) scores were compared pre- and postoperatively. Kaplan Meier analysis was employed to assess actual postoperative survival against a model derived from the machine-learning prognostication tool, PATHFx3.0.

Results:
Ambulatory patients were discharged on the day of the procedure. The AORIF patient cohort displayed universal outcome improvement within two weeks of surgery. By the first postoperative encounter, PAF scores improved from 4.5 ± 2.5 to 7.8 ± 2.2 (p<0.001) and MSTS scores improved from 7.2 ± 8.9 to 20.5 ± 8.7 (p<0.001). All patients with six months follow-up (n=27) experienced continued pain relief and/or functional improvement. There were no instances of surgical site infections, subsequent conversions into arthroplasty, readmissions, or delays in oncologic care observed within our follow-up period. Two patients with renal cell cancer metastases with potential intraoperative hemorrhage were managed with a pre-AORIF angiogram through the contralateral femoral artery and perioperative transfusions. Two patients developed new metastases outside the original fixation site and required additional AORIF with optional screw exchange.

Conclusions:
AORIF provides the orthopedic surgeon with additional options in the treatment of periacetabular bone lesions.
Early diagnosis of intramedullary femoral bone metastasis using CT axial image

Mr. Hirotaka Yonezawa1, Mr. Norio Yamamoto1, Mr. Katsuhiko Hayashi1, Mr. Akihiko Takeuchi1, Mr. Shinji Miwa1, Mr. Kentaro Igarashi1, Mr. Yoshihiro Araki1, Mr. Sei Morinaga1, Mr. Yohei Asano1, Mr. Hiroyuki Tsuchiya1

1Kanazawa University Graduate School of Medical Sciences, Kanazawa, Japan

Introduction:
Metastatic lesions of the proximal femur occur frequently and require surgical treatment. Medical oncologists perform computed tomography (CT) to evaluate local recurrence and distant metastasis. Although the tumors were located in CT scan range, they were sometimes missed. This study aimed to evaluate the usefulness of CT axial imaging for the early diagnosis of intramedullary femoral bone metastasis in early stage.

Methods:
From March 2008 to June 2018, thirty-seven (37) patients with bone metastases of the femur were recruited for this study. We defined the medulla sign as a higher-attenuation area of bone medulla than the intramedullary fat tissue on CT axial imaging. The duration between diagnosis date and medulla sign positive date was also evaluated.

Results:
The mean age of the 37 patients was 63.2 (range 33–85) years. 23 cases was performed CT before diagnosis. In 15 out of 23 cases, the tumor was located within the CT scan range. 9 of 15 cases (60%) was medulla sign positive before diagnosis date. Three medulla sign-positive patients fractured perfectly before operation. Medulla sign positive date was at an average 207.7 (22–861) days earlier than diagnosis date.

Discussion:
CT was frequently used for follow-up of patients with tumors. The femur was only partially visible on CT of the pelvis. In this study, we can diagnosed metastatic bone tumors earlier by only using CT axial imaging. We suggest that if radiologists, medical oncologists, and orthopedic surgeons consider that the proximal femur is a preferred site for metastatic bone tumors, a diagnosis can be established earlier by follow-up CT axial imaging.

Conclusion:
Metastatic bone tumors demonstrate the findings of medulla sign on CT axial imaging. These findings are useful for the early radiological diagnosis of intramedullary femoral metastatic bone tumors.
The value of Xray, CT-scan, and MRI imaging to determine the malignancy status of a bone lesion: analysis of the results of an online quiz.

Ms. Mathilde Gaume¹, Mr. Raphael Campagna², Ms. Sylvie Chevret¹,²,³, Ms. Frédérique Larousserie¹,², Mr. David Biau¹,²,³

¹AP-HP, Paris, France, ²Université de Paris, Paris, France, ³INSERM U1153, Paris, France

Background:
Medical imaging is a key component for the diagnosis of a bone lesion. Physicians treating patients with bone tumors regularly analyse a radiograph, a CT or an MRI scan, and try to determine whether the lesion is benign or malignant. However, the usefulness of these exams in providing relevant diagnostic information is not determined. The main objective of the present study was to assess the value of each type of imaging in determining the malignancy status of a bone lesion.

Methods:
An online quiz was created providing 15 clinical vignettes. For each clinical vignette, the participant was given a short clinical summary, and an MRI-scan, a CT-scan, and a radiograph. After each of these imaging studies, the participant was asked to rate the probability (from 0 to 100%) the bone lesion was malignant. The order of the images (CT, MR, XR) was randomly determined.

Results:
Overall, 64 physicians participated to the study, and provided a total of 154 assessments from 1 (n=18) to 3 (n=44) different clinical vignettes. After the first imaging study, participants favored the correct malignancy status at 70%; after the second imaging study, participants favored the correct malignancy status at 80%; after the third and last imaging study, participants favored the correct malignancy status at 80% (fig1). Participants were more likely to favor the correct malignancy status when the clinical vignette was a malignant lesion than when it was a benign lesion. Participants were more likely to favor the correct malignancy status when first confronted with an X-Ray or a CT, rather than an MRI.

Conclusion:
Assessing malignancy status of bone tumors based on imaging studies remains difficult. The additional information provided by successive imaging studies is moderate. Xrays or CT scans seem more appropriate than MRI as a first imaging studies.
Clinical outcomes of neoadjuvant denosumab treatment in giant cell tumor of the pelvis and spine: single institution experience.

Mrs. Anastasia Tararykova¹, Mr. Elmar Musaev¹, Mr. Alexander Fedenko², Mr. Ruslan Kabardaev¹, Mr Denis Sofronov¹, Mr Andrey Kulaga¹, Mr Aslan Valiev¹

¹Federal State Budgetary Institution «N.N. Blokhin National Medical Research Center of Oncology», Moscow, Russian Federation,
²Federal State Budgetary Institution National Medical Research Radiological Center of the Ministry of Health of the Russian Federation, Moscow, Russian Federation

Background:
Giant cell tumor of bone (GCT) is a relatively rare, benign but locally aggressive osteolytic skeletal neoplasm of young adults, most frequently occurs at the epiphysis of long bones. Less common locations are pelvis and vertebral body, these locations accounts for only 1.7-8.2% and 2-4% of cases respectively. The optimal management of GCT of the pelvis and spine has not been well established. The aim of this study is to analyze the clinical efficiency of denosumab treatment of GCT of the pelvis and spine in neoadjuvant setting.

Methods:
Study was conducted in 2013-2017. Disease was histologically confirmed by a sarcoma pathologist. Patients underwent CT/MRI every 3 months of treatment and every 2–3 months of follow up period. Adult and skeletally mature adolescent patients with resectable GCT of pelvis or spine received subcutaneous denosumab 120 mg every 4 weeks with a loading dose of 120 mg on study days 8 and 15. Options for surgical treatment include intralesional curettage followed by filling of the defect with bone cement, marginal excision, a wide local excision, or en bloc resection with reconstructive surgery. The primary endpoint was Time-To-Relapse (TTR).

Results:
8 patients were enrolled; median age was 31 years. Median follow-up was 12 months. The most commonly affected site was sacrum (4/8), followed by iliac bone (2/8) and spine (2/8). Average amount of preoperative denosumab injections were 14 (6-21). 5 (62.5%) of 8 patients had local disease progression; TTR was 5,6 months after surgery; three patients received intralesional curettage, two – marginal excision. Primary lesion sites were sacrum (3/5) and iliac bone (2/5).

Conclusions:
Although the risk of developing local relapse remains high, the use of neoadjuvant denosumab allows to delay or avoid mutilating surgery for patients with GCT of spine and pelvis. Further investigation is needed.
LUMIC solutions in periacetabular pelvic reconstruction problems

Mr. Osman Emre Aycan¹, Mr Yavuz Arıkan², Mr Devrim Ozer³, Mr Muhammet Coskun Arslan¹
¹Baltalimanı Bone Diseases Training And Research Hospital, Istanbul, Turkey

Introduction:
Reconstruction of periacetabular defects following pelvic resections of primary malignancies is a challenging procedure with the patients who mostly have low survival and high complication rates. We sought to evaluate our experience and survival with LUMIC in challenging resections.

Material and Method:
We retrospectively reviewed the data of 11 patients (7M/4F) who applied LUMIC tumor endoprosthesis between 2012-2015 with the mean age of 38,9±5,8(11-65) years. Apart from epidemiological data patients were evaluated regarding resection type, tumor volume, operation time and blood loss. Concerning complications at early and late postoperative period the presence of incisional necrosis, superficial and deep infections, infection, neurologic deficit, deep vein thrombosis(DVT), recurrence and metastasis were evaluated. Survival analysis performed via Kaplan-Meier curves.

Results:
The diagnoses in our series were chondrosarcoma(n=5), osteosarcoma(n=2), Ewing’s sarcoma(n=2), synovial sarcoma(n=1) and pleomorphic sarcoma(n=1). Periacetabular resections included type 2-3(n=4), type 1-2-3(n=2), type 1-2-4(n=2) type 2(n=2) and type 1-2(n=1). Mean tumor volume was 5599,1±2122,5 mm³, mean operation time was 405,5±47,6 minutes and mean blood loss was 5019,1±851,6 cc. Incisional necrosis was detected in 5 patients, superficial infection in 3, deep infection in 4, dislocation in 2. No neurological deficit or DVT was evaluated. Recurrence was detected in 3 patients despite negative surgical margins and 4 patients developed metastasis. Mean MSTS at last follow-up was 67,7%(60-77,7). 5-year overall survival was 77,9%, metastasis free survival was 57,7%, recurrence-free survival was 72.7% and revision free survival of the prosthesis was 59,7%.

Conclusion:
Despite the challenging surgery with high blood loss and infection risk in periacetabular resections, LUMIC offers a stable reconstruction solution with lower mechanical failure. The dual mobility feature of LUMIC provides stability and good functional outcomes even in patients with massive periacetabular muscular resection.
Bone grafting for pediatric solitary bone cyst patients

Mr. Vitaliy Bayev, Ms. Valeriia Husak, Mr. Oleg Vyrva

Sytenko Institute of Spine and Joint Pathology, Kharkiv, Ukraine

Introduction:
Solitary bone cyst (SBC) is one of the most common bone diseases in children. Surgical treatment consists in cyst resection and defect replacement with bone or ceramic implants. We have proposed original surgical procedure based on allogenic bone implantation after various types of processing that combine optimal osteointegration properties.

Material and method(s):
11 SBC patients (8 males, 3 females, age from 5 to 16 years). The diagnosis was established on the basis of totality disease clinical manifestations, laboratory tests data, X-ray and pathomorphological examinations. The pathological sites were: proximal femur - 6 (54.5%), humerus - 2 (18.2%), calcaneus - 2 (18.2%), pubic - 1 (9.1%). Indications for surgical treatment: massive bone lesion presence in the loaded zones, high risk of pathological fracture, manifest long-term pain syndrome. All patients underwent cyst resection and defect replacement with original allograft bone material that was produced by mechanical and dehydration effect.

Results:
We evaluated the effectiveness of treatment according to clinical, CT and X-ray examination. Bone remodeling in the surgical site occurred about 6–12 months after surgery. The 12–18 months follow-up period X-ray pictures show the total bone-graft remodeling with high quality bone structure and no significant difference between auto-allo bone tissues. Infections complications, locale recurrences, pathologic fractures were not observed, like and no pain syndrome. Good ROM and motor activity were presents for all 11 patients.

Conclusions:
Surgical procedures for SBC treatment with using of original allograft bone graft is effective. That was confirmed good clinical and radiological results at the shortest time after surgery.
Modular fluted tapered stems after tumor resection in the proximal femur.

Mr. Bogdan Cretu1,2, Mr. Florin-Catalin Cirstoiu1,2, Mr. Mihai Nica1,2, Mr. Emanuel-Cristian Sandu1,2, Mr. Adrian Cursaru1,2, Mr. Bogdan Serban1,2, Mr. Dan Popescu1

1University Emergency Hospital, Bucharest, Romania, 2Carol Davila University of Medicine and Pharmacy, Bucharest, Romania

Introduction:
Reconstruction with endoprosthesis or allograft-prosthesis composite are the two main alternatives for managing bone defects resulted after proximal femoral malignancies resection. Using a retrospective study our goal was to assess the main complications when using modular revision implants with fluted tapered stems for proximal femoral reconstruction.

Methods:
We conducted a retrospective review of 15 cases of proximal femoral reconstruction with revision implants for malignant disease, including 8 cases of primary malignant tumors (3 osteosarcoma cases and 5 chondrosarcomas) and 7 cases of metastatic tumors. Ten patients received chemotherapy before and after operation, without any perioperative radiotherapy. All the cases were managed by the same surgeon and consisted of wide resection with intraoperative histologic control of the resected margins followed by reconstruction with modular fluted tapered stems.
The oncologic results (survival status and tumor recurrence), and prosthesis failure (prosthesis survival rate, cause for failure, treatment strategy after failure) were recorded. Intraoperative and the postoperative complications were analyzed.

Results:
The median follow-up for all the patients was 34 months. Two patients died of lung metastasis and multiple metastases. There was no local recurrence for neither of the patients. In terms of complications only one patient suffered a THA dislocation at 3 weeks due to a traumatism. No early or late infections occurred.

Conclusion:
In the setting of a limited supply of costly modular tumoral implants, to increase cost efficiency and for optimizing the oncological management of the proximal femoral malignancies we propose the use of non-dedicated implants such as modular fluted tapered stems that are commonly used for total hip arthroplasty revisions.
The short-term follow-up showed low incidence of complications and good function for non-cemented modular prosthesis system for the treatment of bone defects after proximal femur resection. The main factor affecting the early results was tumor progression.
Comparative results of segmental resection versus radical resection in patients with myxofibrosarcoma of the limbs

Mr. Sergiu Iordache¹,², Mr. Sergiu Iordache¹, Mr. Emanuel-Cristian Sandu¹,², Mr. Dan Anghelescu¹, Mr. Bogdan Serban¹,²
¹University Emergency Hospital Bucharest, Bucharest, Romania, ²Carol Davila University of Medicine and Pharmacy, Bucharest, Romania

Introduction:
Myxofibrosarcoma is a rare subtype of soft tissue sarcoma with a locally infiltrative behavior and ability to determine distant metastases. Preoperative planning consists in high quality MRI imaging and rigorous assessment for distant metastases.

Methods:
Two elderly patients with palpable masses of the proximal thigh and the proximal arm with histopathological results of myxofibrosarcoma after incisional biopsy. One is a 77 years old man with a history of 6 months palpable mass of the proximal thigh proposed for segmental resection with oncological limits. After surgery the patient was admitted in the oncology department for adjuvant treatment with local radiation and chemotherapy. The other one is a 80 years old woman with a history of 12 months palpable mass in the proximal arm with a fast growth in the last 6 months. Because of the proximity of the scapulohumeral joint and the local invasion the patient was proposed for scapulohumeral disarticulation. After surgery was admitted in the oncology department for adjuvant chemotherapy. Both patients were assessed before surgery for distant metastases and no one had any detectable secondary determinations. Also, both patients were discharged with good local and general evolution.

Results:
At three months after segmental resection the patient had no sign of local recurrence with good clinical condition but with pulmonary metastases. He was admitted to oncology department for chemotherapy.
One month after scapulohumeral disarticulation the patient was in good clinical condition with no sign of local recurrence or distant metastases.

Conclusion:
Myxofibrosarcoma presents a challenging situation for the management due to their unpredictable clinical course. The patient with segmental resection had lower grade tumor(G2) and six months between detection of the mass and surgery comparing with G3 tumor and 12 months before surgery and yet developed pulmonary metastases. More follow up required.
Should we treat more aggressively myxofibrosarcoma?
Work ability and leisure time activities in adults with tumor-prostheses in the hip and knee.

Mrs. Linda Fernandes¹,², Mr. Allan Villadsen², Mrs. Christina Enciso Holm², Mrs. Michala Skovlund Sørensen², Mrs. Mette K Zebis¹, Mr. Michael Mørk Petersen²
¹University College Copenhagen, Faculty of Health, Copenhagen, Denmark, ²University Hospital Rigshospitalet, Dept. Orthopedic surgery, Copenhagen, Denmark

Background:
The existing literature reporting physical function after limb-sparing surgery (LSS), commonly use patient-specific scores, i.e. the Musculoskeletal Tumour Society Score (MSTS) or the Toronto Extremity Salvage Score (TESS). We aimed to understand the consequences on functioning after LSS, in a broader perspective by examining the ability to manage work and leisure time activities.

Methods:
This cross-sectional study compared 20 employed patients, receiving resection and reconstruction surgery with a tumor-prosthesis in lower extremity between 2006 and 2016 due to primary bone sarcoma or giant cell tumor of bone, with 20 age and gender matched controls. The MSTS and TESS were used as descriptive information. The Work Ability Index, the Patient Specific Functional Scale (PSFS), the International Physical Activity Questionnaire (IPAQ) and weekley step count were used to evaluate work and leisure time activities. Unadjusted and adjusted univariate general linear models with level of significance p<0.05 was used.

Results:
Mean age was 43 years, BMI 26, MSTS 67 and TESS 77. Between-group differences were found for general work ability (7.8 vs. 9.4 points, p=0.002) and work ability due to physical demands (3.2 vs. 4.6 points, p<0.001). Differences in PSFS (mean number of activities rated as difficult to perform (3.8 vs. 0.3, p=0.001) and mean score (2.5 vs. 8.6 points, p=0.001)) were found between groups. No differences were seen for IPAQ (4107 vs. 3880 METs/week, p=0.94) or step counts/week (10.587 vs. 12.239 steps, p=0.14).

Conclusion:
General work ability and work ability due to physical demands were reduced in this patient group. Although we found no differences in physical activity (IPAQ and step counts/week), patients reported a great number of activities related to work and leisure time that were difficult to perform. Future research and rehabilitation after resection-reconstruction surgery using tumour-prosthesis should include assessments of work and leisure time activities.
Computed tomography-guided navigation versus computer navigation-assisted surgery in the resection of musculoskeletal tumors.

Mr. Philipp Funovics¹, Mr. Markus Schreiner¹, Mr. Kevin Staats¹, Mr. Gerhard Martin Hobusch¹, Mr. Joannis Panotopoulos¹, Mr. Reinhard Windhager¹
¹Medical University of Vienna, Vienna, Austria

Introduction:
CT-guided navigation surgery (CTGNS) as well as computer navigation-assisted surgery (CNAS) may provide additional guidance for tumor resection, increase accuracy and thus reduce the risk of intralesional margins in the resection of musculoskeletal tumors.

Methods:
Eighteen patients, who were treated with CTGNS were compared to 24 patients, who were treated with CNAS. In ten patients (five female), CTGNS was used for resection and/or reconstruction (three osteosarcomas, one osteosarcoma metastasis, one liposarcoma, one liposarcoma recurrence, one myxofibrosarcoma, one chondrosarcoma, one Ewing sarcoma and one osteoidosteoma recurrence). Tumors were localized in the pubis (n=3), the tibia (n=2), the sacrum (n=1), the femur (n=1), the patellar tendon (n=1), the iliosacral joint (n=1) and the thoracic spine (n=1). In seven (one female) patients CNAS was used for tumor resection and reconstruction (three chondrosarcomas, two osteosarcomas, one fibrosarcoma and one Ewing sarcoma). Tumors were localized in the femur (n=2), the tibia (n=1), the sacrum (n=1), the humerus (n=1), the ilium (n=1) and in the gluteal region (n=1).

Results:
Average follow up regarding the ten patients with CTGNS was 10 months (4-22 months). No intra-operative complications occurred. Five tumors were excised with wide margins compared to three marginal resections and one curettage (osteoidosteoma). In three of the five wide resections the pathologist described the smallest resection margin, which ranged from 1mm to 7mm (mean: 3mm). In the CNAS cohort six tumors were excised with wide margin, compared to one marginal resection. Mean dose-length-product of the registration scan in the CTGNS cohort was 436 mGy*cm compared to 571 mGy*cm for the preoperative CT scan in the CNAS cohort.

Conclusion:
CNAS and CTGNS may provide additional assistance in complex tumor resection and thus may enable more limited resections especially in anatomically challenging pelvic resections. Whereas resection margins were similar, radiation exposure was lower in the CTGNS cohort.
Titanium custom-made implants as novel approach to reconstructive surgery after oncologic resection in pediatric patients

Mr. Giovanni Beltrami1,2, Mr. Gabriele Ristori2, Mr. Guido Scoccianti2, Mr. Francesco Muratori2, Mr. Marco Innocenti2, Mr. Domenico Andrea Campanacci2, Mr. Rodolfo Capanna3

1Meyer Children Hospital, Firenze, Italy, 2Azienda Ospedaliero-Universitaria Careggi, Firenze, Italy, 3Azienda Ospedaliero-Universitaria Pisana, Pisa, Italy

Introduction:
The last advances in oncologic medical therapies made amputations increasingly rare in pediatric patients with malignant bone tumors. Many reconstructive techniques have been described for limb salvage, but custom-made implants appear among the most promising in adult patients. This solution has not been yet described in pediatric patients: it would allow more complex reconstructions not possible previously. This paper presents the methods and short-term results of a series of pediatric patients with skeletal tumours, underwent reconstruction with titanium custom made implants.

Methods:
From December 2016 to June 2019, 6 males and 5 females with a mean age of 10.8 years, affected by skeletal tumour underwent one-stage excision surgery with concomitant reconstruction with a 3D printed custom-made implant. Seven patients received a prosthesis, 3 had a plate, and 1 had a prosthetic element linked to a plate. Postoperatively, patients were followed up every 3 months. Functional results were evaluated by the Musculoskeletal Tumor Society Score (MSTS) for upper and lower limb. Intraoperative and postoperative complications were reported.

Results:
The mean follow-up time was 17.3 months. Three patients (27%) experienced complications: 2 of them had soft tissue complications solved by a rotational musculocutaneous flap; 1 patient experienced a venous thrombosis of a musculocutaneous free flap (surgically revised) and then a deep infection that led to the implant removal. The residual 6 patients observed a partial radiographical osseointegration of the implant within a mean of 4 months. At final follow-up, a mean MSTS (Musculoskeletal Tumor Society) score of 75% was obtained.

Conclusion:
We believe the technique may offer additional valid options to the surgeon within a pediatric population. However, although the first results are encouraging, further research is warranted to confirm our initial observations.
Introduction: Soft tissue sarcomas (STS) of the extremities in children account a very heterogeneous group of rare tumors. The optimal treatment remains controversial, depending on the histological type, but the multidisciplinary approach is today mandatory. The surgical time often requires a wide excision with function loss and the problem of reconstruction is still open, especially in the pediatric population.

Our aim is to review a series of patients underwent complex surgical reconstructions (requiring microsurgical support) after wide excision of STS.

Method: We performed a retrospective analysis of 23 patients younger than 10 years seen at Orthopedic Oncology Unit of Careggi Hospital in Florence over a 20-year period (January 1998 – December 2018). Patients were treated with a protocol, where surgery plays the main role and chemo- and radiotherapy are variable associated on the basis of the subtype of tumor.

Results: Seven were rhabdomyosarcoma (RMS) and 16 non-rhabdomyosarcoma (NRMSTS). All patients received surgical treatment, providing wide excision and reconstruction with functional soft tissue flap by a microsurgical team. Limb-salvage surgery was possible in all the cases. Functional outcomes were generally good, with a 28% of patients complaining functional deficit.

Conclusion: The results were generally satisfactory: they underline the primary importance of surgery and a multidisciplinary approach. Reconstructive procedures and functional outcomes must not be left out because life expectancy in these patients is steadily increasing.
Prognostic differences between oligometastatic and polymetastatic osteosarcoma recurrence – A report from the Cooperative Osteosarcoma Study Group (COSS)

**Mr. Stefan Bielack**, Mr. Benjamin Sorg, Mrs. Claudia Rössig, Mr. Christian Kratz, Mr. Thomas Klingebiel, Mr. Peter Reichardt, Mr. Arndt Borkhardt, Mr. Ernst-Christian Urban, Mr. Leo Kager, Mr. Thomas Kühne, Ms. Thekla Von Kalle, Mr. Christiane Franzius, Mr. Godehard Friedel, Mrs. Stefanie Hecker-Nolting, Mr. Matthias Kevric

1. Klinikum Stuttgart – Olgahospital, Stuttgart Cancer Center, Zentrum für Kinder-, Jugend und Frauenmedizin, Pädiatrie 5 (Onkologie, Hämatologie, Immunologie), Stuttgart, Germany
2. Universitätsklinikum Münster, Klinik und Poliklinik für Kinder und Jugendmedizin, Pädiatrische Hämatologie und Onkologie, Münster, Germany
3. Medizinische Hochschule Hannover, Pädiatrische Hämatologie und Onkologie, Hannover, Germany
4. Universitätsklinikum Frankfurt, Klinik für Kinder- und Jugendmedizin, Schwerpunkt Onkologie, Hämatologie und Hämostaseologie, Frankfurt, Germany
5. Helios Privatklinik Berlin-Buch, Klinik für Onkologie und Palliativmedizin, Sarkomzentrum Berlin-Brandenburg, Berlin, Germany
6. Universitätsklinikum Düsseldorf, Klinik für Kinder-Onkologie, -Hämatologie und Klinische Immunologie, Düsseldorf, Germany
7. Universitätsklinikum Graz, Klinik für Kinder- und Jugendheilkunde, Päd. Hämatologie und Onkologie, Graz, Austria
8. St. Anna Kinderspital, Hämatologische und Onkologische Abteilung, Wien, Austria
9. Universitäts-Kinderspital bei der Basel, Onkologie und Hämatologie, Basel, Switzerland
10. Klinikum Stuttgart – Olgahospital, Zentrum für Kinder-, Jugend und Frauenmedizin, Radiologisches Institut, Stuttgart, Germany
11. Zentrum für Nuklearmedizin und PET/CT, Bremen, Germany
12. Universitätsklinikum Tübingen, Klinik für Thorax-, Herz- und Gefäßchirurgie, Tübingen, Germany

Introduction:
The objectives of this retrospective analysis were to compare oligometastatic (≤5 metastases) with polymetastatic (>5 metastases) 1st osteosarcoma recurrences and to identify prognostic factors for post-relapse survival.

Methods:
The COSS database was searched for purely metastatic 1st osteosarcoma recurrences enrolled between 06/2005 and 12/2015. Patients for whom the exact number of metastases was not reported and those with synchronous local relapses were excluded. Patient, tumor, and treatment related factors were evaluated for potential correlations with outcome.

Results:
Among 304 evaluable 1st recurrences, 244 (80%) were oligometastatic (80% lung-only, 11% bone-only, 9% combinations or other metastases) and 60 (20%) polymetastatic (55% / 5% / 40%). Factors associated with oligo-rather than polymetastatic recurrence were absence of primary metastases at initial diagnosis (odds ratio OR=2.8,p=0.001), a good tumor response to 1st-line-chemotherapy (OR=2.6,p=0.003) and a relapse-free interval longer than the median of 23.1 months (OR=3.9,p<0.001). Oligometastatic recurrences were also more likely to be limited to the lungs (OR=3.3,p<0.001) and to be treated by surgery which led to a 2nd complete remission (CR) (OR=10.8,p<0.001). Both 2nd-line chemotherapy (n=186 instances,OR=3.3,p=0.001) and radiotherapy (n=46,OR=2.6,p=0.008) were more likely to be employed against polymetastatic recurrences. After a median follow up from 1strecurrence (MFU) of 1.8 vs. 0.8 years (2.7 vs. 0.5 for 119 vs. 11 survivors) in the oligometastatic and polymetastatic groups, respectively, 3-year survival probabilities were 49% vs. 12% (p<0.001) for all patients and 56% vs. 35% (p<0.001) for those achieving a 2nd surgical CR. Among oligometastatic patients, a longer disease-free interval (p=0.001) and metastases limited to the lungs (p=0.009) correlated with improved survival probabilities.

Conclusion:
1st metastatic osteosarcoma recurrences are mostly oligometastatic. Aggressive surgical approaches are warranted, as more than half of all affected patients who achieved a 2nd surgical CR survived beyond 3 years.
Introduction:
Despite new possibilities in diagnosis and multimodal treatment of sarcomas, patients often suffer from pain caused by this tumors, especially in a metastatic setting. The heterogeneity of pain mechanisms in cancer patients makes a fast solution for optimal pain management even more difficult for the caretakers. Therefore, a multidisciplinary approach is needed to ameliorate the symptoms as fast as possible.

Methods:
The up-to-date literature concerning cancer pain treatment with emphasis on multidisciplinarity and a special view on musculo-skeletal neoplasms will be reviewed.

Results and Conclusion:
Different possible approaches to lower the burden of pain using representative cases and their management will be used to demonstrate the need of teamwork to help patients.
Risk factor related to local recurrence of myxofibrosarcoma and undifferentiated pleomorphic sarcoma by the adjacent tissue of the primary lesion

Tasuro Imai², Masahiko Kanamori², Yoshiharu Kawaguchi¹, Ms. Kayo Suzuki¹, Kenta Watanabe¹, Taketoshi Yasuda¹
¹Department of Orthopaedic Surgery, University of Toyama, Toyama, Japan, ²Department of Orthopaedic Surgery, Takaoka City Hospital, Toyama, Japan, ³Department of Human Science (1), University of Toyama, Toyama, Japan

Introduction:
Myxofibrosarcoma (MFS) and undifferentiated pleomorphic sarcoma (UPS), so-called invasive soft tissue sarcoma (ISTS), causes local recurrence at a high rate even after wide resection. The purpose of this study is to evaluate factors related to postoperative local recurrence according to the tissue adjacent to the primary site of ISTS, and to contribute to a therapeutic strategy for local control.

Methods:
The study included 27 patients with ISTS who underwent resection at our hospital from 2010 to 2019. These cases were divided into two groups according to the tissue adjacent to the primary lesion: muscle tissue alone (M group: 10 cases) and bone / blood vessel / nerve tissue (BAN group: 17 cases). The resection margin was an adequate wide resection. In group M, a margin of 2 cm or more was secured, and in group BAN, the adjacent tissue was resected with the tumor. Tumor diameter, resection margin evaluation, local recurrence, and additional treatment after local recurrence were evaluated.

Results:
Mean transverse diameter of the tumor was significantly larger in the BAN group. Evaluation of the surgical margin was 8 cases of R0 and 2 cases of R1 in M group and 6 cases of R0, 10 cases of R1, and 1 case of R2 in BAN group. Local recurrence was significantly higher in the BAN group (10% in the M group v.s. 64.7% in the BAN group). The local control rate after additional treatment was 67%, and the rate of control in patients who underwent RT after additional resection was high.

Conclusion:
The local recurrence factors for ISTS that were adjacent to tissues other than muscle were considered to have a large tumor diameter. For ISTS with adjacent bone and vascular tissue, combined excision of those tissues was not always useful, suggesting the additional importance of RT.
3D planning for musculoskeletal tumors: an important instrument for the surgeon and the patient. A preliminary study

Mr. Michele Boffano¹, Mr. Nicola Ratto¹, Mr. Pietro Pellegrino¹, Mr. Nicola Ratto¹, Mr. Andrea Conti¹,², Mr. Andrea Ferro¹, Mr. Stefano Marone¹, Mrs. Elena Boux¹, Mr. Ugo Albertini², Ms. Claudia Galletta², Mr. Michele Nardi², Mrs. Tiziana Robba³, Mr. Raimondo Piana³

¹Orthopaedic Oncology Dept - AOU Città Della Salute e Della Scienza, Torino, Italy, ²University of Torino, Torino, Italy, ³Radiology Dept - AOU Città Della Salute e Della Scienza, Torino, Italy

Introduction:
The complexity of surgical techniques is increasing. Often it is difficult to correctly explain the surgery to the patients. Sometimes the surgeon should plan in advance if to realize patient specific instrumentation (PSI), which is the proper implant or the relationships with major vessels or intrapelvic organs. A case study can be prepared using CT and/or MRI to develop a 3D model either on an interactive pdf file or even printed. The aim of the study is to evaluate the reliability of this technique.

Methods:
In a 3-years period 17 patients undergoing surgery for bone and soft tissue sarcomas in an Italian reference centre have been preoperatively studied with HA3D™ technology. Margins, relationship with anatomical structures or organs, realization of PSI if necessary, correct surgical approach/access have been evaluated. Complications during the production process or with the 3D model or PSI have been analyzed.

Results:
Definitive margins reflected preoperative planning. No unplanned damage or resection of organs or vessels occurred. 3D printed model and PSI were correctly sterilized to be used during surgery and no breakage occurred. Four cases of PSI malpositioning or unprecise fixation occurred due to an incorrect preoperative planning of muscles anatomy, but this caused no damages or lesions to the patients.

Conclusion:
3D planning is new approach alternative to navigation to improve surgical skills in orthopaedic oncology. It is also an extremely useful resource to explain to the patient his/her conditions and the surgery ongoing. A learning curve both from engineers and orthopaedic surgeons is advisable to gain the most from this technology.
A new antibiotic prophylaxis approach can decrease infection rate and morbidity.

Results from a prospective study

Mr Pietro Pellegrino¹, Mr. Michele Boffano², Mr. Ugo Albertini¹, Mrs. Elena Boux³, Mr. Andrea Ferro¹, Mr. Stefano Marone¹, Mr. Nicola Ratto³, Mr. Andrea Conti¹,², Mr. Raimondo Piana¹

¹Orthopaedic Oncology Dept - AOU Città Della Salute e Della Scienza, Torino, Italy, ²University of Torino, Torino, Italy

Introduction:
Infection is one of the most common, dreadful and detrimental complications in orthopaedic oncology. No international consensus has been achieved in term of length of prophylaxis or duration of postoperative antibiotic therapy and kind of antibiotics to use. The aim of the study is to prospectively evaluate a new approach to reduce infection rate and morbidity.

Methods:
In an Italian reference centre for orthopaedic oncology 540 consecutive patients in a 1 year period have been enrolled. Prophylaxis was performed one-shot with a 3rd generation cephalosporin in all patients but after chemotherapy. The only exception was surgery longer than 4 hours or major blood loss when a 2nd intraoperative dose was administered. After chemotherapy the length of therapy was 5 days with vancomycin. Previously infected patients were excluded from the study. Early infection rate and infection morbidity was evaluated at a minimum 6-months follow up and compared to historical institution data.

Results:
Overall infection rate was 3.3% (2.5% at the surgical site). The observed infections were all from multi-sensitive drugs bacteria. No cases of sepsis have been observed. Comparing the historical data the infection rate and the virulence of the bacteria dramatically decreased.

Conclusion:
A correct antibiotic prophylaxis could reduce the infection rate and obtain an easier management of infections when occur. Larger case series and international studies are mandatory to confirm the present results.
Can a partial knee replacement be the solution for arthritis secondary to cementation of osteolitic lesions? A case report

Mr. Andrea Conti¹², Mr. Nicola Ratto³, Mr. Pietro Pellegrino³, Mr. Michele Boffano³, Mr. Raimondo Piana¹  
¹Orthopaedic Oncology Dept AOU Città Della Salute e Della Scienza, Torino, Italy, ²University of Torino, Torino, Italy

Introduction:
Giant cell tumor and other benign aggressive bone lesions can be treated with curettage and cement filling. A secondary arthritis can occur if cement is close or submerging the joint surface. The aim of this study is to present a technical note on how to solve this complication with a partial knee replacement.

Methods:
A 35-years-old male was treated for a giant cell tumor of the bone of the right distal lateral femoral condyle with intralesional curettage, local adjuvants and reconstruction with cement and a lateral plate. After 15 months he complained anterior pain progressively worsening with recurrent hemoarthrosis and increasing functional impairment. No benefits from drug or physical therapy. After 3 years MRI and CT scan excluded local recurrence and confirmed a patellofemoral osteoarthritis with impingement of the patella with the cement.

Results:
The plate and cement were removed, the condylar bone gap was reconstructed with TM® cone augments filled with morcellized homologous bone graft and the patellofemoral joint (PFJ) was resurfaced with an oxinium PFJ arthroprosthesis Weight-bearing was allowed after 40 days, complete mobilization of the knee was conceded right away. Within 1 year the patient fully recovered his abilities in both working life and sport activities.

Conclusion:
The definitive treatment can be represented by a total joint replacement with a hinged or semi-hinged total knee arthroplasty or a megaprostheses to solve both problems of arthritis and bone defect. A new approach can be semiconservative by replacing only the compartments involved and preserving the other compartments with ligaments and menisci. Further studies are mandatory to confirm the reliability of this technical solution.
Does preventive fixation of bone metastases increase overall survival? Results from a case control study

Mr. Michele Boffano¹, Mr. Ugo Albertini¹, Mrs. Elena Boux¹, Mr. Andrea Ferro¹, Mr. Stefano Marone¹, Mr. Pietro Pellegrino¹, Mr. Nicola Ratto², Mr. Andrea Conti¹,², Mr. Leoluca Castro³, Mr. Raimondo Piana¹

¹Orthopaedic Oncology Dept - AOU Città Della Salute e Della Scienza, Torino, Italy, ²University of Torino, Torino, Italy, ³Anesthesiology Dept - AOU Città Della Salute e Della Scienza, Torino, Italy

Introduction:
Bone metastases are increasing in number due to the improvement of oncologic therapies. One of the main points of metastatic surgery is to prevent pathologic fractures in order to limit immobilization and the subsequent complications. The aim of the study is to evaluate whether a prophylactic surgery increases survival compared to the treatment of pathologic fractures.

Methods:
58 patients (age range 48-89 years) were treated with osteosynthesis or arthroprostheses for long bone metastases in a 1-year period (for a total of 62 surgical procedures). They were divided into 2 groups whether surgery occurred after a pathologic fracture or not. Minimum follow up was 6 months. Overall survival and major medical complications (heart failure, pulmonary embolism, multiorgan failure, stroke, sepsis/infection) were evaluated.

Results:
36 patients were treated after a pathologic fracture and a variable period of immobilization or rest in bed (Group 1). 22 patients were treated for impending fractures or oncologic purposes (single metastases in good prognosis tumor, Group 2). Overall mortality rate was 8.6% (11.1% Group 1 vs 4.5% Group 2). Major medical complication rate was higher in Group 1.

Conclusion:
We could improve the survival of oncologic patients if we prevent pathologic fracture. The present study could not demonstrate a difference in major medical complications in the two groups. Specific education protocols directed to general orthopaedic surgeons, medical oncologists, radiation therapists are mandatory for early detection of preventable fractures, preparation for surgery in proper timing, and finally to improve overall survival.
The cause of amputation after limb salvage for extremity sarcomas

Mr. Ozgur Baysal, Mr. Omer Sofulu, Mr. Fevzi Saglam, Mr. Ahmet Hamdi Akgulle, Mr. Evrim Sirin, Mr. Bülent Erol

Marmara University School of Medicine, Istanbul, Turkey

Introduction:
The aim of this study was to investigate the demographic characteristics of the patients who underwent limb salvage surgery due to malignant bone and soft tissue tumors and who required amputation during the follow-up.

Methods:
Patients who underwent limb salvage surgery for bone or soft tissue sarcoma in our clinic between 2009 and 2018, who required amputation during follow-up. Demographic characteristics of the patients, location of the tumor, tumor side, pathologic diagnosis, pathologic tumor volume, tumor grade, closure of skin, primary or recurrent tumor at the first admission to our clinic, cause of amputation, from limb salvage to amputation time elapsed, amputation levels, survival time and survival status of patients were obtained from the patients' archive files and hospital computer records.

Results:
Amputation was performed in 25 of 654 patients who underwent limb sparing surgery for primary or recurrent malignant bone and soft tissue tumors. 13 patients presented to our clinic as primary and 12 patients as relapse. When the causes of amputation were examined, 7 of 13 primary cases had local recurrence, 4 had prosthesis infection, 1 had skin necrosis and 1 had amputation due to mechanical insufficiency. 11 of 12 relapse cases had local recurrence and 1 had amputation due to prosthetic infection. When the relationship between tumor location and surgical margin was examined, we found that we remained marginal / intralesional in the upper extremity, foot and ankle region (p = 0.002). Amputation was required due to prosthesis infection in thigh and knee region and local recurrence in upper extremity, foot and ankle (p = 0.037).

Conclusion:
Limb sparing surgery should be preferred in all cases where appropriate surgical margin can be obtained and soft tissue reconstruction can be achieved even if there is distant metastasis regardless of the initial diagnosis (primary / recurrence).
A retrospective European Muskuloskeletal Oncology Society (EMSOS) study of second primary osteosarcoma after retinoblastoma

Mr. Sebastian Dorin Asaftei1, Mrs. Alessandra Longhi2, Mr. G. Ulrich Exner3, Mrs. Angela Tamburini4, Mr. Minna Laitinen5, Mrs. Krakorova D Adamkova6, Mrs. Elisa Tirtei1, Mr. Massimo Berger1, Ms. Celeste Cagnazzo1, Mr. Piero Picci2, Mrs. Franca Fagioli1

1Pediatric Onco-Hematology, A.O.U Città della Salute e della Scienza, Turin, Italy, Turin, Italy, 2Istituto Ortopedico Rizzoli IRCCS, Bologna, Italy, 3FMH Ortopadische Chirurgie und Traumatologie, Zurich, Switzerland, 4Dipartimento di Oncoematologia, AOU A. Meyer, Florence, Italy, 5Department of Orthopaedics, Helsinki University Hospital, Helsinki, Finland, 6Masaryk Memorial Cancer Institute, Brno, Czech Republic

Introduction:
Aim of this multicenter study was to collect information on genetics, the clinical picture and treatment outcomes in this setting of patients.

Patients and methods: Members of the EMSOS submitted institutional data on patients with second primary osteosarcoma (Osteo) after retinoblastoma (RB). The primary end-point was the overall survival (OS).

Results:
Data from 14 Osteo patients, survivors of RB diagnosed and treated between 1971 and 2002 were collect from 6 EMSOS centres. Median age at RB diagnosis was 8 months (range 1-17 months); 50% (7/14) of patients were diagnosed with bilateral disease; Four patients presented germline mutations of retinoblastoma tumour suppressor gene and ten somatic mutations. Treatment strategies for RB were chemotherapy (CT)- enucleation – radiotherapy (RT) in 4, CT – focal therapy in 1, CT – enucleation in 2, enucleation in 6, RT – enucleation in 1. Median age at Osteo diagnosis was 16,5 years (range 9-26,2 y) with median age for germline patients 11,4 y (range 9-13,5y) and somatic patients 18,6 y (range 13,1-26,2); tumour location was radiation-related (n=2) and extremity (n=12). Two patients presented lung metastases. Osteo histological subtypes were fibroblastic (n=4), osteoblastic (n=8), chondroblastic (n=1), osteoblastic/chondroblastic (n=1). All patients received chemotherapy and surgery (2 incomplete). Tumour necrosis evaluated after neoadjuvant chemotherapy was > 90% in 7/14 patients. Event free survival and OS at twenty years were 9±0.08% and 39.8±0.15%, respectively. The univariate analysis for the OS analysis showed no statistical significant factors, however, an unfavorable trend was observed for patients having CT for RB (P=0.17). At the time of analysis seven patients were alive, one of them with disease.

Conclusion:
Despite low number of patients, the study showed that the therapy of RB influences Osteo prognosis. OS at twenty years is not so poor.
A case report of rare biological reconstruction technique in a patient with elbow synovial sarcoma

Mr. Emanuel-Cristian Sandu, Mr. Florin-Catalin Cirstoiu, Mr. Bogdan Cretu, Mr. Sergiu Iordache, Mr. Bogdan Serban

1University Emergency Hospital Bucharest, Bucharest, Romania, 2Carol Davila University of Medicine and Pharmacy, Bucharest, Romania

Introduction:
Synovial sarcoma is a rare malignant mesenchymal tumor, histological subtype of soft tissue sarcomas, occurring with predilection in the para-articular region of the extremities at any age. In our case, the tissue defect after wide resection in the elbow presented a major reconstructive challenge.

Method:
We present a case of synovial sarcoma in a 49-year-old female patient who sought medical advice for a large, painful lump in the elbow. Our patient described the tumor growing for 10 months, a sign of a potentially very aggressive type, measuring a circumference of 12 centimeters at admission, with firm consistency, adhesive to the profound plane, located in the posterior side of the elbow. An imaging protocol was started, identifying a large inhomogeneous, iodine-enhanced tumor that was invading the olecranon and producing osteolysis, impinging the nearby posterior soft tissues with mild vascularization. Patient was metastasis free. Taking into account the probability of a high grade tumor, the high tension in the posterior compartment of the forearm and the high risk of metastasis, a wide resection of the proximal ulna within safe margins was performed firsthand and reconstruction of the elbow joint with radial neck to humeral trochlea transposition, forming a pseudo-elbow. The histopathology and immunochemistry exam confirmed a high grade synovial sarcoma with bone invasion. Adjuvant chemotherapy was administrated postoperatively.

Results:
Postoperatively, elbow splinting at 90 degrees flexion was used for 4 weeks to protect the reconstruction, with patient being able to do routine actions (drinking water, combing hair) using the shoulder joint at 2 months. TC-scan at 2, 12 months confirmed local recurrence, but the one done at 12 months showed a new pulmonary nodule.

Conclusion:
Radial neck to humeral trochlea transposition provides an alternative reconstruction technique for resection of tumors of the proximal ulna with good functional outcome.
Is it possible to predict the factors affecting the process during the treatment of post-musculoskeletal tumor surgery wound problems through negative pressure wound therapy?

Mr. Ozgur Baysal, Mr. Fevzi Saglam, Mr. Omer Sofulu, Mr. Ahmet Hamdi Akgulle, Mr. Evrim Sirin, Mr. Bülent Erol

Marmara University School of Medicine, Istanbul, Turkey

Introduction:
In the present study, the patients with the majority of risk factors recovered after one session of negative pressure wound therapy (NPWT), while others needed ≥100 sessions of NPWT. The aim of the present study is to investigate the risk factors identified in literature that have been associated with prolonged NPWT.

Methods:
The study included patients who were operated on due to bone or soft tissue sarcoma at our clinic between 2012 and 2018, who developed postoperative local wound problems, who received NPWT and who were followed up for at least 6 months.

Results:
Of the 436 patients operated due to bone or soft tissue sarcoma at our clinic between 2012 and 2018, 46 developed postoperative local wound problems, received NPWT and were followed up for at least 6 months. A statistically significant difference was noted between postoperative intensive care unit (ICU) need and number of NPWT sessions (p=0.003; p<0.01); cases requiring postoperative ICU had a higher number of NPWT sessions that those without a postoperative ICU requirement. No statistically significant difference was identified between the number of NPWT sessions required and the culture results (p=0.072; p>0.05), although it is remarkable that the number of NPWT sessions required was higher in cases with a positive culture than it was in cases with a negative culture. No statistically significant difference was established between the VAC numbers of the cases and albumin levels (p=0.053; p>0.05), although it is remarkable that the VAC number was higher in cases with low levels of albumin than it was in cases with normal albumin levels.

Conclusion:
When encountering postoperative wound problems in patients with bone or soft tissue masses, NPWT is one of the most reliable methods for the treatment of wound site problems.
Clinical outcome in children and young adults with pelvic rhabdomyosarcoma treated with proton therapy

Mrs. Sarah Peters1, Ms. Theresa Steinmeier2, Mrs. Sandija Plaude3, Ms. Sarah Peters1, Mr. Christoph Blase3, Mr. Dirk Geismar4, Mrs. Beate Timmermann4

1Department of Particle Therapy, University Hospital Essen, West German Proton Therapy Centre Essen (WPE), West German Cancer Center (WTZ), Essen, Germany, 2West German Proton Therapy Centre Essen (WPE), West German Cancer Center (WTZ), University Hospital Essen, Essen, Germany, 3AnästhesieNetz Rhein-Ruhr, Bochum, Germany, 4Department of Particle Therapy, University Hospital Essen, West German Proton Therapy Centre Essen (WPE), West German Cancer Center (WTZ), German Cancer Consortium (DKTK), Essen, Germany

Introduction:
Rhabdomyosarcoma (RMS) constitutes 3-4% of all childhood malignancies, pelvis being one of the common sites of origin. Due to the significant rate of functional morbidity associated with surgical resection in pelvic RMS, definitive radiotherapy is an important alternative. Proton therapy (PT) has the potential to achieve long-term local control with improved functional outcome.

Methods:
Prospectively collected data on 44 children with pelvic RMS treated between December 2013 and July 2019 with a median follow-up of 1.3 years (range 0.4 – 5.2) with median age of 4.5 years (range 1.6-25 years) was analyzed. All patients received PT with median dose of 54Gy (50.4Gy-59.4Gy). Adverse events were documented according to CTCAE v4.0.

Results:
At last follow-up, 21 children had a complete remission, 6 experienced local failure, 5 had stable disease and 2 developed distant metastasis and 10 children had died. Cause of death was local failure in 3 children, systemic failure in 5, severe infection in 1 and unknown in 1, respectively. The 2-year overall survival and progression free survival were 77.3% and 59%, respectively. Tumour size > 5cm (n=15) was associated with poorer local control (p=0.01), whereas total dose > 54Gy (n=15) resulted in better local control (p=0.01). A R2 surgical resection before PT (n=12) did not appear to add significant benefit (p=0.52). During PT, 12 children experienced CTCAE° 2 or 3 toxicities with mainly cystitis, proctitis and dermatitis. Late toxicities were observed in five children with grade CTCAE° 2 or 3 cystitis. Four children had undergone cystectomy before PT. Two children underwent cystectomy after 3 months of PT due to progressive disease and another two due to repeated urinary tract infection and severe incontinence.

Conclusion:
PT is associated with good clinical outcome and favourable toxicity profile. Verification of these results with larger cohort and a longer follow-up is necessary.
Energy cost and gait biometrics after rotationplasty

Ms. Floortje Verspoor\textsuperscript{1}, Ms. Gitte G.J. Krebbekx\textsuperscript{1}, Dr. Jos A.M. Bramer\textsuperscript{1}, Dr. Gerard R. Schaap\textsuperscript{1}
\textsuperscript{1}Amsterdam University Medical Centers, Nijmegen, Netherlands

Introduction:
Rotationplasty is a rare surgical procedure indicated for a very select group of patients diagnosed with malignancies, endoprosthetic failures or trauma of the lower extremity, or proximal femoral focal deficiencies. Little is known on the long-term functional outcome. This study compares energy cost and gait biometrics of patients after rotationplasty or above-knee amputation and healthy controls.

Methods:
On September 12th 2019, a literature search was performed in Medline, EMBASE, and Cochrane on the main terms rotationplasty, energy, and gait. Case reports and case series with less than 3 patients were excluded. Methodological quality was critically appraised by the Joanna Briggs Institute checklist. When available data was complete, a pooled independent t-test was performed. Energy cost was described in forest plots.

Results:
Of 42 articles, 16 were eligible. Both energy cost and heart rate were significantly higher in rotationplasty patients compared to healthy controls (figure 1). Gait biometrics (temporal-spatial gait parameters, kinematics, kinetics, electromyography) confirmed these outcomes showing compensation mechanisms of rotationplasty patients. Rotationplasty patients showed slightly increased energy costs compared to patients with an amputation.

Conclusion:
Rotationplasty patients showed lower functionality compared to the healthy controls and similar functional outcomes compared to above-knee amputations in small and heterogeneous patient groups.
Schwannoma of the Tibial and Peroneal nerves: clinical considerations and surgical outcomes

Mr. Lorenzo Andreani², **Mr. Edoardo Ipponi**, Mr. Alfio Damiano Ruinato¹, Ms. Silvia De Franco¹, Mr. Rodolfo Capanna¹,²
¹University of Pisa, Pisa, Italy, ²Department of Orthopaedic and Trauma Surgery AOUP, Pisa, Italy

Background and aim of the work:
Schwannomas of the lower limb are uncommon benign tumors. The ones arising from Tibial and Peroneal Nerves are particularly rare. We evaluated their clinical presentation and reported our experience with surgical treatment, paying particular attention to clinical presentation and lower limbs overall functionality before and after treatment.

Materials and methods:
16 patients consequentially treated for schwannomas of the lower limb were included in our study. Time between symptoms outbreak and diagnosis, as well as pre-operative tumor size were evaluated for each case. MRIs were used to identify mass’ size and position. Pre-operative and post-operative overall lower limb functionality was assessed using MSTS score. Sensitive symptoms and muscular strength were also evaluated before and after surgery.

Results:
The nerve involved was Tibial Nerve in 7 cases, Common Peroneal Nerve in 5 cases, Superficial Peroneal Nerve in 3 cases and Deep Peroneal Nerve in 1 case. The mean follow-up was 24.7 months. Average diagnostic delay was 7.2 months. Tumor size was 29.3mm while distance from Sciatic fork was 7.6cm. Before surgery each patient had positive Hoffmann-Tinel sign and an at least mild paresthesia, 4 cases had slight reduction of muscular strength. Pre-operative MSTS score was 23.9. Tumor size, distance from the sciatic fork and diagnostic delay were associated with pre-operative functionality. No major local complication was recorded during or after surgery. Post-operative MSTS score was 29.2. Each patient with pre-operative sensitive or motorial deficit benefited the effects of surgical treatment.

Conclusions:
Our data suggest early diagnosis could reduce the impact of the disease on patients’ activities of daily living and quality of life. Surgery, for its part, is a safe and reliable approach to lower limb schwannomas with good chances of clinical remission.
The 10 year results of the fixed-hinge, cemented, Stryker modular endoprosthetic distal femoral tumour system: a multicentric retrospective review of 125 cases

Mr. Jean-Camille Mattei1, Mr. Vincent Crenn5, Mr. Louis-Romée Le Nail6, Mr. B Chapat5, Mr. B Ferembach6, Mr. P Bizzozero4, Mr. François Gouin5, Mr. Philippe Rosset6, Mr. Richard Alexandre Rochwerger4, Mr. David Biau1,2,3
1AP-HP, Paris, France, 2Université de Paris, Paris, France, 3INSERM U1153, Paris, France, 4AP-HM, Marseille, France, 5CHU Nantes, Nantes, France, 6CHU Tours, Tours, France

Background:
Resection and reconstruction of the distal femur is the most common orthopedic oncologic procedure. Surgeons may choose between cemented or uncemented fixation and fixed or rotating hinge mechanism. We report our 10 year result with cemented fixed-hinged Stryker distal femoral METS.

Materials and methods:
125 patients, 63 women and 62 men, with a minimum 10 year potential followup, from four centers, were included in this retrospective study. The median age was 37 years old (min-max: 17 – 80). The most common histologies were osteosarcomas (48%) and chondrosarcomas (28%); 21% presented with a pathologic fracture; the median resection length was 145mm.

All patients were implanted with a fixed-hinge, cemented, Stryker distal femoral METS. A standard epiphysis was used in 73% of cases, with a short tibia (82%). The most common reconstruction diaphysis used were 45, 60, and 75mm accounting for 66% of the series; the most common diameters used were 14 and 15mm accounting for 70% of the series.

Cumulative incidences were computed to determine revision rates for any reason, and for mechanical reasons.

Results:
The median followup was 92 months (Q1 – Q3: 47 – 130). Thirty-six (29%) patients died over followup. The 10 year patient survival was 71% (95% CI: 63 – 80).

Overall, a revision (partial or complete) was performed in 28 patients (22%): 14 times for mechanical reasons, 8 times for infection, and 6 times for tumor recurrence. The 10 year cumulative probability of revision (partial or complete) for any reason was 23% (95% CI: 16 – 31). The 10 year cumulative incidence of revision for mechanical reason was 11% (95% CI: 6 – 18%).

Conclusion:
The fixed-hinge, cemented, Stryker modular endoprosthetic distal femoral tumour system gives good long term mechanical results with a low probability of revision for mechanical reasons.
Effectiveness of cyber knife for oligometastatic lung lesions of musculoskeletal sarcoma.

Mr. Taketoshi Yasuda¹, Mrs. Kayo Suzuki¹, Mr. Kenta Watanabe¹, Mr. Masahiko Kanamori², Mr Yoshiharu Kawaguchi²
¹Department of Orthopaedic Surgery, University of Toyama, Toyama, Japan, ²Department of Human Science 1, University of Toyama, Toyama, Japan

Introduction:
Cyber Knife (CK) is one of the stereotactic radiotherapy and the radiation source is X-ray. Indication for CK of lung metastatic lesions (LML) is 1) lesion diameter within 5 cm, 2) less than 3 lesions, and 3) no other lesions. We have performed CK for LML expecting the same effect as surgical treatment. The purpose of this study is to evaluate the effectiveness of CK for LML of musculoskeletal sarcoma.

Methods:
The study included 8 patients (12 lesions) with LML who underwent CK from 2015 to 2019. The mean age at the time of CK was 68 years. All cases are followed up more than 6 months and the average follow-up period was 22 months (range: 6-40). The histopathological diagnose were UPS in 4, liposarcoma in 2, and others in 2. The irradiation method for 1 lesion was 56-60 Gy/4 fr. Lesions were evaluated by CT every 3 months, and effect was assessed using RECIST at 6 months later and the final observation. The response rate was effective when the effect was more than SD. The effective duration was evaluated by the period until regrowth. Adverse events (AE) were evaluated using CTCAE version 4.0.

Results:
1) Therapeutic effect: Good response was obtained in all cases after 6 months: SD in 2, PR in 7 and CR in 3. The effect was maintained until the final observation and there was no regrowth lesion. 2) AE: During irradiation, arrhythmia was observed in 1. Grade 2 pneumonitis was observed in 1 case after 3 months. It improved with medication. 3) Oncological outcome: There were AWD in 5 and NED in 4.

Conclusion:
In the case of lung oligometastases, CK may be a valuable therapeutic tool without severe AE. Early diagnosis of LML is necessary to match the indications for CK.
Clinical differences between central and peripheral ex-osteochondroma chondrosarcomas

Mrs. Minna Laitinen1, Mr Scott Evans2, Mr Jonathan Stevenson3, Mr Guy Morris2, Mr Lee Jeys2, Mr Michael Parry2
1Helsinki University Hospital, Helsinki, Finland, 2Royal Orthopaedic Hospital, Birmingham, Iso-Britannia

Chondrosarcoma (CS) is the second most common primary bone sarcoma. The most common CS is conventional CS accounting about 85% of all the cases. Conventional CS can be further categorized to central and peripheral ex-osteochondroma CS. The clinical behaviour and prognosis of these tumours is multimodal. In most of the studies, central and peripheral CS are grouped together, although there is growing evidence that they behave differently. The aims of the study were (i) to analyse differences in characteristics between central and peripheral CS and, (ii) to study the incidence and role of different syndromes in CS patients.

We retrospectively reviewed data from two international tertiary referral sarcoma centres, between 1995 and 2018. 720 patients with surgically treated conventional CS of the pelvis and extremities were included.

Patient demographics are summarized in table 1 and comparison between central and peripheral ex-osteochondroma characteristics are summarized in table 2. In patients with Ollier’s disease and Mafucci’s syndrome, 61.9% and 60% of malignancies were in extremities, more likely in proximal humerus, proximal tibia and hand and feet. In patients with multiple hereditary osteochondroma (MHO), 60.7% of the CS were located in the pelvis and scapula, more precisely in ilium 42.3% or scapula 7.1%. In central CS, comparison of survival between Ollier’s patients and non-syndrome patients was equal (p=0.805). In peripheral CS, survival among MHO patients was similar (p=0.676), after stratification to pelvis and extremities tumours.

In conclusion, both central and peripheral CS have specific characteristics. MHO is frequently seen in peripheral CS patients and tumours are commonly located in ilium and scapula. The incidence of Ollier’s disease is uncommon among central CS. The mean age of patients with MHO or Ollier’s is on average 20 years younger, but the disease specific survival is comparable when compared to patients without known predisposing factors.
Surgical treatment of skeletal metastases in proximal tibia.

Mr Kaarel Kilk¹, Mrs Jessica Ehne², Mr Jonathan Stevenson³, Mr Gilber Kask⁴, Mr Jyrki Nieminen⁵, Mr Rikard Wedin², Mr Michael Parry³, Mrs. Minna Laitinen¹

¹Helsinki University Hospital, Helsinki, Finland, ²Karolinska University Hospital, Stockholm, Sweden, ³Royal Orthopaedic Hospital, Birmingham, Iso-Britannia, ⁴Tampere University Hospital, Tampere, Suomi, ⁵Coxa Hospital for Joint Replacement, Tampere, Finland

The skeleton is the third most common site affected by metastatic malignancies. Fracture of a long bone due to a metastatic deposit causes significant disability. The proximal tibia is a rare site for skeletal metastases and surgical treatment of metastatic lesions in this site can be very challenging. The aims of our study are to investigate the implant survival (IS) and complications of different surgical methods.

A retrospective analysis of patients treated for non-spinal skeletal metastases in four institutions acting as a retrospective analysis of patients treated for non-spinal skeletal metastases in four institutions managing metastatic bone disease (ROH, Birmingham, UK, Tampere and Helsinki, Finland, Karolinska, Stockholm, Sweden) between 2000 and 2018 was conducted. Reconstruction survivorship was calculated using the Kaplan-Meier method whilst factors affecting reconstruction survival were assessed using Cox-regression multivariate analysis.

A total of 72 patients with surgically treated pathological or impending fracture in the proximal tibia due to metastases were included. Overall IS was 89.6% (95% CI 82-98) at 1 year, 73.1% at 3 and 5 years (95% CI 57-89). According to the surgical procedure, IS at 1 and 3 years treated with tumor prosthesis was 84.9% (71-99%) and 73.6% (55-92); treated with osteosynthesis 96.9% (91-103) and 54.7% (21-88); and total knee arthroplasty 100% and 100% (Figure). Preoperative radiotherapy significantly influenced IS (p=0.001). Complications were observed in 17 (23.9%) patients. Patients treated with tumor prostheses showed a high incidence of postoperative complications, particularly infection. In this study, the best results were obtained with cemented long-stem knee prostheses. However, the follow-up period in this group was the shortest and, as the follow-up increases, so the risk of tumour progression and implant failure increases. The osteosynthesis group demonstrated good results in the short term accepting of the selection bias in this group.
The role of time and size of local recurrence in disease specific survival of chondrosarcoma

Mrs. Minna Laitinen¹, Mr Lee Jeys², Mr Scott Evans², Mr Jonathan Stevenson², Mr Robert Grimer³, Mr Michael Parry³
¹Helsinki University Hospital, Helsinki, Finland, ²Royal Orthopaedic Hospital, Birmingham, Iso-Britannia, ³Tampere University Hospital, Tampere, Finland

Chondrosarcoma (CS) is the second most common primary malignancy. CS is resistant to chemotherapy and radiotherapy and therefore is considered a surgical disease. The role of surgical margin is very important, since local recurrence (LR) is known to decrease survival especially in high grade chondrosarcoma. The aim of this study was to investigate the effect of the time to presentation of LR on disease specific survival (DSS) in CS.

A retrospective review of all patients treated at two international collaborative sarcoma centres between 1995 and 2018 identified 720 patients with conventional CS of the pelvis and extremities. Of these, 168 (23%) had LR and 91 (54%) subsequently died of their disease. Univariable Cox regression analysis was used to identify the role of investigated continuous variables (time to LR and size of LR) on DSS. 43 had metastasis before LR and were excluded. Multivariable Cox regression analysis was used to evaluate the association between time to LR and size of LR to DSS. Long LRFS was a statistically significant positive factor for DSS after LR (HR 0.990, 95%CI 0.981-0.999, p=0.04) and increasing size of LR was a statistically significant negative factor (HR 1.105, 95%CI 1.057-1.155, p=0.000). In the interaction of the size of LR and appearance time of LR on DSS after LR, we did not observe a statistically significant difference (p=0.424).

In this study we have shown that increasing size of LR negatively affects survival and long local recurrence free survival improves the DSS after LR. However, we could not detect any interaction between the size of LR and appearance time of LR so they seem to have an independent effect on DSS after LR. In conclusion we say, that LR should be operated early and if appearance time from surgery to LR is long, patient should be operated aggressively.
Multifocal Leiomyosarcoma of the thigh. A case report.

Florin-Catalin Cirstoiu¹, Bogdan Cretu¹, Adrian Cursaru¹, Sergiu Iordache¹, Mr. Bogdan Serban¹
¹Carol Davila University of Medicine & Pharmacy, Bucharest, Romania

Introduction:
Leiomyosarcomas are rare malignant soft tissue tumors derived from smooth muscle cells whom aggressiveness, location, size and management require multidisciplinary approach. Long-term survival depends on tumor type, surgical excision and early detections of metastases.

Methods:
We report a case of a 57-year old female admitted to our department with a 10-month history of two distinct progressively enlarging, painless lumps located in the thigh. Initial imaging included plain radiographs, MRI of the lesion, and a CT scan. The CT-scan revealed two relatively well defined expansive formations, one of 135/123 mm projected at the root of the thigh between the muscles of the posterior thigh compartment and the lodge of adductor muscles, and a second one measuring 73/68 mm located between sartorius and quadriceps. CT-Angiography scan revealed the presence of an arteriovenous malformation in the proximal part of the tumor. The CT scan of the chest, abdomen and pelvis as part of the metastatic work-up revealed no distant metastases. Open biopsy and amputation specimens from both sites were submitted for pathological examination in two separate medical centers. The pathological examination as well as the immunohistochemistry diagnosis obtained was leiomyosarcoma. A treatment protocol conducted by a multidisciplinary board decided that the patient will receive preoperative radiotherapy followed by tumor resection.

Results and conclusions:
Tumor reduction was significantly greater after radiotherapy and a wide local resection with the salvage of the limb was possible, with clear surgical margins. The particularity of this case is due to the presence of two distinct tumors, with the same characteristics described on conventional imaging investigations and with the same histological diagnosis. The importance of a multidisciplinary team involvement is mandatory in establishing the best treatment plan and in this case led to a limb-salvage surgery although a disarticulation of the limb considered in the initial preoperative planning.
Custom-made pelvic prosthesis, fixed to the sacrum, after internal hemipelvectomy as a limb-salvaging alternative.

Tiago Barbosa¹, Pedro Cardoso², André Dias Carvalho¹, Sara Diniz², Ms. Catarina Pereira¹, Ana Ribau¹
¹Centro Hospitalar Universitário do Porto, Porto, Portugal

Introduction:
Between 2017 and 2019, our orthopedics department implanted three custom-made implants after internal hemipelvectomy, a limb-salvaging procedure for patients with pelvic malignant bone tumors. We intend to go over our experience when using these implants, looking at patient follow-up, functional outcomes and implant related complications.

Methods:
Three women aged between 50 and 61 years-old diagnosed with malignant pelvic bone tumors (a leimiossarcoma, and two osteossarcomas) were submitted to internal hemipelvectomy and reprosthetization with a custom-made pelvic prosthesis (MUTARS®, IMPLANTCAST) produced with a computer-aided design and CT data. The implant consisted in a sacral-acetabular component, fixed to the sacrum, combined with cemented hip arthroplasty. A TREVIRA TUBE® was used for joint capsule reconstruction. Antibiotic prophylaxis was used before and during surgery. The iliac vascular structures were isolated and preserved in all patients and the abdominal wall was closed using GORETEX® to prevent herniation.

Results:
The tumors were resected with appropriate margins and integrity of the tumor capsule. In one case, the femoral nerve root was involved in the tumor and was resected. We faced early post-operative complications such as one pulmonary embolism and two prosthetic infections, needing revision surgery. Functionally, one patient was able to walk and the other were able to sit down. No local tumor recurrence was observed. One patient died during follow up.

Conclusion:
According to the literature, these megaendoprosthesis are prone to several intraoperative and post operative complications, such as neurovascular lesion, material failure, joint dislocation and a very high risk of infection. Our results do not differ from these reports. Although there is a need for studies with larger series to improve experience and produce statistically significant results, we believe this procedure may be a viable limb salvaging solution for patients with malignant pelvic bone tumors.
Long term results of surgical hip dislocation and osteo-articular allograft reconstruction for a chondroblastoma in the femoral head.


Introduction:
Descriptions of adult epiphyseal chondroblastoma are rare in the literature, but when it occurs, it can affect the femoral head by 16%. The treatment of these tumors is challenging since there is a great possibility of joint damage or local recurrences. Most of the series show treatments with curettage and nonstructural bone grafting. However, the follow-up presented is usually short, and therefore long term results are not frequently described. Additionally, few reports mention the use of osteoarticular structural allografts for the treatment of this type of lesions.

Methods:
Case report and literature review.

Results:
A 48 years-old male patient attended our institution with increasing pain in the inguinal region. At physical examination, a log roll test was found positive. Hip X rays revealed a lytic lesion in the femoral head that presented calcifications and was compatible with chondroblastoma. Due to the articular damage, the patient was treated with surgical hip dislocation, curettage and reconstruction with an structural osteoarticular allograft. The patient had a very adequate postoperative evolution, and has been followed for the last 10 years. No limitation, pain or local recurrences have been recorded.

Conclusions:
The surgical treatment for chondroblastoma of the femoral head is still a challenge in orthopaedic oncology. Due to the more frequent presentation in children, most of the series suggest that curettage and bone grafting is a reliable option; however, long-term results are not frequently reported. In the current case, the reconstruction of a femoral head with an osteoarticular allograft proved to be an adequate option after 10 years of follow up. No pain or local recurrence has been observed, and therefore, we believe this type of treatment may be an alternative when the tumor has damaged the structure in a significant manner.
Limb salvage and complication management after (sub-)total humerus resection in sarcoma patients during early infancy

Mr. Julian Röder¹, Mr. Arne Streitbürger¹, Mr. Jendrik Hardes¹, Mr. Lars Erik Podleska¹, Mr. Philipp Scheidt¹, Mr. Markus Nottrott¹, Ms. Wiebke Guder¹

¹University Hospital Essen, Essen, Germany

Introduction:
The proximal humerus is a common site of primary malignant bone tumors. Reconstruction techniques after tumor resection include megaendoprostheses, k-wires with cement coating, clavicula pro humero and vascularized fibular epiphyseal transplants. However, after (sub-)total resection, reconstruction options in the immature skeleton are limited and provide numerous challenges.

Methods:
Review of three patients (age < 6 years) who underwent limb salvage operations after (sub-)total humerus resection for failed reconstructions. Osteosarcoma was treated in one and Ewing sarcoma in two cases. Total humerus resection was performed in two cases; the distal metaphysis was preserved in one patient. Follow up was 21, 41 and 63 months.

Results:
Both patients treated with total humerus resection underwent revisions due to implant failure. They were initially reconstructed using a 3D printed smooth-surfaced prosthesis, explanted due to soft tissue failure and replaced by antibiotic cement spacers. Dislocation of shoulder and elbow joint were observed despite soft-tissue reconstruction efforts in both patients. One patient was finally reconstructed with a growing megaendoprosthesis, the other patient’s operation (clavicula pro humero) is pending.
The third patient underwent near-total resection of the humerus. Due to soft tissue scarcity at initial reconstruction, a spacer was implanted and anchored to the remaining distal humerus. 3 years later, the spacer was replaced with a growing megaendoprosthesis.

Conclusion:
Humeral reconstruction of large bone defects in early childhood is a challenging procedure. Salvage of the distal humerus, whenever feasible from an oncological point of view, can prevent complications such as joint dislocation and insufficient growth of the remaining arm. Temporary usage of spacers - until soft tissue coverage improves with increasing age - may reduce implant-associated complications. Limb salvage with growing endoprostheses proves to be a promising salvage procedure. However, in case of total humerus resection, hinged implants in the elbow joint are necessary to prevent dislocation.
Four newly discovered USP6 fusion partners (ASAP1, FAT1, SAR1A, TNC) in primary aneurysmal bone cysts

Mr. Blaz Mavcic\textsuperscript{1,4}, Mr. David Martincic\textsuperscript{1,4}, Ms. Daja Sekoranja\textsuperscript{2,4}, Mr. Andrej Zupan\textsuperscript{2,4}, Ms. Vladka Salapura\textsuperscript{3,4}, Mr. Ziga Snoj\textsuperscript{3,4}, Ms. Katarina A. Limpel Novak\textsuperscript{3,4}, Mr. Joze Pizem\textsuperscript{3,4}

\textsuperscript{1}University Medical Centre Ljubljana, Department of Orthopaedic Surgery, Ljubljana, Slovenia, \textsuperscript{2}University of Ljubljana, Faculty of Medicine, Institute of Pathology, Ljubljana, Slovenia, \textsuperscript{3}University Medical Center Ljubljana, Institute of Radiology, Ljubljana, Slovenia, \textsuperscript{4}University of Ljubljana, Faculty of Medicine, Ljubljana, Slovenia

\textbf{INTRODUCTION:}
Aneurysmal bone cyst (ABC) is a benign locally-aggressive bone tumor, treated with extensive curettage and high local recurrence risk. In contrast to other cystic bone tumors, ABC typically shows USP6 gene rearrangement. There is a growing list of known USP6 fusion partners, identified with the next generation sequencing: CDH11, CNBP, COL1A1, CTNNB1, EIF1, FOSL2, OMD, PAFAH1B1, RUNX2, SEC31A, SPARC, STAT3, THRAP3 and USP9X. The aim of our work was to analyze any possible new USP6 fusion partners in a series of consecutive ABCs.

\textbf{METHODS:}
We analyzed a series of 11 consecutive primary ABCs of the pelvis and long bones with the next generation sequencing. USP6 fusion was identified in all cases, thereby providing further evidence of universally present USP6 fusions in this bone tumor. Polymerase chain reaction and Sanger sequencing were then used to identify novel fusion partners in this ABC series.

\textbf{RESULTS:}
Four novel fusion partners were identified in five ABCs, including ASAP1, FAT1, SAR1A and TNC (in two cases). Because of high sensitivity and specificity, detection of a USP6 fusion by the next generation sequencing may assist in differentiating between ABC and its mimics, especially in small biopsy samples when a definite diagnosis cannot be achieved on morphological grounds alone.

\textbf{CONCLUSION:}
Next generation sequencing of USP6 gene rearrangement has the potential to become an important tool in diagnostics of aneurismal bone cysts and identification of its subtypes. Clinical relevance of different genetic fusion partners and correlation with their characteristics (e.g. pathologic features, recurrence rates, local aggressiveness, optimal filling method after curettage) remain to be investigated with further studies on larger patient series.
Does choice of surgical procedure correlate with survival in high-grade central osteosarcoma around the knee? - A report from the Cooperative Osteosarcoma Study Group (COSS)

Mrs. Stefanie Hecker-Nolting¹, Mr. Benjamin Sorg¹, Mr. Daniel Baumhoer², Mr. Hans-Roland Dürr³, Mr. Rüdiger Von Eisenhart-Rothe⁴, Mr. G. Ulrich Exner⁵, Mr. Georg Goshger⁶, Mr. Hendrik Hardes⁷, Mr. Ulrich Heise⁸, Mr. Axel Hillmann⁹, Mr. Matthias Kevric¹, Mr. Andreas H. Krieg¹², Mr. Burkhard Lehner¹³, Mr. Per-Ulf Tunn¹⁴, Mr. Reinhard Windhager¹⁵, Mr. Thomas Wirth¹⁴, Mr. Stefan Bielack¹

¹Klinikum Stuttgart - Olgahospital, Stuttgart Cancer Center, Zentrum für Kinder-, Jugend- und Frauenmedizin, Pädiatrie 5 (Onkologie, Hämatologie, Immunologie), Stuttgart, Germany, ²Knochentumor-Referenzzentrum am Institut für Pathologie, Universitätsspital und Universität Basel, Basel, Switzerland, ³Klinikum der Universität München, Campus Großhadern, Orthopädische Klinik und Poliklinik, Schwerpunkt Tumorthorapdie, München, Germany, ⁴Klinikum rechts der Isar, Technische Universität München, Klinik und Poliklinik für Orthopädie und Sportorthopädie, München, Germany, ⁵Orthopädie Zentrum Zürich, Zürich, Switzerland, ⁶Universitätsklinikum Münster, Klinik für Allgemeine Orthopädie und Tumororthopädie, Münster, Germany, ⁷Universitätsklinik Essen, Zentrum für Orthopädie und Unfallchirurgie, Abteilung für Tumorthorapdie und Sarkomchirurgie, Essen, Germany, ⁸Orthopädie-Zentrum Hamburg, Hamburg, Germany, ⁹Krankenhaus Barmherzige Brüder Regensburg, Klinik für Unfallchirurgie, Orthopädie und Sportmedizin, Abteilung für Sarkome und Muskuloskelettale Tumore, Regensburg, Germany, ¹⁰Universitätsklinik Basel, Zentrum für Knochen- und Weichteilumore, Basel, Switzerland, ¹¹Universitätsklinikum Heidelberg, Klinik für Orthopädie und Unfallchirurgie, Heidelberg, Germany, ¹²Helios Klinikum Berlin-Buch, Klinik für Tumororthopädie, Berlin, Germany, ¹³Universitätsklinikum Wien, Klinik für Orthopädie, Wien, Austria, ¹⁴Klinikum Stuttgart – Olgahospital, Zentrum für Kinder-, Jugend- und Frauenmedizin, Orthopädische Klinik, Stuttgart, Germany

Introduction
This retrospective analysis compared outcomes after limb-salvage vs. ablative surgery for osteosarcomas around the knee.

Methods
The COSS database (01/80-12/16) was searched for high grade central osteosarcomas around the knee whose treatment included complete surgical removal. Patient-, tumour-, and treatment-related factors were analysed for potential correlations with type of surgery and outcome.

Results
2,175 evaluable patients (1,358 distal femur, 696 proximal tibia, 121 proximal fibula; 1,392 limb-salvage, 783 ablative surgery (296 amputation, 123 disarticulation, 364 rotationplasty)). Factors associated with ablative surgery: younger age (Odds Ratio OR=1.49), site above knee (OR=1.17), pathological fracture (OR=2.5), large tumour size (OR=2.14), metastatic disease (OR=1.33), poor response (OR=1.54), (p<0.05 resp., Chi²-test). Strong shift towards limb-salvage 1980-1999 (51%) vs. 2000-2016 (78%) (p<0.01). Median follow-up after surgery of the primary: 7.3 (0.03–36.9) years for all patients, 9.9 years for 1,557 survivors. 809/2,175 patients suffered recurrence (713 purely metastatic, 96 local or combined). Ablative surgery correlated with occurrence of relapse (OR=1.33, p=0.002). At recurrence, primary site more likely to be involved after limb-salvage than after ablation (16.1% vs. 5.5% of recurrences; OR=3.28, p<0.0001). Overall survival estimates at 5/10 years: 75.4/69.9%, no difference 1980-1999 vs. 2000-2016 (p=0.74, log-rank). Upon univariate testing, 5/10-year overall survival estimates significantly higher after limb-salvage than ablation (78.6%/72.9% vs. 69.8%/64.7%;p<0.0001, log-rank). In Cox regression analysis, osteosarcoma as secondary malignancy (HR=2.5), primary metastases (HR=2.44), and poor histological response (HR=2.46), but also ablative surgery (Hazard ratio HR=1.36) were independently associated with inferior survival estimates.
Conclusion
This very large multicenter study of osteosarcoma around the knee observed a strong shift from ablation towards limb-salvage after the millennium. Overall, this was not associated with altered survival expectancies, pointing out the relative safety of the latter approach. Patients treated by ablation surgery, however, represented a strongly negatively selected cohort, making direct prognostic comparisons between procedures almost impossible.
Does Bone Grafting Reduce Fracture Risk After Curettage of Atypical Cartilaginous Tumors?

Mrs. Gitte G.J. Krebbekx, Mr. Felix J. Fris, Mr. Stein Janssen, Mr. Gerard R. Schaap, Ms. Floortje G.M. Verspoor, Mr. Jos A.M. Bramer

AUMC Amsterdam, Amsterdam, Netherlands

Introduction:
Curettage of bone lesions in the treatment of atypical cartilaginous tumors (ACT) may result in a defect which weakens the affected bone. The purpose of this study was to determine the difference in fracture risk between no augmentation and allograft bone graft augmentation of defects after curettage of ACT. In addition, we assessed risk factors for fracture after curettage of these tumors.

Methods:
322 patients after curettage of a histopathologically confirmed ACT followed by phenolisation and augmentation were retrospectively reviewed at our tertiary care orthopedic oncology referral center (January 2008- May 2019). Tumor size was documented by musculoskeletal radiologists and the presence of subsequent fracture was radiologically diagnosed during follow-up by the orthopedic oncologist.

Results:
199 (62%) females and 123 (38%) males were included, with a mean age of fifty-six years (range: 17-87). The mean follow-up period was 42.5 months. The majority of the patients received allograft cancellous bone chips (n=203, 62%) or allograft femoral head bone graft (n=77, 24%). The defect was left empty in a smaller group (n=31, 9.8%). Others received cement (n=11, 3.4%), autograft bone (n=4, 1.2%), or DBX putty (n=1, 0.3%). The mean diameter of the lesions was 4.4 (SD: 2.8) cm. No significant result in fracture risk was found between no augmentation and allograft bone chip/graft augmentation after curettage (p=0.102). We did found a higher risk of fracture among men (p=0.035) (Fig. 1), and lesions larger than 3.7 cm (p=0.007) (Fig. 2).

Conclusion:
Results showed no difference in fracture risk based on the type of augmentation. Male patients with a lesion ≥ 3.7 cm appeared to have a higher fracture risk which should be taken into account when performing surgical curettage of ACT.
Comparative analysis of quality of life in patients with spine metastases before and after surgical treatment

Ms. Ekaterina Usmanova¹, Mrs. Olga Shchelkova², Mr. Aslan Valiev¹
¹N.N. Blokhin Russian Cancer Research Center, Medicine Rehabilitation, Moscow, Russian Federation, ²Saint Petersburg State University, Department of clinical psychology, Saint Petersburg, Russian Federation

Introduction:
The issue of choosing the optimal method of treatment for patients with spine metastases is one of the most difficult and opened at the moment. The main criteria for choosing the method of treatment are patients’ survival rate and quality of life (QoL). For patients with poor prognosis the only criterion for choosing treatment is QoL. Quality of life in oncological patients is studied intensively. In clinical and epidemiological researches quality of life more often is considered a measure of medical intervention efficiency. According researchers reports the factor significantly decreased QoL in patients with spine tumors is pain syndrome.
The aim of the study was to reveal basic parameters of QoL and pain syndrome in patients with spine metastases before and after surgical treatment. Study participants were 65 inpatients with spine tumors of N.N. Blokhin Russian Cancer Research Center.
The methods were VAS and Watkins scales, SF-36 Health Status Survey, Quality of Life Questionnary-Core 30 of European Organization for Research and Treatment Cancer, Spine Oncology Study Group Outcomes Questionnaire.

Results:
All patients had pain syndrome before treatment. Pain assessment using VAS and Watkins scales before and after treatment revealed pain reduction as a result of surgery. Patients with spine metastases assess their QoL in general after surgery significantly higher than before treatment. As well patients report increasing QoL after surgery on the parameters of neurological status and pain intensity which corresponds to VAS and Watkins scales assessment. Besides the results revealed improving of QoL in patients with spine tumors after treatment on the parameter of emotional functioning.

Conclusion:
Currently patients with spine metastases undergo effective surgical treatment, which significantly improves their QoL and relieves pain.
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Infection Revision Megaprosthetic Reconstruction after Bone Tumor Replacement

Mr. Oleg Vyrva¹, Mr. Roman Malik¹, Mrs. Yanina Golovina¹, Mr. Ivan Skorik¹, Mrs. Irina Bets¹
¹Sytenko Institute of Spine and Joint Pathology, Kharkiv, Ukraine

Introduction:

of this study is to review the Sytenko Institute experience in infection revisions of prosthetic reconstructions of the lower limb for bone tumors. Special attention was given to the analysis of megaprostheses-related complications.

Methods:

incidence of infections and type of revisions were analyzed in a series of 32 Ukrainian tumor prostheses implanted from 2006 to 2020 after resection of proximal femur 2, distal femur 15, total femur 2, distal femur and proximal tibia 9, proximal tibia 4, in 14 males and 18 females.

All patients were periodically checked in the Institute Clinic. Data for this study was obtained from clinical charts and imaging studies were carefully. Revision surgery was performed overall in 32 cases for prosthesis-related infection complications. Functional results were assessed according to the MSTS and TESS scores.

Results:

infection was treated with removal of prosthesis, debridement and customized temporary metal-cement antibiotic loaded spacers until infection healed and new modular megaendoprosthesis were implanted in most of the cases. Non healed infections required amputation. Revisions for infection were successful in 24 pts., while 8 pts. were amputated.

Revisions for septic loosening achieved good durable results at an average follow-up of 12 years. Statistical analysis showed reduction of the complication rate with the evolution of designs and materials.

Conclusions:

Newer designs and materials of modular prostheses were significantly associated with a decreased incidence of major complications and therefore positively affected the implant survival. Functional results were satisfactory in most of the patients. Treatment of major infection complications is challenging and appropriate timing of revision surgery is a crucial issue, affecting functional outcome.
Extraskeletal Ewing Sarcoma of trunk and extremities: a single Institution retrospective review of 57 patients.

Mrs. Marta Karpik, Mrs. Debora Lana, Mr. Marco Gambarotti, Mr. Davide Maria Donati, Mrs. Anna Paioli, Mr. Giuseppe Bianchi

1Department of Orthopedics and Traumatology, Medical University of Bialystok, Clinical Hospital, Bialystok, Poland, 2Department of Orthopedic Oncology, Rizzoli Orthopedic Institute, Bologna, Italy, 3Department of Pathology, IRCCS Rizzoli Orthopedic Institute, Bologna, Italy, 4Department of Chemotherapy, IRCCS Rizzoli Orthopedic Institute, Bologna, Italy

Introduction:
Extraskeletal Ewing Sarcoma (EES) is a rare primary, malignant tumor with high potential for metastasis. The prognosis in EES is still poor: the rate of 5-year survival ranges between 60%-70%. The aim of this study was to evaluate the prognostic factors that may influence the outcome.

Methods:
We retrospectively reviewed 57 patients diagnosed with Extraskeletal Ewing Sarcoma treated at the Instituto Ortopedico Rizzoli, Bologna between 1977-2018. We evaluated the significance of clinicopathological factors such as gender, age, site of tumor, type of chemotherapy and local treatment, surgical margins, histologic response to chemotherapy (Bologna and Huvos systems) and correlation with event-free survival (EFS).

Results:
The median follow-up 124 was months (range 3 to 336), the median age at diagnosis was 27 years old (range 4 to 56), 25% of the patients were aged 16 years or younger, no gender predilection. The most common location was the lower leg – 47%. Five and 10-year EFS was 69% and 59%. The worst outcomes were observed in patients with metastases at diagnosis (5 and 10-year EFS– 18%). Twenty six percent of the patients developed distant metastases and 9% local recurrence. The most common combination of treatment was neoadjuvant chemotherapy, surgery and postoperative chemotherapy. The surgical margins were wide (R0) in 72%. Bologna and Huvos systems could be used for assessment in 36 cases. According to the Bologna system, in 89% cases the response was poor; and likewise in the Huvos system– 81% responded poorly.

Conclusion:
Response to neoadjuvant chemotherapy was poor in our series regardless of the kind of chemotherapy protocols and other evaluated factors. No independent factors for development of distant metastasis or local recurrence were found. The patients who developed distant metastasis had worse outcomes. The EFS in our study was not significantly correlated with any investigated clinicopathological factors.
The long term outcome of extra-articular resection of the knee joint for malignant bone tumors of the distal femur: a comparative retrospective review of 133 cases

Mr. Louis-Romée Le Nail², Mr. Gregoire Rougereau¹, Mr. Vincent Crenn³, Mr. Jean-Camille Mattei⁴, Mr. François Gouin³, Mr. Philippe Rosset³, Mr. Richard Alexandre Rochwerger⁴, Mr. David Biau¹,⁵,⁶
¹AP-HP, Paris, France, ²CHU Tours, Tours, France, ³CHU Nantes, Nantes, France, ⁴AP-HM, Marseille, France, ⁵Université de Paris, Paris, France, ⁶INSERM U1153, Paris, France

Background:
Primary bone tumors of the distal femur sometimes contaminate the knee joint and an extra-articular resection is warranted. Although the extra-articular resection of the knee from the distal femur adds very little to the procedure, it could be associated with significant worse outcome.

Materials and methods:
133 patients, 27 with an extra-articular resection (EAR) and 105 with an intra-articular resection (IAR) of the joint, were retrospectively included with a minimum 10 year potential followup. Patients in the EAR group were younger (25 compared to 42 in the IAR group), presented more frequently with a pathologic fracture (32% compared to 16%). Margins were comparable in both groups (91% R0 in the EAR, compared to 96% R0 in the IAR).
All patients were implanted with a Stanmore distal femoral METS. A small epiphysis was used in 44% of EAR cases compared to 26% of the IAR cases.
Cumulative incidences were computed to determine revision rates for any reason; Cox regression models were used to find variables associated with the outcomes.

Results:
The median followup was 93 months. 44 (33%) patients died over followup. Overall, a revision was performed in 30 patients (23%): 15 for mechanical reasons, 9 for infection, and 6 for tumor recurrence. The 5 and 10 year cumulative probability of revision (partial or complete) for any reason were 26% (95% CI: 11 – 44%) and 36% (95% CI: 17 – 55%) respectively for the EAR group compared to 17 (95% CI: 10 – 24%) and 20 (13 – 28%). Extra-articular (p=0.00882) and longer resection length (p=0.00491) were both significantly associated with early revision.

Conclusion:
Extra-articular resection of the knee joint for malignant bone tumors of the distal femur is achievable with appropriate oncologic objectives. It is however associated with increased revision rate in the long term.
Myxofibrosarcoma: a strategy to achieve consistently wide margins for better local control.

Mrs. Benedetta Spazzoli, Ms. Deborah May, Mr. Peter FM Choong, Ms. Claudia Di Bella
1Saint Vincent Hospital, Melbourne, Australia, 2Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction:
Myxofibrosarcoma (MFS) is a rare soft tissue tumor associated with difficult local control due to its infiltrative pattern, with a reported rate of local recurrence ranging from 30% to 65%. In this study we demonstrate how a combined radiotherapy, orthopaedic and plastic surgical approach can significantly improve the resection margins therefore reducing the rate of local recurrence in these tumors.

Methods:
We conducted a retrospective study on patients with MFS treated from 1998 to 2019 in a single major sarcoma centre (St Vincent’s Hospital, Melbourne). 42 patients were included: median follow up was 59 months, median age: 65.5 years; 29 F/28 M; tumor site in extremities in 89.5%; tumor size >5cm in 70% of patients, superficial location in 27%, deep in 63%. We analysed the rate of wide margins compared to inadequate (intralesional or marginal) margins achieved with our combined approach, as well as the rate of local recurrence, metastases, disease free survival and overall survival.

Results: We obtained wide histological margins in 97.6% of the cases (41 patients); local recurrence occurred in 14.3% of patients at a median time of 24 months. 7 patients developed metastases (16.6%), with a disease free survival of 13.6 months and an overall survival of 69%.

Conclusions:
A combined approach characterized by pre-operative radiotherapy followed by orthopaedic oncology resection and plastic surgery reconstruction, can achieve very high rate of wide margins in MFS. This approach allows for a significantly lower rate of local recurrence compared to literature.
Which patients with pre-treated locally advanced or metastatic sarcoma benefit most from trabectedin treatment? First results from a retrospective study of the German Interdisciplinary Sarcoma Group (GISG-14 ReTraSarc)

Mr. Dimosthenis Andreou, Mr. Peter Reichardt, Mr. Stephan Richter, Ms. Anne Floerken, Mr. Christoph Deinzer, Mr. Bernd Kasper, Ms. Gerlinde Egerer, Mr. Philipp Ivanyi, Mr. Armin Tuchscherer, Mr. Torsten Kessler, Mr. Markus Schuler, Mr. Christian Schmidt, Ms. Jeanette Bahr, Mr. Till Ittermann, Mr. Adrian Richter, Mr. Daniel Pink, Helios Hospital Bad Saarow, Sarcoma Center Berlin-Brandenburg, Bad Saarow, Germany, Helios Hospital Berlin-Buch, Sarcoma Center Berlin-Brandenburg, Berlin, Germany, University Hospital and Medical Faculty Carl Gustav Carus, Dresden, Germany, Charité University, Medicine Berlin, Berlin, Germany, University Hospital Würzburg, Wuerzburg, Germany, Mannheim University Medical Center, Mannheim, Germany, Heidelberg University Hospital, Heidelberg, Germany, Hannover Medical School, Hannover, Germany, Cologne University Hospital, Cologne, Germany, Muenster University Hospital, Muenster, Germany, Helios Hospital Emil von Behring, Berlin, Germany, University Medicine Greifswald, Greifswald, Germany

Introduction:
Despite the growing amount of published data regarding the outcomes of sarcoma patients treated with trabectedin, many questions remain unanswered. The aim of this trial (NCT03284320) was to evaluate the efficacy of trabectedin in a large German population.

Methods:
A total of 509 patients treated between 2007-2018 were retrospectively analyzed. All patients had histologically confirmed soft tissue (STS – n=478) or bone (BS – n=31) sarcoma, metastatic (n=468) or locally advanced (n=41) disease and had received at least one cycle of chemotherapy with trabectedin. Progression-free survival (PFS) probability after initiation of trabectedin treatment was calculated with the Kaplan-Meier method and compared with the log-rank test, based on follow-up data as of October 2019.

Results:
Mean patient age was 54 years for STS and 30 years for BS-patients. 25% of the patients were older than 65 years of age, 71% of the patients had a good performance status (ECOG 0/1). 38% had 2 previous lines of systemic treatment, 28% had 3 and 34% more than 3 previous lines of systemic treatment. Patients received a median of 3 (IQR, 2–6) cycles of trabectedin.
Overall response rate (ORR) under trabectedin was 10%, disease control rate (DCR) was 37%. The median overall survival after trabectedin treatment amounted to 8 months (IQR, 3–21 months) in this heavily pretreated patient population. Patients with liposarcoma had a significantly higher PFS of 22% [95% CI, 15–32] at 1 year, compared to 9% [95% CI, 5–15] for patients with leiomyosarcoma.

Conclusion:
In this large, real-life study of patients with locally advanced or metastatic sarcomas, trabectedin treatment was associated with a good ORR and DCR. The best PFS in our cohort was documented in liposarcoma patients. Further analyses of our dataset to evaluate whether these results apply to all liposarcoma subtypes are ongoing.
Local treatment of lung cancer metastases to spine

Mr. Andrei Kulaga, Mr. Elmar Musaev, Mr. Aslan Valiev
1N.n. Blokhin National Medical Research Center of Oncology, Moscow, Russian Federation

Introduction:
The relevance of treatment in patients with spine metastases increased simultaneously with increasing in number of these patients in clinical practice. The choice of treatment are based on patients survival rate (SR), functional status (FS) and quality of life (QoL).
The aim was to study possibilities of improving local treatment (LT) results in patients with lung cancer metastases to spine.

Materials and methods:
The data of 126 patients with lung cancer metastases to spine underwent LT were analyzed. Post-treated and distant functional and oncological results of LT were studied, QoL before and after treatment were revealed, as well prognosis factors were analyzed and ranked to justify choice of the optimal LT.

Results:
One-year SR after LT of patients was 68.0%. Moreover, the overall SR was different in patients with EGFR-mutation and ALK-translocation adenocarcinoma compared to patients with small cell and squamous cell carcinomas. The multivariate regression analysis showed the most significant prognosis factors in patients with lung cancer metastases to spine were histological type of tumor, molecular and genetic characteristics of tumor, number of affected areas, solitary or multiple metastases, FS and quantity of chemotherapeutic lines. These factors correlate with patients SR and consequently are significant for choosing the optimal treatment.

Functional results using dynamically comparison of indices of general health status, pain syndrome and neurological status before and after LT showed surgery had higher efficacy rates in all patients groups. Surgical treatment supports the rate of these indices in dynamics after 6 and 12 months compared with monoradiation therapy unstable effect.

Conclusion:
Due to sufficient SR in patients with lung cancer metastases to spine these patients may undergo surgical treatment in order to support functional results and improve QoL. Choice of LT type should be determined using neurological, orthopedic state, general health status and SR of patients.
Postoperative complications and functional outcomes of reconstructions following pelvic resections: Single center experience

Mr. Osman Emre Aycan¹, Mr. Muhammet Coskun Arslan¹, Mr. Yavuz Arıkan¹, Mr. Devrim Ozer¹, Mr Abdulhamit Misir²
¹Baltalimani Bone Diseases Training And Research Hospital, Istanbul, Turkey, ²Gaziosmanpasa Taksim Training and Research Hospital, Istanbul, Turkey

Introduction:
Pelvic resections with massive osteotomies and muscular resections necessitate challenging reconstructions that may complicate with inevitable failures ranging from deep infections to instability. We aimed to evaluate our institutes experience on postoperative complications and functional outcomes of pelvic reconstructions.

Material and Method:
We retrospectively reviewed the data of 28 patients (18M/10F) who underwent pelvic resection between 2010-2015 with the mean age of 42.8±4.1(8-81) years. The patients were evaluated according to resection types, resected tumor volume, operation time and blood loss. Regarding postoperative complications; incisional necrosis, superficial and deep infections, infection, recurrence and metastasis were evaluated. Estimated survival was calculated by using Kaplan-Meier curves.

Results:
The tumors included chondrosarcoma (n=15), osteosarcoma (n=4), malignant mesenchymal tumor (n=4), Ewing’s sarcoma (n=3), synovial sarcoma (n=1) and pleomorphic sarcoma (n=1). Pelvic resections included type 1 (n=6), type 2 (n=3), type 3 (n=6), type 1-2 (n=2), type 2-3 (n=4), type 1-2-3 (n=3), type 1-2-4 (n=2) and type 1-2-3-4 (n=2). Mean tumor volume was 4409.5±1064.6 mm³, mean operation time was 377.8±43.5 minutes and mean blood loss was 3862.9±721.6 cc. Surgical margins were positive in two patients. The periacetabular defects were reconstructed mostly by LUMIC (n=11). Biological reconstructions constituted vascularized fibular reconstruction (n=2) in type 1 resections. Ten patients remained free of reconstruction constituting type 1 (n=4), type 3 (n=5) and type 2 (n=1) resections. Postoperative complications included incisional necrosis (n=9), superficial infection (n=7), deep infection (n=9), prosthetic dislocation (n=2) and neurological deficit (n=1). Recurrence was detected in 8 patients with mean recurrence time of 16.5 months. 7 patients developed metastasis and 8 patients were DOD. Mean MSTS at last follow-up was 69.9% (46.7-90). 5-year overall survival was 61%, recurrence free survival was 74.3% and metastasis free survival was 68.2%.

Conclusion:
Various options exist for reconstruction of pelvic reconstructions, considering patient comorbidities and reconstruction goals are essential. The patients who applied prostheses and biological reconstruction had better MSTS, however they had higher complications. Patients without reconstruction have lower MSTS and lower complications.
New Technique of Allograft Reconstruction following the Acetabulum Tumor Pelvic Resection

Mr. Oleg Vyrva¹, Mrs. Yanina Golovina¹, Mr. Roman Malik¹, Mr. Igor Shevchenko¹, Mr. Yaroslav Doluda¹
¹Sytenko Institute of Spine and Joint Pathology, Kharkiv, Ukraine

Introduction:
Reconstruction of pelvic after malignant tumor resection remains a major challenge in orthopedic oncology surgery. To restore weight bearing along anatomical axis while preserving motions is the aim after reconstruction to improve functional outcome. The objective of this study was to evaluate the clinical and functional outcome after limb salvage surgery and new technique of allograft reconstruction following the pelvic acetabulum resection.

Methods:
The files of 11 patients with malignant pelvic bone tumors, who underwent surgical resection at Sytenko Institute between 2016 and 2021, were retrospectively analyzed (9 chondrosarcoma, 2 osteosarcoma). All patients underwent pelvic tumor resection and allograft + attachment “Trevira” tube reconstruction. The resection involved the acetabular area. We elaborated techniques, functional outcome and complication following the new procedure in 1 to 3 years follow up.

Results:
All 11 patients received a non-structural allograft bone reconstruction. They all alive and free of disease, no local recurrence, neurological deficits. Deep infection was successfully treated by wound revision and debridement. CT and x-rays pictures show good periacetabulum bone formation from 8 to 36 month after surgery. The average MSTS functional score was 68 % (range, 54–96 %) when the acetabulum was preserved. All patients walked with or without any assistive device, and 6 of them had normal function with a slight limp.

Conclusions:
New “chips” allograft reconstruction technique seems to be reliable for treating patients with a malignant periacetabulum bone tumors. Early promising results were reported in our 11-cases series with advantages of preserving more host bone for reconstruction without compromising the oncological resection margin when the surgeries were performed with good preoperative planning. We recommend the use of new method of pelvic acetabulum allograft that can restore the anatomy and provide good functional results. However, longer period of follow up and larger number of cases treated are needed.
Aggressive Osteolytic Breast Cancer Inflammatory Tumor Microenvironment in the Skeletal Compartment

Mr. Francis Lee
Yale University, New Haven, United States

Introduction:
We present an inflammatory interactive paradigm by which aggressive osteolytic metastatic breast cancer cells convert quiescent osteoblasts into inflammatory cells that destroy their own skeletal compartment.

Methods:
(1) Inducible multi-gene knockout Plasmid constructs: sgRNAs were designed using a specialized lab server. The fragments of sgRNA scaffold and U6 promoter were amplified using Lenti-multi-Guide.
(2) In vivo animal experiments: 5 × 10^5 MDA231/iCas9-c1 cells carrying either control sgRNA or MEK1/2 sgRNAs were injected into 10-week-old female nude mice. After the tumors reached the size of 0.2 cm^3, the animals were fed with normal chow or chow containing 625 mg/kg DOX for 10 days before euthanizing and harvesting tumor tissues for analyses. Additionally, breast cancer cell xenografts were implanted into female Nu/J immunodeficient mice of 9 to 10 weeks of age. Mice bearing breast cancer xenografts were orally administered either vehicle or 1 mg/kg trametinib 5 consecutive days a week for 21 days starting from day 14 after tumor implantation (N=10).

Results:
MDA-MB-231 (MDA) and HCC1806 (HCC) cells grew more aggressively in the tibia in comparison to other well-established breast cancer cells such as MCF-7, or MDA-MB-436 (p<0.01). pERK1/2-high inflammatory MDA cells convert quiescent osteoblasts into pERK1/2-high inflammatory osteoblasts that collaborate in osteoclastic bone resorption by co-producing RANKL and MCSF. Additionally, inducible MEK1/2 knockout MDA cells were not only unable to induce ERK activation in osteoblasts, but also demonstrated decreased RANKL expression in comparison to the control group. We also observed that with pharmacologic suppression of pERK1/2, quiescent osteoblasts were not converted into an inflammatory state compared to placebo-treated breast cancer-bearing mice in vivo.

Conclusion:
Our data demonstrate that aggressive osteolytic breast cancer cells trigger innate inflammatory interactions with quiescent bone cells. Our study introduces a new concept of targeted therapies for osteolytic breast cancers in general.
Combined treatment with pazopanib and paclitaxel is active in superficial angiosarcoma but not in hepatic/visceral angiosarcoma - Results of a phase II trial of the German Interdisciplinary Sarcoma Group (GISG-06 EVA)

Mr. Daniel Pink, Mr. Dimosthenis Andreou, Mr. Sebastian Bauer, Mr. Thomas Brodowicz, Mr. Peter Reichardt, Mr. Bernd Kasper, Mr. Stephan Richter, Mr. Peter Hohenberger

Helios Hospital Bad Saarow, Sarcoma Center Berlin-Brandenburg, Bad Saarow, Germany, Essen University Hospital, Essen, Germany, Medical University of Vienna, Vienna, Austria, Helios Hospital Berlin-Buch, Sarcoma Center Berlin-Brandenburg, Berlin, Germany, Mannheim University Medical Center, Mannheim, Germany, University Hospital Carl Gustav Carus, Dresden, Germany

Introduction:
Angiosarcomas account for 2-3% of all soft tissue sarcomas. About 60% develop at the skin, several of which are radiation-induced angiosarcomas following breast cancer therapy. Paclitaxel and VEGF-inhibitors have shown activity in metastatic or locally advanced angiosarcoma. Our aim was to evaluate the efficacy of a combined treatment with pazopanib and paclitaxel.

Methods:
In this multicenter, open, prospective, single-arm phase II trial (NCT02212015) patients received pazopanib (800mg/d) and paclitaxel (70mg/m2 d1, 8, 15 of a 28d cycle). The primary endpoint was progression-free survival (PFS) at 6 months using RESIST 1.1. The trial was planned in two steps with an interim futility analysis after at least 14 patients had been recruited, with no planned recruitment stop during interim analysis.

Results:
At the time of interim analysis, 26 patients with local advanced (n=5) or metastatic (n=21) angiosarcoma with a median age of 61 years (IQR, 48-70) had been recruited and received study medication at least once. 18 patients had superficial primary tumors, 5 patients had a hepatic angiosarcoma and 3 patients an angiosarcoma of other visceral organs.

No patient had a complete response at 6 months, 8/26 patients (31%) achieved a partial response according to RESIST 1.1. PFS at 6 months amounted to 46% (12/26 patients). As this was below the pre-specified threshold for the futility analysis, the study was discontinued. A post-hoc analysis showed that 0/8 patients with hepatic or other visceral angiosarcoma was progression-free at 6 months, while 6-month-PFS of patients with superficial angiosarcoma was 66% (12/18 patients).

Conclusion:
Patients with superficial angiosarcoma appear to benefit from a combined treatment with pazopanib and paclitaxel. However, the combined treatment showed no activity in patients with hepatic or other visceral angiosarcomas.
What’s an adequate resection margin? Analysis of resection margins in currently sixty-four patients treated for locally aggressive and malignant bone tumors of the extremities

Mrs. Wiebke Katharina Guder¹, Mr. Jendrik Hardes¹, Mr. Lars Erik Podleska¹, Mr. Markus Nottrott¹, Mr. Arne Streitburger¹

¹University Hospital Essen, Essen, Germany

Introduction:
Tumor resections in locally aggressive or malignant bone tumors aim at complete tumor removal surrounded by a layer of healthy tissue. In an effort of defining and reporting resection margins, different classifications have been proposed. However, controversy remains whether dichotomous, descriptive or scaled systems are most apt in estimating adequacy of resection margins, risk of local recurrence and need for adjuvant treatment. This study aims to compare resection planes planned using MRI imaging with pathological findings and the accuracy of common classifications against their ability to discern adequacy of margins.

Methods:
Interim analysis of prospectively collected data on sixty-four patients treated since April 2018.

Results:
Primary bone sarcomas were treated in forty-seven and metastatic bone disease in fifteen cases. Sixty resections were planned with clear and four resections for bone metastasis with R1 margins. Achieved bone safety margins in bone sarcomas were a mean of 4.3cm. The closest soft tissue margin was <1-5mm in thirty-five, 6-10mm in six and >10mm in two cases. Two patients had unplanned R1 margins. Vascular tumor infiltration was observed in two cases. Response to chemotherapy according to Salzer Kuntschik was good (I-III) and poor (IV-VI) in thirteen patients each. One soft tissue local recurrence was observed (V1 status, poor chemotherapy response).

Conclusion:
Defining adequate resection margins remains difficult especially for soft tissue margins. While reporting presence or absence of tumor cells at the resection plane is precise, it doesn’t report achieved safety margins. Yet, scaled measurements are incorrect because surrounding soft tissues shrink ex vivo due to elastic tissue properties. Then, descriptive systems are highly subjective, dependent on experience and difficult to compare. Each system’s aptness at predicting risk of local recurrence needs to be seen with increasing follow-up. But existing knowledge suggests that additional techniques to define adequate margins need to be established.
Chondrosarcoma of the hand and feet—when to worry?

Mr. Gilber Kask1,3, Mr. Jonathan Stevenson2, Mrs. Minna Laitinen1, Mr. Scott Evans2, Mr. Lee Jeys2, Mr. Michael Parry2
1Tampere University Hospital, Tampere, Finland, 2Royal Orthopaedic Hospital, Birmingham, United Kingdom, 3Helsinki University Hospital, Helsinki, Finland

Chondrosarcomas of the hands and feet are rare and are thought to behave in a less aggressive manner when compared to chondrosarcomas of the more proximal skeleton.

The purpose of this study was to investigate factors affecting prognosis for chondrosarcomas of the hands and feet. The study comprised a retrospective review from two international sarcoma centres, the Helsinki University Hospital, Finland and Royal Orthopedic Hospital, Birmingham, England. All patients with chondrosarcoma treated between 1995-2018 were included. A total of 720 chondrosarcomas were identified with 70 (9.7%) arising from bones of hands and feet.

32 (46%) were grade 1, 31 (44%) grade 2, 6 (9%) grade 3 chondrosarcomas and 1 (%) had dedifferentiated chondrosarcoma. 19 were treated with curettage, 38 with amputation, and 8 with excision. There were 11 local recurrences (LR) (15.7%) and 3 had pulmonary metastases (4.3%). Radiologically, soft tissue expansion was found in 76% of cases, endosteal scalloping 7%, cortical thickening 13%, bone expansion 74%, periosteal reaction 61%, tumor calcification 91% and pathological fracture 13%. Factors predisposing to LR were the tumour location in the fingers, radiological endosteal scalloping and intralesional curettage. In all metastatic cases, the tumor grade was III or dedifferentiated. The 5-year overall survival (OS) rate was 100% for grades I and II, and 0% for grade III or dedifferentiated tumors. Intralesional surgery was a significant negative factor for LR free survival (figure), however, LR did not affect OS.

Grade I and II chondrosarcomas in the hand and feet can be treated intralesionally as long as function remains acceptable. However, intralesional curettage involves a high risk of LR though recurrence does not affect OS. Higher grade tumours behave more aggressively and should be treated with radical surgery though the affect on OS remains unclear due to the rarity of these tumour types in these locations.
Resections and megaprostheses of the lower limb in the very elder

Mr. Guido Scoccianti, Mr. Matteo Innocenti, Mr. Roberto Scanferla, Mr. Marco Distefano, Mr. Francesco Muratori, Mr. Carlo Rostagno, Mr. Domenico Andrea Campanacci

1Careggi University Hospital - Department of Orthopaedic Oncology, Firenze, Italy, 2Careggi University Hospital - Department of Internal and Postoperative Medicine, Firenze, Italy

Introduction:
Few data are available about the results of resections and megaprostheses reconstructions in the very elder. Aim of the study was to assess survival and complications in this particular subset of patients.

Methods:
From 2000 to 2017 we performed 40 resections and reconstructions with megaprostheses in the lower limb in patients aged 80 or older. 24 procedures were performed for oncological disease (11 metastatic lesions, 11 primary tumors, 2 myeloma), 10 for failures of joint arthroplasty, 6 for trauma sequelae.
25 patients were operated at the hip (one at both hips), 13 at the knee, one at both hip and knee (total femur).

Results:
25 patients (64,1%) were alive at two years from surgery and 9 of these patients (23,1%) lived more than 5 years, but an early postoperative death during the first 3 months occurred in 6 patients (15%).
Survival of oncological patients was lower than non-oncological patients; we could not detect any other preoperative factor significantly affecting prognosis. 32 patients could regain walking ability (with or without aids); in 4 patients no gait recovery after surgery was obtained; for two patients no data were available about gait ability and in one patient this parameter was not applicable due to perioperative death.
Local complications were similar to reported rates in series including all-age patients.

Conclusion:
Resection and megaprosthetic reconstruction can be a valid choice also in very elderly patients, with more than half of the patients living more than two years from surgery and about one fourth living more than five years. Nevertheless, early postoperative deaths are frequent. Multidisciplinary evaluation of the grade of frailty of the patient must be accomplished and patient and relatives must be deeply informed about risks of the procedure. Intensive Care Unit availability is mandatory.
Malignant myoepithelioma of bone and soft tissue

Mrs. Alessandra Longhi, Mr Giovanni Ciani, Mr Marco Gambarotti, Mr Alberto Righi, Mr Davide Maria Donati, Mr Costantino Errani

IRCSS, Istituto Ortopedico Rizzoli, Bologna, Italy

BACKGROUND:
Malignant myoepithelioma of soft tissue and bone is an unusual tumor of uncertain differentiation. Few studies are available regarding the role of chemotherapy in malignant myoepithelioma of bone and soft tissue. The purpose of this retrospective study is to analyze the role of chemotherapy in this rare tumor.

MATERIALS AND METHODS:
We analyzed all patients with myoepithelioma diagnosis in our database. Primary site was soft tissue in 24 patients and bone in 16 patients. Five cases (3 soft tissue and 2 bone) were low grade myoepithelioma and were excluded from this analysis. 35 patients had high grade malignant myoepithelioma (myoepithelial carcinoma) males: females = 25:10; median age 52 years (13-86). Lower limb was most common site of presentation; 7/35 patients with malignant myoepithelioma were metastatic at diagnosis: to the lung (4), lymph-nodes (2), lung and bone metastases (1). 14 of the 28 patients (53%) with Malignant myoepithelioma localized at diagnosis developed distant metastases to the lung (11), lung and soft tissue (2), bone and lung (1). Data on chemotherapy treatment are available for 9 metastatic patients (3 metastatic at diagnosis) treated with chemotherapy mainly Cisplatin based: Cisplatin Doxorubicin (7), Cisplatin Paclitaxel (1) Ifo-Doxo (1).

RESULTS:
Median follow up for all 35 malignant myoepithelioma patients was 63 ms (3-234); 5 years overall survival (OS) for all these patients was 60% (95% CI 37-77) Median OS was 46 ms (13-172) for localized and median OS was 30 ms (6-233) for those who developed metastases. Of the 9 patients treated with chemotherapy 5 cases obtained partial response (median response duration was 12 ms, range 7-158), stabilization in 2 and progression of the disease was seen in other 2 (V Table 1).

CONCLUSIONS:
From this case series Cisplatin based chemotherapy seems to be effective in the treatment of metastatic Malignant Myoepithelial. Further larger cooperative studies should be encouraged.
Case report of a juxta-articular osteoid osteoma in the femoral neck of a 3-year-old child

David Martincic¹, Mr. Blaz Mavcic¹, Aljaz Mercun¹
¹University Medical Centre Ljubljana, Department of Orthopaedic Surgery, Ljubljana, Slovenia

INTRODUCTION:
Osteoid osteoma most commonly occurs in patients in the second and third decades of their life. Juxta-articular osteoid osteomas of the femoral neck in adults have been treated with hip arthroscopy, but this is not feasible in infants due to small joint dimensions. Reports on osteoid osteoma in infants are rare and there has been no report published with juxta-articular localization of such tumor in the femoral neck. The aim of our paper is to present a case-report of a 3-year-old child with osteoid osteoma in the femoral neck.

METHODS:
A 3-year-old boy with a history of minor trauma 3 weeks before was referred to the emergency department due to limping and increasing night pain in the left groin and thigh. Radiographs showed an osteolytic lesion 1.5 cm in diameter in the femoral neck, bounded by a thin sclerotic margin and MRI a lesion with surrounding bone/soft tissue edema. Dynamic bone scan confirmed focal radiopharmaceutical uptake in the area of the solitary lesion in the femoral neck.

RESULTS:
Initial drill biopsy of edematous bone revealed no diagnosis and excluded osteomyelitis or CRMO. Further RFA of the solitary lesion achieved total pain subsidence of and normalization of gait, but clinical symptoms recurred very soon after just 6 weeks of follow-up. Finally, the child was treated with combined CT-guided drilling of the thick sclerotic margin and subsequent RFA of the osteoid osteoma nidus in the immediate vicinity of the hip joint. Two weeks after the last procedure the patient was walking normally and remains asymptomatic after one year of follow-up.

CONCLUSION:
Juxta-articular osteoid osteomas in the femoral neck of infants can be successfully treated with RFA. Small body dimensions, extensive sclerotic margin and hip joint proximity may prolong the diagnostic procedure and make the technical performance of RFA more difficult.
Does the use of intraoperative angiography reduce the incidence of postoperative wound complications in complex ortho-plastic reconstructions?

**Mr. Joseph Ippolito, Jr., Ms. Kavita Kapadia, Ms. Margaret Dalena, Mr. Edward Lee, Mr. Joseph Benevenia**

*Rutgers New Jersey Medical School, Newark, United States*

**Introduction:**
Postoperative wound complications pose serious challenges to successful soft tissue coverage after orthopaedic resections. Intraoperative laser angiography via indocyanine green (ICG) has recently become a valuable tool in assessing tissue perfusion and potentially decreasing complications in other procedures, but its use in orthopaedic oncology has yet to be studied. The primary objective of this study is to compare wound complications in ortho-plastic reconstructions treated with or without laser assisted ICG angiography (ICG).

**Methods:**
Thirty-three patients undergoing complex orthopaedic resections and reconstruction with plastic surgery soft tissue coverage treated at a single institution from 2010-2018 were retrospectively reviewed. Patients with plastic surgery reconstruction utilizing ICG angiography (n=7, 2016-2018) were compared to those without, Non-ICG (n=26, 2010-2016). Patient information including age, primary diagnosis, follow-up duration, defect size and postoperative wound complications were collected for analysis.

**Results:**
Mean age at initial surgery was 39.0±27.9 years and 45.3±25.9 for the ICG and Non-ICG groups, respectively. Primary diagnosis between groups was similar, including bone tumor (57.1% vs. 61.5%), soft tissue tumor (14.3% vs. 15.4%) and non-oncologic reconstruction (28.6% vs. 23.1%) for ICG and Non-ICG groups, respectively. Mean follow-up for the ICG group was 21.7 months (range 12-41 months), and Non-ICG was 92.4 months (range 14-229 months). Mean defect size was similar between ICG and Non-ICG groups (384.0cm² vs. 298.0cm²). Postoperative wound complications occurred in 57.7% of Non-ICG patients (15/26) at a mean of 15.0 months, compared to 28.6% of ICG patients (2/7) at a mean of 1.0 months.

**Conclusion:**
The incidence of postoperative wound complications after complex ortho-plastic reconstructions remains high in this at-risk population. The utilization of ICG angiography resulted in fewer postoperative wound complications, and may assist surgeons intra-operatively to determine viability of skin and soft tissue after resection. Long-term follow-up and prospective studies are needed to further investigate this trend.
Validate the results of Pathfx on Turkish patients with skeletal metastasis

Mr. Burak Ozturan, Mr. Zilan Karadag, Mr. Jonathan Agner Forsberg, Mr. Bülent Erol, Mr. Bugra Alpan, Mr. Harzem Ozger, Mr. Volkan Gürkan, Mr. Omer Sofulu, Mr. Osman Mert Topkar
1Istanbul Medeniyet University Gaztepe Hospital Orthopedics and Traumatology Department, Istanbul, Turkey, 2Memorial Sloan-Kettering Cancer Center, New York, United States, 3Marmara university Medical Faculty Orthopedics and Traumatology Department, Istanbul, Turkey, 4Acibadem University Medical Faculty Orthopedics and Traumatology Department, Istanbul, Turkey, 5Bezmi Alem University Medical Faculty Orthopedics and Traumatology Department, Istanbul, Turkey, 6Sultan Abdulhamit Han Educate and Research Hospital, Turkey

Introduction:
Accurate determination of the life expectancy of the patient becomes very important when determining the treatment of patients with pathological fractures. Our aim is to validate the results of Pathfx (offered by Forsberg et al.) on Turkish patients in Turkey.

Methods:
The data of 233 patients who applied to 4 centers dealing with oncologic orthopedic surgery in Istanbul (2010-2017) and who were operated due to pathological fractures were collected retrospectively. 111 patients whose follow-up period was less than one year and whose information could not be reached fully were excluded. Patients were evaluated according to age, sex, type of pathological fracture, presence of organ metastasis, presence of lymph node metastasis, hemoglobin concentration at presentation, primary oncologic diagnosis, number of bone metastases and ECOQ status. Estimation of Pathfx program by months was statistically evaluated by ROC analysis.

Results:
Of the 122 patients, all survived at the first month, while 102 survived at the third month, 89 were alive in 6 months and 58 patients survived at the 12 months. In the 18th month, 39 patients and finally at the 24th month, 27 were alive.
The AUC value for each period was 0.677 at 3m, 0.695 at 6m, 0.69 at 12m, 0.674 at 18m and 0.693 at 24 months. The expected life expectancy obtained with Pathfx software was used in the study of our patients 3, 6, 12, 18, 24th month survival rates were statistically significant.(p<0.01 and p<0.05)

Conclusion:
Treatments may vary for patients depending on the life expectancy. Inadequate surgery performed in patients with long life expectancy may cause insufficiency of the implant and necessitate re-surgery. The objective data used by Pathfx for prediction provided statistically accurate estimates on Turkish patients presumed to have mixed genomes through history both from Europe and Asia and demonstrated their applicability.
Total humerus replacement with the MUTARS™ system in patients with bone sarcomas – risk factors for endoprosthetic failure and functional outcome

Mr. Kristian Nikolaus Schneider¹, Mr. Christoph Theil², Mr. Georg Gosheger¹, Mr. Jan Niklas Bröking¹, Mr. Tim Vogler¹, Mr. Jendrik Hardes³, Mr. Dominik Schorn³, Mr. Dimosthenis Andreou²

¹Department of Orthopaedics and Tumor Orthopaedics - University Hospital of Münster, Münster, Germany, ²Helios Sarcoma Center Bad Saarow, Bad Saarow, Germany, ³Department of Tumor Orthopaedics and Sarcoma Surgery - University Hospital Essen, Essen, Germany

Introduction:
Endoprosthetic reconstruction of the total humerus may be necessary after the resection of locally advanced bone sarcomas. Our goal was to identify risk factors for the first endoprosthetic failure and to assess postoperative functional outcome.

Methods:
We performed a retrospective analysis of 30 consecutive patients, who underwent resection of the entire humerus due to bone sarcomas and reconstruction with the MUTARS™ system between 1999 and 2018. Endoprosthetic failure was classified according to Henderson et al. and function was assessed using the Musculoskeletal Tumor Society (MSTS) and the American Shoulder and Elbow Surgeons score (ASES). The median follow-up was 39 (IQR 15 – 75) months for all patients and 66 (IQR 33 – 76) months for the ten surviving patients. Implant survival curves were calculated with the Kaplan-Meier method and compared with the log-rank test.

Results:
Five patients developed an infection, two a local recurrence and one patient a soft tissue failure. Both patients with a local recurrence underwent amputation after 9 and 12 months, respectively, while limb salvage was achieved in all other patients. The one- and five year revision-free implant survivorship was 76% and 72%.
Extra-articular resections (p=0.006), the presence of primary metastases (p=0.016) and postoperative radiotherapy (p=0.034) were associated with a reduced revision-free survival probability, while BMI (p=0.97), age (p=0.534), reconstruction length (p=0.624) and duration of surgery (p=0.4) were not.

The median MSTS score in 10 surviving patients was 90% (IQR 70%-93%), the median ASES score was 88 (IQR 75 - 89).

Conclusion:
Total humerus replacement is a feasible alternative to amputation for patients with locally advanced bone sarcomas, but the probability of prosthetic failure is high especially in patients with primary metastases, extra-articular resections and after postoperative radiotherapy. If the prosthesis survives the first year, the further risk for failure appears to be low.
Reconstruction of the humerus using the Comprehensive Segmental Revision System in patients suffering from metastatic bone disease.

Mr. Claus Lindkær Jensen¹, Ms. Michala Skovlund Sørensen¹, Mr. Michael Mørk Petersen¹
¹Rigshospitalet, Department of Orthopaedic Oncology, Copenhagen, Denmark

Introduction:
Surgical treatment of malignant bone tumors of the humerus is often followed by reconstruction with a tumor prosthesis. The Comprehensive Segmental Revision System® (Zimmer-Biomet, Warsaw, IN, USA) (SRS) offers a new option for such reconstructions and we evaluated implant failure incidence, surgical complications, and clinical results.

Methods:
A study of 22 consecutive patients (F/M= 9/13, mean age = 67 (51-83) years) suffering from metastatic bone disease having surgery with bone resection of the humerus (18 proximal humerus replacements (hemiarthroplasty/total-reverse joint = 4/14) and 4 distal humerus replacements) and reconstruction using the SRS prosthesis from May 2014 to January 2017. Kaplan-Meier survival analysis (patient survival) and Aalen-Johansson estimate (incidence of implant failure) presented with 95%-confidence intervals (CI). Results are given as mean (range).

Results:
Two-year overall patient survival was 41% (CI: 20-62%). Five patients suffered from surgical complications: radial nerve palsy (n=2) and superficial postoperative infection (n=3). Two patients experienced revision surgery: soft tissue revision (n=1) and a hemiarthroplasty revised to a reverse total shoulder replacement (n=1). Two-year implant failure incidence was 5% (CI:0-13%). The mean MSTS score (n=6) was 16 (11-25), 221 (95-360) days postoperatively.

Conclusion:
The use of the SRS prosthesis in orthopedic oncology patients resulted in low incidence of implant failure. Since the introduction of the SRS prosthesis in our department represented a shift from using hemiarthroplasty to prefer total-reverse joint implants, the fact that we observed no shoulder dislocations was a positive short-term result.
Which factors are associated with negative surgical margins in soft tissue and bone sarcoma patients? Results from a German-wide cohort study (PROSa-study)

Herr Markus Schuler, Mr. Dimosthenis Andreou, Mr. Stephan Richter, Mr. Peter Hohenberger, Mr. Bernd Kasper, Mr. Daniel Pink, Ms. Henriette Golcher, Mr. Stephen Fung, Ms. Eva Wardelmann, Ms. Karin Arndt, Mr. Vitali Heidt, Mr. Leopold Hentschel, Ms. Maria Eberlein-Gonska, Mr. Martin Bornhäuser, Mr. Jochen Schmitt, Mr. Markus Schuler

1 University Hospital Dresden, Dresden, Germany, 2 University Hospital Muenster, Muenster, Germany, 3 Sarcoma Center Berlin-Brandenburg, Bad Saarow, Germany, 4 Mannheim University Medical Center, Mannheim, Germany, 5 University Medicine Greifswald, Greifswald, Germany, 6 University Hospital Erlangen, Erlangen, Germany, 7 University Hospital Duesseldorf, Duesseldorf, Germany, 8 Das Lebenshaus e.V., Bad Nauheim, Germany, 9 The Scientific Institute of Office-based Hematologists and Oncologists, Cologne, Germany, 10 Helios Hospital Emil von Behring, Berlin, Germany

Introduction:
A wide excision with negative surgical margins (R0-resection) is the local treatment of choice for bone and soft tissue sarcomas. The goal of this study was to evaluate which factors are associated with R0-resections in German sarcoma patients.

Methods:
We analyzed data from 654 adult patients from the Germany-wide PROSa cohort study with bone (22%) and soft tissue (78%) sarcomas, who underwent surgical treatment between 1995 and 2019. Patients with unplanned excisions and patients, whose margin status was not documented or unclear, were excluded from this study. The median age at diagnosis was 51.5 years (IQR, 41.5 – 63.6 years). Contingency tables were analyzed using the chi-square test. Possible predictors for negative surgical margins were evaluated with multivariable logistic regression analysis.

Results:
Negative surgical margins were achieved in 67% of the patients with soft tissue sarcomas and 89% of patients with bone sarcomas (p<0.001). Patients treated in self-designated sarcoma centers (a certification system started in 2018) had a significantly higher probability to have negative surgical margins (OR 2.7 (95%CI, 1.6-4.5)), compared to patients treated outside sarcoma centers. A tumor localization in the extremities was also associated with a higher probability for negative surgical margins, compared to a localization in the axial skeleton or trunk (OR 1.7 (95%CI, 1.2-2.7)). Furthermore, patients who underwent neoadjuvant chemotherapy had a significantly higher probability to have negative surgical margins (OR 3.9 (95%CI, 1.9-8.2)), compared to patients who underwent primary surgery. On the other hand, neoadjuvant radiotherapy was not associated with a higher probability of negative surgical margins, compared to primary surgery (OR 1.01 (95%CI 0.5-2.2).

Conclusions:
Surgical treatment in sarcoma centers appears to be associated with a higher probability for negative surgical margins. Contrary to neoadjuvant radiotherapy, neoadjuvant chemotherapy was also associated with a higher probability for R0 resections in our cohort.
Predictors for the use of biopsy in sarcoma patients and impact of place of biopsy – Results from a German-wide cohort study (PROSa-study)

Mr. Dimosthenis Andreou1,4, Mr. Stephan Richter1, Mr. Peter Hohenberger3, Mr. Bernd Kasper3, Mr. Daniel Pink2,5, Ms. Henriette Golcher6, Mr. Stephen Fung7, Ms. Eva Wardelmann8, Ms. Karin Arndt8, Mr. Vitali Heidt9, Mr. Leopold Hentschel1, Ms. Maria Eberlein-Gonska7, Mr. Martin Bornhäuser1, Mr. Jochen Schmitt1, Mr. Markus Schuler1,10
1University Hospital Dresden, Dresden, Germany, 2Sarcoma Center Berlin-Brandenburg, Bad Saarow, Germany, 3Mannheim University Medical Center, Mannheim, Germany, 4University Hospital Muenster, Muenster, Germany, 5University Medicine Greifswald, Greifswald, Germany, 6University Hospital Erlangen, Erlangen, Germany, 7University Hospital Düsseldorf, Düsseldorf, Germany, 8Das Lebenshaus e.V., Bad Nauheim, Germany, 9The Scientific Institute of Office-based Hematologists and Oncologists, Cologne, Germany, 10Helios Hospital Emil von Behring, Berlin, Germany

Introduction:
The standard approach to sarcoma diagnosis consists of a biopsy prior to treatment, as recommended by guidelines. Our aim was to evaluate which factors are associated with the implementation of biopsies in German sarcoma patients and whether there is a possible correlation between the facility, where the biopsy was performed, and the rate of tumor recurrence or plastic reconstructions in a subgroup of patients with extremity soft tissue sarcomas (STS).

Methods:
We analyzed data from patients from the Germany-wide PROSa cohort study, including 674 adult patients with bone sarcomas (16.6%), STS (73.7%) and GIST (9.6%), diagnosed between 1984 and 2019, whose first treatment was surgery. Patients with small superficial tumors were excluded. The median age at diagnosis amounted to 54.1 years (IQR, 45.0 – 65.7 years). Contingency tables were analyzed using the chi-square test. Possible predictors for a preoperative biopsy were identified using a multivariable logistic regression.

Results:
A pre-treatment biopsy was performed in 59% of the patients. Patients first treated in self-designated sarcoma centers (OR 2.8 (95% CI, 1.7-4.7)) and tertiary hospitals (OR 2.6 (95% CI, 1.6-4.3)) had a significantly higher probability to receive a pre-treatment biopsy. Among 182 patients with extremity STS, 14% underwent plastic reconstruction and 17% developed a local recurrence. Patients who were biopsied in self-designated sarcoma centers had a significantly lower risk for plastic reconstructions (10% vs. 21%, p=0.048) and local recurrences (12% vs. 23%, p=0.043), compared to patients who were biopsied prior to referral to a sarcoma center.

Conclusions:
The probability for a patient to undergo a pre-treatment biopsy is higher in sarcoma centers and tertiary hospitals. Biopsies prior to referral to a sarcoma center were associated with higher local recurrence and plastic reconstruction rates and should be avoided.
Clinical outcomes and prognosis of patients undergoing unplanned excisions of malignant soft tissue tumors

Yohei Asano, Katsuhiro Hayashi, Kentaro Igarashi, Shinji Miwa, Mr. Sei Morinaga, Shiro Saito, Kaoru Tada, Akihiko Takeuchi, Hiroyuki Tsuchiya, Norio Yamamoto, Hirotaka Yonezawa

1Department of Orthopaedic Surgery, Graduate School of Medical Sciences, Kanazawa University, Kanazawa, Japan

Introduction:
It is not uncommon that malignant tumor excisions are performed without the required preoperative imaging, staging, or wide resection margins for sarcomas, possibly leading to the presence of gross residual tumor tissue post-excision. This study aimed to analyze the characteristics of unplanned excision and recurrence, life expectancy, and appropriate treatment.

Methods:
Forty-nine patients who underwent unplanned excision at other hospitals and additional wide excision at our hospital between January 2002 and December 2018 were identified. Among them, 42 patients (24 men and 18 women) with follow-up for more than one year were included in this retrospective study. The relationships between variables and prognosis were statistically analyzed. Survival curves were generated using the Kaplan-Meier method and compared using the log-rank test. Cox regression analysis was used for multivariate analysis.

Results:
Mean patient age was 57.3 years (15–85 years), and the mean observation period was 72.5 months (14–181 months). The 5-year locoregional recurrence-free survival (LRFS) was 53.7 %, 5-year distant metastasis-free survival (DMFS) was 71.7 %, 5-year overall survival (OS) was 90.3 %, and 5-year disease-free survival (DFS) was 48.8 %. Univariate analysis revealed that tumor location influenced the 5-year LRFS (p=0.02) and reconstruction influenced the 5-year DMFS (p=0.01). Multivariate analysis revealed that a positive margin during additional wide excision was significantly associated with a lower 5-year LRFS (p<0.01).

Conclusion:
Surgeons should be aware that a positive margin during additional wide excision is an independent risk factor for local recurrence.
Artificial intelligence and chondrosarcoma: an international validation of the Skeletal Oncology Research Group (SORG) survival algorithm

Mr. Michiel E.R. Bongers², Mr. Aditya V. Karhade³, Mrs. Elisabetta Setola¹, Mr. Marco Gambarotti³, Mr. Olivier Q. Groot², Mrs. Kıvılcım Eren Erdoğan⁴, Mr. Piero Picci⁵, Mr. Tommaso Frisoni⁶, Mr. Davide Maria Donati⁶, Mr. Joseph Schwab², Mrs. Emanuela Palmerini¹

¹Chemotherapy Unit, IRCCS Istituto Ortopedico Rizzoli, Bologna, Italy, ²Department of Orthopaedic Surgery, Division of Orthopaedic Oncology, Massachusetts General Hospital – Harvard Medical School, Boston, United States, ³Department of Pathology, IRCCS Istituto Ortopedico Rizzoli, Bologna, Italy, ⁴Department of Pathology, Cukurova University, Medical Faculty, Adana, Turkey, ⁵Italian Sarcoma Group, Bologna, Italy, ⁶Orthopaedic Unit, IRCCS Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction:
The Skeletal Oncology Research Group (SORG) machine learning algorithm for survival prediction in chondrosarcoma was developed with Surveillance, Epidemiology, and End Results (SEER) registry data. Aim of this study is to validate this algorithm externally, in a non-American patient population.

Methods:
Patients from a European tertiary care center constituted the international validation population. Between 2000 and 2014, 435 patients underwent surgical resection of chondrosarcoma of the bone. All living patients with at least 5-years of follow-up were included. Variables needed for the SORG algorithm (sex, age, histologic subtype, tumor grade, tumor size, tumor extension, and tumor location) were collected. By inputting these variables in the algorithm, predicted probabilities were calculated individually for each patient. Then, performance of the SORG algorithm in the validation cohort was assessed through discrimination, calibration, overall performance, F1-score, and decision curve analysis.

Results:
Validation of the SORG algorithm in a primarily Italian population achieved a c-statistic of 0.86 (95% confidence interval [CI], 0.81-0.90). The calibration plot showed good agreement between predicted probability and observed survival in the probability thresholds 0.8 to 1.0. With predicted survival probabilities lower than 0.8, the SORG algorithm underestimated the observed proportion of patients with 5-year survival, reflected in the overall calibration intercept of 0.80 (95%CI, 0.51-1.08) and calibration slope of 0.79 (95%CI, 0.63-0.95). The Brier score for the 5-year survival algorithm performance was 0.15, compared to a null-model Brier of 0.20. In the validation cohort, the algorithm scored a F1 score of 0.84 (95%CI, 0.80-0.88). The algorithm showed favorable decision curve analysis in the validation cohort.

Conclusions:
The SORG algorithm underestimated 5-year survival for patients chondrosarcoma with predicted probabilities of 0.8 or lower. The differences between international external validation and previous USA-based studies may reflect baseline differences between the two study populations. Open-access digital application for the algorithm: https://sorg-apps.shinyapps.io/extremitymetssurvival/.
Multidrug resistance Protein 1 silencing in osteosarcoma and chondrosarcoma cell lines

Mrs. Sarah Stammose Freund¹, Mr. Michael M Bendtsen¹, Mr. Akmal Safwat², Mr. Peter Holmberg Jørgensen¹
¹Aarhus University Hospital, Department of Orthopedics, Sarcoma Center, Aarhus, Denmark, ²Aarhus University Hospital, Department of Oncology, Sarcoma Center, Aarhus, Denmark

Introduction:
The poor response of metastatic osteo- and chondrosarcomas to chemotherapy could be the result of multi-drug resistance (MDR), which may be overcome through the use of small interfering RNA (siRNA). However, several methodologic questions are still unresolved. The aim of this study was to test the toxicity of three commonly used siRNA transfection reagents and apply the least toxic reagent to investigate the siRNA induced MDR1 mRNA knockdown.

Methods:
The toxicity of TransIT-TKO, Lipofectamine 2000, and X-tremeGENE siRNA transfection reagents was investigated on osteosarcoma (MG-63) and chondrosarcoma (SW1353) cell lines. The toxicity was measured at 4 and 24 hours using a MTT toxicity assay. The least toxic transfection reagent was applied to investigate the siRNA induced MDR1 mRNA knockdown effect using qRT-PCR. Furthermore, five housekeeping genes were assessed in the BestKeeper program to obtain mRNA expression normalization.

Results:
Lipofectamine 2000 was the least toxic transfection reagent reducing the cell viability only in chondrosarcomas 24 hour following the exposure to the highest dose. In contrast, TransIT-TKO and X-tremeGENE transfection reagents displayed a significant reduction in cell viability in both chondrosarcomas after 4 hours and in osteosarcomas after 24 hours. Significant MDR1 mRNA silencing of over 80% was achieved in osteo- and chondrosarcomas using Lipofectamine and a final siRNA concentration of 25 nM. No significant dose-response was observed in knockdown efficiency in either Lipofectamine or siRNA concentration.

Conclusion:
Lipofectamine 2000 was the least toxic transfection reagent in osteo- and chondrosarcomas. Successful siRNA induced MDR1 mRNA silencing over 80% was achieved.
Patients’ Perceptions of Changes and Consequences after Tumor Resection. A Qualitative Study in Austrian Patients with musculoskeletal Malignancies.

Ms. Carmen Trost, Mr. Stephan Heisinger, Mr. Philipp Theodor Funovics, Mr. Reinhard Windhager, Mr. Gerhard Martin Hobusch, Mrs. Tanja Stamm

1Medical University Of Vienna Department Orthopedics and Trauma-Surgery, Vienna, Austria, 2Medical University of Vienna Center for Medical Statistics, Informatics and Intelligent Systems, Institute of Outcome Research, Vienna, Austria

Introduction:
The aim of this study was to investigate how patients with musculoskeletal malignancies develop a concept of their disease and how they cope with the impact and consequences of treatments after surgery.

Methods:
Two narrative, 11 guided and three expert interviews (surgeon, physical therapist, and patient advocate) were conducted and transcribed verbatim. Data collection and analysis were done alternately until data saturation was reached. A constructivist Grounded Theory approach was followed to generate a theory based on systematically and simultaneously collected and analyzed qualitative data. The main category was identified and the theoretical model around the affected person was described.

Results:
"Movement" had to be recovered to get a feeling of "normality" and depended on the "individuality" of the affected person. In addition, support from the relatives/partners and the general practitioner were essential for the patients.

Conclusion:
Considering these findings could be helpful in creating a patient information system, involving General Practitioners and a personal network to support and speed up recovery.
Juxta-articular distal femur resection sparing knee joint with custom made surgical guide.

Mrs. Benedetta Spazzoli¹, Mr. Marco Focaccia¹, Mr. Alessandro Bruschi¹, Mr. Tommaso Frisoni¹, Mr. Luca Cevolani¹, Mr. Stefano Pasini, Mr. Davide Maria Donati¹

Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction:
Juxta-articular distal femur resection sparing knee joint in malignant bone tumors can be a risky procedure due to the possible outcome of positive margins or fracture of the articular bone. The usual approach in malignant bone tumors close to the joint more than 6 cms is resection and joint replacement. Custom made surgical guides can be a useful device to help surgeon to perform osteotomies and to trim the bone allograft and fit the surgical gap. The aim of this study is to assess oncological, radiographical and functional results.

Methods:
We retrospectively analyzed cases with malignant bone tumor in the distal femur closer than 6 cms treated with intercalary reconstruction. The mean follow-up was 32.8 month (12-44). We compared cases performed with and without guides. Radiological evaluation on postoperative and at 3, 6, and 12 months X-ray films was performed looking to the host allograft contact scoring from 0 (no contact) to 4 (full contact). Functional evaluation (MSTS score, IKDC) and quality of life (SF-12) were assessed.

Results:
From 2012 to 2019, 7 patients matching criteria: 3 were treated with guides and 4 without them. In the first group, radiological findings showed full cortical contact and bone fusion at 6 months in all cases. In the second group, full cortical contact was present in 1 patient and bone fusion at 6 months in 2. Functional evaluation showed low level of pain in both and satisfied ROM and gait better in cases with guides. Among cases without guides, 3 had complications, 2 with reoperation.

Conclusion:
The use of custom made surgical guides in juxta-articular distal femur bone tumors, can help to better perform osteotomies even in cases markedly close to the articular joint. These cases presented also better results in terms of complications, time of bone fusion and functional scores.
Comparison of non-vascularized and vascularised fibula grafts in reconstruction of tumor bone defects at the extremities – a single center experience with mid-to longterm results

Mr. Andreas H. Krieg1,2, Mr. Chao Dong1,2, Ms. Sabrina Gorski2,3, Mr. Martin Haug2,3
1Paediatric Orthopaedic Department, University Children’s Hospital (UKBB), Basel, Switzerland, 2Bone and Soft Tissue Tumor Center (KWUB), University Hospital of Basel, Basel, Switzerland, 3Departement of Plastic and Handsurgery, University Hospital, Basel, Switzerland

Introduction:
Vascularised (VFG) and Non-vascularised fibula grafts (NVFG) were widely used in reconstruction of segmental bone defects after tumor resection. We compared both types of autograft and its results, its risk factors and complications.

Methods:
Between 1976 and 2018, our institute performed bone tumor resection and reconstruction by using VFG (n=17) and NVFG (n=36) in 53 patients (3- 65 years age, mean: 21.2 ± 13.2 years) with 24 of them were female. Malignant bone tumors were diagnosed in 29 patients (VFG = 16 patients - 94%). The mean follow-up was 14.9 years (range from 1.5 to 43 years). Factors like fracture, non-/union, infection, graft size and donor site morbidity were analyzed.

Results:
All over75 struts of fibula totally were taken. The mean length of fibula was 11.3 cm (10.2 in NVFG and 14.9 in VFG). The mean union time was 13 months (6 to 25 months) overall. However, VFG revealed union after a mean of 10.5 months, NVFG after 5.9 months. The overall hypertrophy was found in 65 of 75 grafts (86.7%) and consolidation was found in 69 (92%). Hypertrophy rate was similar in VFG (85.3%) and NVFG (87.1%). Complication rate in VFG was 41 % and in NVFG 25 %. There were documented 7 fractures (13%), 4 infections (7.5%) and nonunion in 5 patients (9.4%). The chemotherapy was the only negative prognosis factor of the union time (p=0.021).

Conclusion:
Vascularised and Non-vascularised fibula grafts were both techniques with effective and successful results in reconstruction of segmental tumor bone defects. NVFG showed comparable results to the VFG with lower complication rate but it is limited in indication by the size for greater defects, malignant tumors and the site. Chemotherapy is an adverse factor leading to prolonged union time in both techniques.
Physical function is reduced and associated to quality of life after limb-sparing surgery due to bone sarcoma

**Mrs. Linda Fernandes¹, Mr. Allan Villadsen², Mrs. Christina Enciso Holm³, Mrs. Michala Skovlund Sørensen², Mrs. Mette K Zebis¹, Mr. Michael Mørk Petersen²**

¹University College Copenhagen, Copenhagen, Denmark, ²University Hospital Rigshospitalet, Dept. Orthopedic surgery, Copenhagen, Denmark

**Introduction:**
Patients with bone sarcoma report that quality of life (QoL) is affected years after treatment. In rehabilitation, patients’ QoL is taken into account, however QoL is a complex construct and little is known about modifiable factors. The purpose was to investigate if physical function in patients with bone sarcoma receiving resection and reconstruction surgery with a tumour-prosthesis was affected and associated with QoL.

**Methods:**
Thirty patients operated (proximal femur (n=12), distal femur (n=14), proximal tibia (n=4)) between 2006 and 2016 were compared to 30 matched controls in a cross-sectional design. Differences between groups (Paired samples t-test) were tested for objectively measured physical function: isometric muscle strength in gluteus medius and quadriceps, six-minute walk test (6MWT) and 30s sit-to-stand test (STS). With-in the patient group, objective physical function was correlated (Spearman’s rank correlation) with EORTC QLQ-C30 Global Health (GH) and Physical functioning (PF) subscales.

**Results:**
Mean age of participants was 51 years and mean BMI 26. Significant (statistical and clinical) differences were found for all muscle strength tests between the two groups, both for comparisons of the leg that underwent surgery and the contralateral leg. Significant differences were also seen for the 6MWT (499 vs. 607 m, p<0.001) and the STS (12 vs. 18, p<0.001). Hip abduction strength correlated with GH (rho 0.43, p=0.019) and with PF (rho 0.51, p=0.006), and knee extension strength correlated with PF (rho 0.40, p=0.034).

**Conclusion:**
Patients with bone sarcoma going through resection of bone and reconstruction with a tumour-prosthesis in lower extremity showed deficits in muscle strength bilaterally, walking speed and chair standing capacity when compared to controls. Muscle strength deficits were associated to lower PF and GH, indicating that muscle strength influence the perception of health related QoL. Muscle strength is modifiable in intact muscles and may be targeted in post-operative care.
Segmental diaphyseal bone defect reconstruction using vascularized fibula. First single institution experience.

Mr. Lauris Repsa

1Hospital of Traumatology and Orthopaedics, Riga, Latvia

Introduction:
In literature are described several diaphyseal bone reconstruction methods after primary malignancy resection-endoprosthetic reconstruction, bone recycling, bone transport, allograft, non-vascularized fibula reconstruction and vascularized bone reconstruction. Each of them have advantages and disadvantages. I will share my experience of diaphyseal segmental bone defect reconstruction using vascularized fibula graft.

Method:
Retrospective study of 2 consecutive cases, where aforementioned reconstruction method were applied.

Results:
1. case was 25 y.o. girl with pain in her left shin. Previously received 3x treated as osteomielitis, after last recurrence histological samples proved Ewing’s sarcoma. Received chemotherapy after regime EURO-EWING 99. Response rate was poor, <90% necrosis. Segmente resection of 23 cm was performed and reconstruction with contralateral vascularised fibula, osteosynthesis with locking plate. In 1 week partial necrosis of skin flap, soft tissue reconstruction with medial gastrocnemius flap, after one more week total soft tissue necrosis and secondary infection. In revision surgery fibula component was alive, hardware were changed and soft tissue reconstruction with toracodorsal flap. After 1 year she is FOD, full weight bearing.
2. case is 30 y.o. girl with 8 months lasting pain in right upper arm. Pathologic fracture occured. In histological examination- Low grade Ostesarcoma. In first stage surgery was performed- tumor resection (12 cm of humerus bone) and reconstruction with vascularized fibula. After surgery total plexus brachialis palsy was observed for unknown reasons. She received adjuvant chemotherapy, physiotherapy for nerves damage, wich fully recovered after 8 months. She is FOD, with fully functional right hand.

Conclusion:
Vascularized segmental bone reconstruction is usefull method for bone reconstruciton, but it is associated with high short- term complication rate and excellent long term results.
Physeal distraction before excision of metaphyseal malignant bone tumors in children

Mr. Roberto Velez1, Mr. Daniel Pacha1, Mr. Marius Aguirre1
1Hospital Vall De Hebron, Barcelona, Spain

Introduction:
Physeal distraction technique, described by Cañadell, enables metaphyseal bone tumor resection in pediatric patients whilst preserving the joint. The objective is to assess its oncologic safety and complication rates.

Methods:
We performed a retrospective review of this technique from 2008 to 2018. Gender, age, diagnosis, tumor location, duration of distraction, delay to definitive resection, resection length, graft used, margins, and orthopaedic or oncologic complications were recorded. MSTS functional score was evaluated at a minimum of 12 months of follow-up.

Results:
Seven patients (5 boys and 2 girls) on average 8 years old (4-13y) with malignant metaphyseal bone tumors underwent physeal distraction as the first stage in tumor resection and had an average follow up of 65.8 months (12-144). Six patients had Ewing’s Sarcoma and one patient had an osteosarcoma. Their location was: proximal tibia (3), distal femur, proximal humerus, distal radius and distal fibula. Physeal distraction lasted 10.7 days (3-15) and delay to definitive resection was 17.2 days (13-22). Resection length was on average 11.5 cms (9-14) and an allograft was used in 5 patients, the others recieved one fibula autograft and one vascularized fibula. All patients underwent neoadyuvant and adyuvant chemotherapy, one patient received adyuvant radiotherapy, and they all had negative margins. There were no local recurrences and three patients had disease progression with metastasis and died. Complications related to the procedure were: one patient had pin infection, one patient had surgical site infection, and 2 patients had non union of the diaphyseal junction. The mean MSTS score was 75% (53%-97%). All physeal distractions were successful although one patient whom soft tissue margins were deemed too close intraoperatively underwent a definitive transepiphyseal resection.

Conclusions:
We consider that the physeal distraction technique is an oncologically safe option with good functional results in the treatment of metaphyseal pediatric malignant tumors.
Elbow joint reconstruction using MUTARS Distal humerus endoprosthesis

Mr. Lauris Repsa
1Hospital of Traumaology and Orthopaedics, Riga, Latvia

Introduction:
Primary malignancy around elbow joint is rare. More common are metastatic lesions of distal humerus. Despite of primary origin, life quality after distal humerus pathologic fracture, is poor. Osteosynthesis worsens general prognosis, en-block resection is with better overall and functional result.

Methods:
Retrospective study was carried-out. In year 2019 in Hospital of traumatology and orthopaedics were performed 3 distal humerus resection and reconstruction using MUTARS distal hymerus endoprosthesis.

Results:
3 patient with distal humerus pathologic fracture were treated in year 2019. All 3 cases were pathologic fractures due to other malignancies. In 1 case- small cell pulmonaly CA MTS, in other 2 cases primary origin was renal cell carcinoma. In all cases injured was right arm. Fine-needle biopsies were carried out in all cases. In all cases intra-articular resections were performed, length or reconstruction- 12 cm. In all cases uncemented implants was used, no nerve injury occurred during operation. Length of surgery was 2,5-4,5 h, average blood loss- 350 ml. All patients survived at least 6 months after surgery (Pulmonary CA MTS patient more than 1 year). MSTS score was close to maximum, in average 28. Patients after surgery were able to play billiard or even chop wood.

Conclusion:
Elbow joint reconstruction using elbow prosthesis gives excellent functional results in patients with pathologic fractures of distal humerus. We have no enough data for long-term results and complications, but it significantly improves quality of life.
Retrospective evaluation of silver coated tumour prostheses in complex joint infection with major bone destruction: about 24 cases with 46 months follow up.

Mr. Fabrice Fiorenza¹, Mr JP Bernard¹, Mr. Armand Garot¹, Mr. Julien Boscher², Ms Céline Cuenca¹, Mr Jeremy Hardy¹, Mr. Alexandre Picouleau¹, Mr. Christian Martin², Mrs. Hélène Durox³, Mr. JL Charissoux¹

¹Dupuytren Teaching Hospital, Orthopaedics department, Limoges, France, ²Dupuytren Teaching Hospital, Bacteriology Department, Limoges, France, ³Dupuytren Teaching Hospital, Infectious Disease Department, Limoges, France

Introduction:
Complex prosthetic joint infection (PJI) often require an aggressive surgical debridement that can lead to major bone loss. Reconstruction can be difficult in such cases and the use of a silver coated tumour prosthesis is an interesting option.

Methods:
It is a retrospective study. Our series included 24 patients with complex PJI all operated in our reference centre for PJI. There were 16 men and 8 women. Mean age was 69 (50 to 89). There were 7 proximal femur, 8 distal femur, 5 knee arthrodesis, 1 total femur, 1 proximal humerus, 1 ice cream cone prosthesis and 1 bipolar reconstruction using an ice cream cone and a proximal femur endoprosthesis. Each case was discussed in our reference centre with a multidisciplinary team and treatment included systemic antibiotics with a 2 stage revision procedure for 19 patients and 1 stage revision surgery for 5 patients.

Results:
Mean follow-up was 46 months (7 -168). On average each patient had 2.1 germ (1-10). 59 % of the germs were Staphylococcus spp (Staphylococcus aureus: 30%, coagulase negative Staphylococcus: 70%). Each patient had from 3 to 10 operations before the final silver coated prosthesis (Mutars® prostheses, ImplantCast, Germany) was implanted. At last follow up, 5 patients had chronic infection: 3 were dead of other cause (2 with chronic fistulisation) and 2 were alive with a thigh amputation because of painful chronic infection. The overall infection rate was 33% (8/24) with 21 % (5/24) of chronic infection and 12% (3/24) of acute infection successfully treated with a DAIR procedure.

Conclusion:
The overall success rate in controlling infection with this treatment strategy using silver coated tumour implants and systemic antibiotics was 79 % at 46 months in this short series. The authors recommend the use of silver coated implants in complex joint infection with major bone destruction.
Early Outcomes in Modular Prostheses of the knee and Physical Recovery

Mr. Georgian Iacobescu1,2, Mr. Dan Popescu1, Mr. Adrian Cursaru1,2, Mr. Florin-Catalin Cirstoiu1,2

1University and Emergency Hospital of Bucharest, Bucharest, Romania, 2Carol Davila University of Medicine and Pharmacy Bucharest, Bucharest, Romania

Introduction:
Resection arthroplasty is frequently used in the treatment of proximal tibia and distal femur in primary and metastatic bone tumors. The use of Modular Prostheses permits early limb loading and improvements in physical recovery and performance.

Aim:
The purpose of this study was to determine the early treatment outcomes of modular endoprosthetic replacement and to evaluate physical recovery after surgery.
To establish a correlation between the extent of resection, tumor size and physical recovery and performance.

Material and methods:
We included 13 patients (5 women and 8 men) with distal femoral and proximal tibia bone tumors who had modular prostheses surgery in the Orthopaedic and Traumatology Department in University and Emergency Hospital of Bucharest between 2014 and 2019. Pain intensity was evaluated using Visual Analogue Scale (VAS). Musculoskeletal tumor society score (MSTS) and Harris hip score (HHS) were used to assess the functional outcomes. We also analysed the length of the resection and the dimensions (weight and volume) of the tumor.

Results:
Mean age of the patients was 49.3 (range 18-64 years).
Mean duration of spitalization was 17 days (13-20 days).
The intensity of pain had decreased at a 6 weeks follow-up from a mean of 6.4 points to 3.8 points. Recovery and physical performance assessed with HHS and MSTS scores were 75 and 20 points, showing improvements. The mean tumour weight was 238 g (120-465g), while the mean length of the implant was 11 cm.
Two patients experienced complications with superficial infection of the wound.

Conclusions:
The use of modular prostheses for bone tumor leads to good functional outcomes with early rehabilitation which improves the patients quality of life. The dimensions of the tumour might have a significance in the postoperative functional results.
Re-excision after R1 resection of soft-tissue of limb and trunk wall sarcomas improves overall survival of patients operated in a non reference center. A nation-wide study on 1 284 patients.

Mr. Francois Gouin¹, Mrs. Sylvie Bonvalot¹, Mr. Eberhard Stoeckle¹, Mr. Charles Honoré¹, Mr. Gualter Vaz¹, Mr. Antonio Di Marco¹, Mr Pierre Meeus¹, Mr. Gwennael Ferron¹, Mr. Jean Camille Mettei¹, Mr. Mickael Ropas¹, Mr. Louis-Romée Le Nail³, Mr. Vincent Crenn³, Mr. Francois Sirveaux³, Mr. Philippe Anract³, Mr. Sebastien Carrere³, Mr. Jean Yves Blay³

¹Centre Leon Berard, Lyon, France

Introduction:
R1 margins after resection of limb and trunk wall soft tissue sarcomas (STS) occur up to 38%. We previously reported that secondary resection (RE) after unplanned 1st excision improved local relapse free (LRFS) but not overall survival (OS) in a retrospective series. Here we investigated the impact RE specifically after a first R1 resection carried out of a reference center.

Patients:
Netsarc is the expert sarcoma network in France. All patients from Netsarc database with STS of limb and trunk wall firstly operated outside of a Netsarc center and who had a R1 resection between 2010 and 2017 were retrospectively analyzed.

Results:
1284 patients met criteria for inclusion, 707 (55.1%) were male, mean age 58 ± 19y.o. 558 (43.5%) tumors were located in lower limb, 423 (32.9%) in trunk wall, 303 (23.6%) in upper limb. 745 (61.9%) were deep-seated. Among these 1284 pts, 698 (67.8%) were systematically reoperated (RE).
Age at diagnosis, site, size of the tumor, histology, presentation to MDT before treatment, were different between RE and non-RE pts.
OS on Multivariate analysis showed that RE were associated with a better OS than NoRE (HR=0.38, 95% CI [0.24;0.59], p<0.0001). Multivariate analysis also showed that obtaining R0 final margins is associated a with better OS than when final margins status is R1 (HR=0.44, 95% CI [0.27;0.70]) (p<0.0001).
Progression free survival and local recurrence free survival were also better in RE population.
Survival analysis showed that all patients except those with a synovialsarcoma will benefit from RE, mainly those with small tumors an grade 1 and 2 tumors

Discussion:
This study shows from of a large national database, that overall survival of patients re-operated after R1 resection might expected to be improved. Limitations of this study are multicenter study, missing data and non-considering (neo) adjuvant treatments.
Genomic landscape and identification of therapeutic targets in Clear Cell Sarcoma.

Mr. Dawid Krzeciesa¹, Mr. Thomas Mühlenberg¹, Ms. Susanne Grunewald¹, Ms. Stefanie Bertram², Mr. Hans-Ulrich Schildhaus², Mr. Christian Britschgi³, Mr. Charles Keller⁴, Mr. Johannes Köster⁵, Mr. Sebastian Bauer¹

¹Translational Sarcoma Research Group / University Hospital Essen, Essen, Germany, ²Institute of Pathology / University Hospital Essen, Essen, Germany, ³Department of Medical Oncology and Hematology / University Hospital Zürich, Zürich, Switzerland, ⁴Children’s Cancer Therapy Development Institute, Beaverton, United States, ⁵Human genetics/ AG Genome informatics / University Hospital Essen, Essen, Germany

Introduction:
Clear Cell Sarcoma (CCS) represent a rare sarcoma with an unusually aggressive phenotype (frequent in-transit, lymphatic and early distant metastases). Translocations resulting in chimeric genes involving EWSR1 with either ATF1 or rarely CREB1 or CREM represent the defining molecular event. As of today, no effective treatment is available and 5-year survival is 59%. Bioinformatics analyses and novel disease models are urgently needed to identify and validate therapeutic vulnerabilities.

Methods:
Next generation sequencing (NGS), including whole genome, exome, and transcriptome data of 21 CCS patients and three CCS cell lines were collected. A new variant calling approach (Varlociraptor) as well as gene fusion calling (Arriba) and somatic copy number alternation (SCNA) analysis (CNVkit; GISTIC2) were optimized on a training data set and then applied to the CCS cohort.

Results:
Variant calling revealed only few variants in cancer associated genes. Apart from the characteristic CCS fusion, Arriba called very few other gene fusions, all of which have not been previously reported. SCNA analyses revealed a loss of 9p21.3 in 12/21 patients. One of the genes in this locus is CDKN2A, frequently lost in cancer. In 2/3 novel CCS cell lines, we detected loss of CDKN2A as well.
Importantly, we could not identify additional recurrent, therapeutically relevant variants (such as single nucleotide variants or small insertions/deletions) or gene fusions.

Conclusion:
We here report the first worldwide CCS genomic landscape, revealing a recurrent loss of CDKN2A in about half of the patients. Given the rarity of CCS, it is likely the largest NGS dataset ever reported for this disease. Our novel CCS cell line models will allow us validation of CDKN2A loss as a therapeutic vulnerability, by evaluation of CDK4-inhibitors.
Image-Guided Percutaneous Biopsy for the Diagnosis of Musculoskeletal Tumors

Mr. Pietro Ruggieri, Dr. Giulia Trovarelli, Dr. Ivette Castaneda-Martinez, Dr. Elisa Pala, Dr. Andrea Angelini

University of Padova - Italy, Padova, Italy

Introduction:
Biopsy is the last step of the staging of musculoskeletal tumor. It represents a compromise between needing to have significant tissue and needing to avoid dissemination. Aims of this study were to evaluate the diagnostic accuracy and incidence of complications of percutaneous biopsy in the diagnosis of musculoskeletal lesions.

Methods:
This is a retrospective analysis of imaging-guided percutaneous biopsies performed in patients with bone or soft tissue lesions at our Institution. From January 2016 to September 2019, 722 image-guided percutaneous biopsies were performed: ultrasound-guided with tru-cut needle of a 14-gauge in soft tissue lesion (322 cases), and guided by fluoroscopy (376 cases) or by CT (24 cases) in bone lesions (400 cases) with a core needle of an 8-gauge.

Results:
Tru-cut needle biopsy was diagnostic in 92% of cases, with a diagnostic accuracy of 93%. Core needle biopsy was diagnostic in 96% of cases, with a diagnostic accuracy of 98%. No complications were observed.

Conclusions:
Correct biopsy requires: (1) choosing approach on the base of subsequent surgical approach for tumor resection in order to be able to remove needle track; (2) avoiding contamination of compartments not involved by tumor; (3) providing significant/adequate samples containing vital tumor cells. Percutaneous needle biopsy has many advantages compared to open biopsy: it is a safe, minimal invasive and cost-effective technique to obtain adequate samples for diagnosing of bone and soft tissue lesions. Close communication among the surgeon, radiologist, and pathologist is imperative for arriving at the correct diagnosis of the musculoskeletal lesions. Image-guided percutaneous biopsy should become the gold standard for diagnosis of musculoskeletal lesions. Biopsy should be performed in Referral Centers.
Treatment of pseudotumors in hip prostheses revision surgery

Mr. Pietro Ruggieri1, Dr. Andrea Angelini1, Dr. Giulia Trovarelli1, Dr. Elisa Pagliarini1, Dr. Elisa Pala1, Dr. Antonio Berizzi1

1University of Padova - Italy, Padova, Italy

Introduction:
Aseptic lymphocyte-dominated vasculitis-associated lesion (ALVAL) development (including pseudotumors) secondary to metal debris generation around total hip arthroplasties is a well-recognized histopathologic phenomenon. The complexity of treatment of such condition lies in periprosthetic osteolysis and in extensive damage to the soft tissues, which compromise the stability of the revision implant. Aim was to report preliminary results of complex revision surgery for hip prosthesis in patients suffering from “pseudotumor”, analyzing 1) implant survival, 2) incidence of complications and 3) functional results.

Methods:
We retrospectively analyzed patients surgically treated at our Institution with “pseudotumor” associated with hip prosthesis, between June 2016 and May 2019. We included 14 patients (3 males and 11 females) with a mean age of 68 years (range, 50-80 yrs). One patient was treated with excision only, whereas prosthesis revision was required in other, using standard (6 cases) or custom-made 3D-printed prostheses (7 cases). Complications classified as acute (intra-operative), early (within 6 months), late (after 6 months). The functional results were assessed prior and after the surgery, using the Harris Hip Score.

Results: At a mean follow-up of 19 months (range, 3-39 months), four patients (28%) reported as early complications a wound dehiscence requiring surgical debridement without implant removal. Survival rate to all complications was of 71%. Functional results were excellent in all patients. Harris Hip Score ranged from a mean pre-operative score of 35 (range 18-45) to a mean post-operative score of 74 (range 60-89).

Conclusions:
Prosthetic revision associated with pseudotumor excision is the key of treatment; it can be performed in a single or in two stages surgery. The prosthetic revision can be performed with standard revision prostheses or custom-made prostheses, depending on the type of bone defect. The use of custom-made 3D-printed prostheses is increasing and, in such a case, two-stage revision is advisable.
Multidisciplinary approach in musculoskeletal oncology: collaboration between vascular and orthopedic surgeon in complex cases.

Mr. Pietro Ruggieri, Dr. Andrea Angelini, Dr. Giulia Trovarelli, Dr. Elisa Pagliarini, Dr. Andrea Spertino, Dr. Elisa Pala, Dr. Michele Piazza

1University of Padova - Italy, Padova, Italy

Introduction:
The standard of treatment for bone and soft-tissue sarcoma is limb-sparing surgery. Vascular surgeon may be included in the multidisciplinary team to preserve limb viability and function while completely excising the tumor with adequate margins, if the tumor is close to vessels. Aim of study was to evaluate our experience in operative treatment and outcome of complex musculoskeletal tumor resections, where there was a need of collaboration between vascular and orthopedic surgeon.

Methods:
A retrospective review was performed of all patients who underwent soft tissue or bone resection between October 2015 and February 2019, recording tumor characteristics, type of orthopedic and vascular procedures, oncologic and vascular outcomes and complications.

Results. Seventy-four patients were treated in conjunction with both orthopedic and vascular surgeon: there were 37 male and 37 female, treated for primary or metastatic bone tumor (44 cases), soft tissue tumor (20 cases) or complications of previous oncologic surgery (10 cases). Mean age was 46 years (range 9 – 88 years). The mean follow-up was 17 months (range 6 – 44 months). Patients underwent curettage (3 cases), bone resection and reconstruction (36 cases), soft tissue excision (17 cases), amputation (8 cases) and revision surgery (10 cases). The vascular procedures included: 64 (86%) vascular dissection/protection/ligation and 10 (14%) vascular reconstruction with vascular bypass/patch/termino-terminal vascular anastomosis. There were no intraoperative/perioperative deaths. Major complications that required further surgery were reported in 11 cases and amputation was performed 2 cases. No arterial bypass occluded during the follow-up, 2 out of 4 venous bypasses occluded but without major complications.

Conclusions:
Wide surgical margins are mandatory in treatment of sarcomas, and could be obtained also when important vessels are involved. A multidisciplinary approach with preoperative consultation between orthopedic and vascular surgeon may lead to a reduced rate of peri- and postoperative complications optimizing complex resections.
Intramedullary nailing for impending or pathologic fracture of the long bone: titanium vs carbon fiber peek nailing

Mr. Pietro Ruggieri¹, Dr. Elisa Pala¹, Dr. Alberto Procura¹, Dr. Giulia Trovarelli¹, Dr. Andrea Angelini¹, Dr. Antonio Berizzi¹
¹University of Padova - Italy, Padova, Italy

Introduction:
Indications for resection and prosthetic reconstructions also in metastatic patients are increasing; however, intramedullary nailing is still indicated for metaphyseal and diaphyseal fracture in patients with advanced cancer stage. Carbon fiber nails offer the advantages of better visualization of the lesion during the follow-up, to reduce the radiotherapy field with higher healing and union rate of the lesion. Aim of the study was to compare titanium and carbon fiber nailing, evaluating: 1) response to radiotherapy with callus formation and local control, 2) incidence of failures

Methods:
Between October 2015 and November 2019, 28 patients were treated for impending or pathologic fracture of long bones due to metastasis. Sites were: femur diaphysis (16), proximal femur (5), humerus (6), tibia (1). Carbon fiber peek nails (Carbofix®) were used in 8 cases: 6 femoral and 2 humeral nails. Mean dose of post-operative radiotherapy was 20 Gy.

Results:
At a mean follow-up of 4.5 months, 10 patients were DWD and 18 were AWD. No complications were observed in the carbon fiber nail group while one case of wound dehiscence, treated with debridement, was observed in the titanium nail group. Signs of radiographic consolidation were assessed in 4 patients (50%) treated with carbon fiber peek nails and in 6 (33%) treated with titanium nail. Time of surgery was similar in both group.

Conclusion:
Intramedullary nails are still indicated for metaphyseal and diaphyseal fracture in patients with advanced cancer stage. Carbon fiber nails have the advantage of lower CT artifacts allowing better target volume centering for radiotherapy. Our series confirmed a better union rate and local control after radiotherapy in carbon fiber nail. Time of carbon fiber nail positioning and radiological exposure are similar to other titanium intramedullary nail. Multicentric studies and larger series are needed to confirm the advantage of these types of nails.
Sunitinib effectively reduces the viability of tumor stromal cells in a giant cell tumor of bone

Mr. Michal Mahdal1, Mr. Jakub Neradil2,4, Mrs. Silvia Paukovcekova2, Mrs. Iva Staniczkova Zambo3,4, Mr. Lukas Pazourek1, Mrs. Renata Veselska2,4, Mr. Tomáš Tomáš1

1Department of Orthopedic Surgery, St. Anne’s University Hospital, Faculty of Medicine, Masaryk University, Brno, Czech Republic, 2Laboratory of Tumor Biology, Department of Experimental Biology, School of Science, Masaryk University, Brno, Czech Republic, 3Pathology Department, St. Anne’s University Hospital, Faculty of Medicine, Masaryk University, Brno, Czech Republic, 4International Clinical Research Center, St. Anne’s University Hospital, Brno, Czech Republic

Introduction:
Giant cell tumor of bone is an intermediate type of primary bone tumor characterized by local aggressive growth with metastatic potential. Histologically, giant-cell tumor of bone contains 2 groups of cells, osteoclast-like giant cells and mononuclear neoplastic (stromal) cells. The stromal cells express RANK ligand, and via the RANK-RANK ligand pathway, they activate osteoclasts. Denosumab is a human monoclonal antibody against RANK ligand that inhibits osteoclasts.

Methods:
Tissue samples were obtained from 13 patients: 8 samples from patients after denosumab treatment and 5 samples from patients not treated with denosumab. Tissue samples were analyzed for phosphorylation of receptor tyrosine kinases using the Proteome Profiler Human Phospho-RTK Array Kit. Tumor cells derived from tissue samples were cultured in the presence or absence of denosumab or sunitinib (tyrosine kinase inhibitor) or combinations of the two. The MTT assay was used to analyze the proliferation and viability of cells after treatment with both inhibitors.

Results:
The tumor tissue samples showed specific patterns of receptor tyrosine kinase phosphorylation. There was increased phosphorylation of M-CSFR, InsR, and PDGFRβ, as well as CREB and ERK1/2. Statistically significant elevation of phosphorylation of EGFR, IGF-IR and HSP27 was observed in samples obtained after denosumab treatment. Nevertheless, all cell lines treated with 10 µM sunitinib (platelet-derived growth factor receptors inhibitor) showed a significant decrease in cell viability, which was not modified by therapeutic concentrations of denosumab. The data were analyzed using one-way ANOVA followed by the Scheffé post hoc test.

Conclusion:
Sunitinib is a multi-targeted receptor tyrosine kinase inhibitor, which is responsible for significantly reducing the viability of tumor stromal cells. Treatment with denosumab in combination with sunitinib could be an effective type of targeted treatment in locally advanced tumors and metastatic disease.

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Gene expression profiles correlating with tumor inflammatory response in myxoid liposarcomas, synovial sarcomas and myxofibrosarcomas

Mr. Moritz Goetz¹, Mrs. Yvonne Krause³, Mrs. Stefanie Bertram¹, Mr. Arne Streitbürger³, Mr. Jendrik Hardes², Mrs. Wiebke Guder², Mr. Lars Erik Podleska³, Mr. Sebastian Bauer³, Mr. Rainer Hamacher³, Mr. Hans-Ulrich Schildhaus¹

¹Institute of Pathology, University Hospital of Essen, University of Duisburg-Essen, Essen, Germany, ²Department of Musculoskeletal Oncology, University Hospital of Essen, University of Duisburg-Essen, Essen, Germany, ³West German Cancer Center, Department of Medical Oncology, University Hospital of Essen, University of Duisburg-Essen, Essen, Germany

Introduction:
Immuno-oncologic therapy is an emerging field in the treatment of advanced soft tissue tumors. Until now, several biomarkers (e.g., tumor mutational burden, expression of PD-L1 etc.) have been discussed as predictors for clinical response to immuno-oncologic treatment. However, some of these features were infrequently found in mesenchymal malignancies. We aimed to investigate comprehensively the expression of more than 500 genes which are involved in immuno-response of tumors and to correlate these findings with NY-ESO-1 expression and tumor infiltrating inflammatory cells.

Methods:
A series of 70 soft tissue tumor specimens (consisting of synovial sarcomas, myxoid liposarcomas and myxofibrosarcomas) were analyzed by immunohistochemical staining for NY-ESO-1 expression and using nuclease protection assay (HTG Immuno-Oncology Assay) to determine gene expression. Data were correlated with expression of PD-L1 and the amount of inflammatory cells in tissue highlighted by immunohistochemical staining.

Results:
NY-ESO-1 was found to be highest in myxoid liposarcoma followed by synovial sarcoma, which showed heterogeneous expression, and myxofibrosarcoma with the lowest prevalence. PD-L1 was only expressed in a subset of cases. Expression of NY-ESO-1 correlated with diagnosis and showed evidence for correlation to amount of infiltration by inflammatory cells.

Conclusion:
NY-ESO-1 is heterogeneous expressed in different soft tissue tumors and seems to be correlated with inflammation and inflammatory response of tumors. We provide first evidence for biomarkers beside PD-L1 and TMB in soft tissue tumors. NY-ESO-1 is a promising candidate as potential biomarker for immuno-oncologic treatment. Although further investigation is needed, we suggest to include these biomarkers in upcoming clinical trials in this field.
Is it safe to observe grade 1 chondrosarcoma?

Mrs. Minna Laitinen¹, Mr Robert Grimer², Mr Lee Jeys², Mr Scott Evans², Mr Jonathan Stevenson², Mr Michael Parry²

¹Helsinki University Hospital, Helsinki, Finland, ²Royal Orthopaedic Hospital, Birmighman, UK

Chondrosarcoma (CS) is the second most common primary malignancy. The clinical behaviour and prognosis of these tumours depends on many variables, of which the grade is one of the most important. Histological grading can be difficult, and discrepancies among experienced pathologists exist. In our previous work we have shown that true grade 1 CS rarely, almost never metastasize and therefore the aim of this study was to investigate whether it would be safe to observe grade 1 CS.

We retrospectively reviewed data from two international collaborative hospitals between 1995 and 2018 identifying 720 patients who were treated for their conventional CS of the pelvis or extremities. 223 (30.2%) had grade 1 CS, of which 160 (71.7%) were central CS. These patients formed the basis of our analysis. Linear regression was used to determine trends in size increase in a time-series analysis.

Patient characteristics are shown in the table. In 17 patients (10.6%) historical images could be found. The reason for these images were usually trauma or unrelated pain. The cartilaginous tumours were either ignored or diagnosed as benign at that time. The mean follow-up time was 47 (range 1-150) months and mean increase in size 1.7 (range 0.05-5) cm. From the linear regression analysis, we could not detect a significant increase (p= 0.104). Figure.

In this study we have shown that size increase of grade 1 CS tumours is surprisingly low. It is known from the literature that accurate histologic grading is challenging, as less than 50% of the biopsies can detect grade 1 CS, therefore a true grade 1 CS can be diagnosed only from resection specimen. Our results reinforce the notion that for true grade 1 CS, observation may be appropriate, but a very long follow-up is required.
Molecular based diagnostics of sarcoma provides basis for reliable diagnoses, outcome prognostication and correlates with clinical phenotypes

Mr. Moritz Goetz¹, Mrs. Stefanie Bertram¹, Mr. Thomas Herold¹, Mr. Arne Streitbürger³, Mr. Jendrik Hardes², Mrs. Wiebke Guder², Mr. Lars Erik Podleska², Mr. Sebastian Bauer¹, Mr. Hans-Ulrich Schildhaus¹

¹Institute of Pathology, University Hospital of Essen, University of Duisburg-Essen, Essen, Germany, ²Department of Musculoskeletal Oncology, University Hospital of Essen, University of Duisburg-Essen, Essen, Germany, ³West German Cancer Center, Department of Medical Oncology, University Hospital of Essen, University of Duisburg-Essen, Essen, Germany

Introduction:
Diagnosis of mesenchymal tumors is historically based on morphology of tumors added by immunohistochemical detection of more or less specific protein expressions. With emerging knowledge of the genetic background of mesenchymal tumors, molecular methods for the detection of gene fusions, mutations and gene copy number variations play an increasing role in tumor typing. We herewith report on our experience with a systematic molecularly based diagnostics at a high volume clinical center for sarcoma treatment and describe the diagnostic use of NGS-based methods for detection of genomic rearrangements.

Methods:
Biopsy specimens and tumor resections of 190 patients diagnosed and treated at our center within a one year period from January to December 2019 were enrolled in the study. RNA was extracted from FFPE material and target-enriched NGS-based analysis was undertaken using Archer FusionPlex®-Sarcoma-Panel on Illumina® MiSeq™-system. Gene copy number variations and mutations were detected by FISH and customized DNA NGS panels, respectively.

Results:
Gene fusions were found in 50% of cases. The majority of molecular results confirmed the afore suspected diagnosis on a molecular level. In seventeen cases (~ 9%), molecular findings led to clinically meaningful change of previous diagnosis incl. prior external reference pathology reports. In some cases, gene fusions were found by sequencing although in situ hybridization had failed to detect genomic rearrangement. Moreover, we found uncommon and not yet described gene fusions that correlated with unusual clinical presentation and histologic appearance.

Conclusion:
Molecular characterization of mesenchymal tumors is crucial for making a reliable diagnosis in mesenchymal neoplasms. Entity defining gene fusions are found in a certain proportion of sarcoma that do not show typical morphologic differentiation. Furthermore, sarcomas harboring genomic rearrangements may show correlation between genotype and clinical or histological phenotypes that may provide basis for clinical therapeutic decision making.
Clinicians’ adherence to practice guidelines for soft tissue sarcoma analyzed with Quality Indicator

Mr. Shintaro Iwata¹, Ms. Tomone Watanabe¹, Mr. Takahiro Higashi¹, Mr. Akira Kawai¹
¹National Cancer Center Hospital Japan, Tokyo, Japan

Objective:
A total of 60 facilities were designated as specialized hospitals (SH) for soft tissue sarcoma (STS) treatment in Japan, which can provide expert treatment of extremity or trunk STS. On the other hand, 382 facilities performed treatment of STS in all over Japan. Clinicians’ adherence to clinical practice guidelines (CPGs) was shown as an implementation rate of standards of care. The purpose of this study is to clarify the difference in implementation rate of standards of care based on the CPGs for STS and overall survival between SH and non-specialized hospital (NSH).

Methods:
DPC data of 2,974 patients with extremity or trunk STS treated in designated cancer hospitals from 2013 to 2015 were extracted by the topography and morphology code of ICD-O. Five standards of care based on the three CPGs for STS (R1: Appropriate local imaging before treatment, R2: Biopsy before treatment, R3: Wide resection as a definitive surgery, R4: Postoperative radiotherapy for the patient with a positive margin, R5: Postoperative radiotherapy for high-risk groups) were determined. Each implementation rate and 5-year overall survival were calculated, and a comparison between SH and NSH was performed by Pearson’s chi-square test.

Results:
Implementation rate of R1 to R3 were significantly higher in SH (R1, 81% vs 71%, p < .0001; R2, 80% vs 63%, p < .0001; R3, 85% vs 82%, p = .049). However, in R4 (19% vs. 22%, p = .52) and R5 (10% vs. 10%, p = .96), there was no significant difference in the implementation rate. 5-year overall survival was superior in SH comparing with NSH (69% vs 64%, p = .0055).

Conclusion:
Regarding diagnosis and surgery, the implementation rate of standards of care for STS was significantly higher in SH comparing to NSH. This can result in a better outcome of STS patients treated in SH.
Unplanned excision of soft tissue sarcomas: a systematic review.

Mr. Federico Sacchetti¹, Mr. Andac Alsina², Mr. Lorenzo Andreani¹, Mr. Simone Colangeli¹, Mr. Antonio D’Arienzo¹, Mr. Rodolfo Capanna¹

¹Università di Pisa, Pisa, Italy, ²Ege University, Izmir, Turkey

Introduction:
Unplanned-excision are defined as tumour removal without an appropriate diagnosis or planning. In the majority of the re-resection specimen, tumoral residual is found; actually there is no way to predict before re-excision when residual tumour is very unlikely to be found. Systematic surgical re-resection of the scar tissue area is the gold standard of care in U.E. patients.

Methods:
a searching strategy was applied to two database as Pubmed-Central and Ovid Medline. 77 articles were included in the analysis. Odds ratio to develop a local recurrence, distant metastasis or death due to the pathology were calculated considering several risk factors.

Results:
Having a residual tumour in the resected specimen after the re-excision led to an Odds ratio to develop a local recurrence of 3,56; the distant metastasis OR was 3,42;the OR of death was 3,42. Having a local recurrence lead to a metastasis OR of 1,55 and to an death OR of 2,32. Patients who underwent a re-excision compared to who had a planned surgery in sarcoma centres have the same OR of local recurrence and had an OR to develop distant metastasis of 0,56.

Conclusions:
Our analysis confirmed the importance of residual tumour as a predictor of a worsened outcome. Since it is impossible to predict in advance with enough precision in which patients residual tumour will be very unlike to be found, systematic re-resection can be envisaged. Our data confirm the strong relation between local recurrences and the development of distant metastasis and death, nevertheless is still impossible to attribute a clear cause-effect link between these events. Our analysis highlights the optimal oncological outcome in patients who underwent re-resection. The rationale for systematic re-resection after unplanned excision of soft tissue sarcomas is very strong and this treatment remains the gold standard of care in these patients.
Off The Rack Reconstruction Solution with TMARS for Periacetabular Pelvic Resections – An Experience of 20 Cases at a High Volume Referral Centre

Mr. Muhammad Ather Siddiqi1,2, Ms. Sophia Thomas1, Ms. Harriet Branford White1, Mr. Duncan Whitwell1

1Nuffield Orthopaedic Centre, Oxford University Hospitals, Oxford, United Kingdom, 2Liaquat National Hospital and medical College, Karachi, Pakistan

Introduction:
Complex anatomy makes resection of pelvic tumors a difficult enough job and to have a simpler solution that saves time during reconstruction has clear surgical advantages. EPR, autografts, allografts and no reconstruction all have their own problems and no solution fits all. A tool that gives intraoperative modularity, shortens reconstruction time and is biological is desirable. Unlike limb salvage where modular prosthesis have given surgeons a clear advantage, such an option does not exist for pelvic reconstructions. We are sharing our experience of using TMARSTM designed for revision hip arthroplasty for managing bone loss following P2 pelvic resections.

Methods:
This study is a retrospective review of prospectively collected data of 20 patients treated from 2013 to 2016 at the Nuffield Orthopaedic Centre, Oxford University Hospitals. A Type 2 partial or complete resection was performed. Modular TMARSTM augments were used to reconstruct the acetabular defect and they received a primary hip prosthesis.

Outcomes measures were oxford hip score, TESS score (%), adverse events.

Results:
In all patient adequate oncological margins were achieved. The longest follow-up was 6 years, the shortest 3 years. All patients are alive at the time of this review with 1 chondrosarcoma local recurrence. Average oxford hip score was 49 (Range 45 – 57). Average TESS score was 62/100. Other adverse events were 1 sciatic nerve neuropraxia recovering spontaneously, one dislocation managed with open reduction and 1 death due to PE. There were no failures of the reconstruction itself.

Conclusions:
We think that within the limitations of this study, TMARSTM augments give the intraoperative maneuverability saving the surgeon valuable time and easy stable biological reconstruction following P2 pelvic resection.
Prognostic factors in clear cell sarcoma

Abbas Agaimy, Sebastian Bauer, Stefanie Bertram, Stephane Collaud, Farhad Farzalyev, Mr. Janik Sebastian Grothues, Rainer Hamacher, Jendrik Hardes, Lars Erik Podleska, Christoph Pöttgen, Hans-Ulrich Schildhaus, Arne Streitbürger

1 Sarcoma Center, West German Cancer Center, Essen, Germany, 2 Institute of Pathology, Erlangen, Germany

Introduction:
Clear cell sarcoma (CCS) of tendons and aponeuroses and CCS-like gastrointestinal sarcoma (Synonym: GINET) are characterized by frequent local and distant relapses and notorious resistance to medical treatments. Translocations involving EWSR1 represent a pathognomonic molecular event which yet failed as a therapeutic target. We have sought to collect a comprehensive dataset for patients with CCS to identify prognostic factors.

Methods:
We queried our institutional database (including consults) for the diagnosis clear cell sarcoma and GINET with subsequent chart review. Among the covariates were gender, age at diagnosis, primary location, tumor size, presence of translocation, stage (TNM), resection status, as well as duration of systemic treatment. All data was put into a SPSS database for further statistical analyses.

Results:
We identified 43 patients with a diagnosis of CCS/GINET (w:24, m:19) with a median age of 41yrs. 92% of patients were translocation-positive. The distant extremity was affected in 72%. Median size was 3.6cm (range: 0.3-11.1cm). Of note, a majority of patients received a resection biopsy (benign histology suspected in 30.2 %) leading to frequent incomplete resection. Notably, 32.6% of patients initially presented with lymphatic spread and 23.3% with distant metastases. Univariate analyses revealed no significant difference in survival for tumor size (≤5 vs > 5cm, p=0.116), but for metastasis-free survival (≤5 vs > 5cm, p=0.005). For N+ vs no lymph node involvement median overall survival (OS) was 11.2 years vs 2.6 years. Presence of metastases at diagnosis was associated with a much poorer survival (1.4yrs vs 7.1yrs) when compared to M0 stage. 5 year OS was better in female than male patients (49% vs 31%, p=0.099). OS for all patients was 3.6 years and metastasis free survival was 2.6 years in median.

Conclusion:
We here present one of the largest clinical cohorts of patients with clear cell sarcomas. Our data underscores the exceptional risk of metastatic disease even in small tumors and the dismal outcome for patients with metastatic disease. While nodal status and presence of metastases are prognostic at time of diagnosis, size may not help to predict outcome in CCS.
Prognostic factors for post-progression survival after trabectedin treatment in patients with advanced soft tissue sarcoma

Mr. Shintaro Iwata¹, Mr. Kan Yonemori¹, Mr. Ayumu Arakawa³, Ms. Aiko Maejima¹, Mr. Hiroyuki Fujimoto¹, Ms. Chitose Ogawa², Mr. Kenji Tamura³, Mr. Akira Kawai³

¹National Cancer Center Hospital, Tokyo, Tokyo, Japan

Background:
In the randomised Phase 3 trial, compared with dacarvazine, trabectedin improved progression-free survival in patients with advanced soft tissue sarcoma (ASTS); however, it did not improve overall survival. An analysis of the post-progression survival (PPS) would help explain the discrepancy; however, the prognostic factors for PPS in ASTS patients are ill-defined. This analysis investigates the clinical factors affecting PPS in ASTS patients treated with trabectedin.

Methods:
ASTS patients who developed the progressive disease (PD) while receiving treatment with trabectedin in our hospital from 2016 to 2018 were eligible for this study. Kaplan-Meyer estimates of PPS, which included the time from PD while on trabectedin treatment until death by any cause to final follow-up, were computed. Potential prognostic factors including disease extent (locally advanced disease vs metastasis), PD type (new lesion vs lesion increasing in size), clinical benefit (PD vs PR + SD), number of treatment courses and additional treatment after PD were analysed using Cox proportional hazards models.

Results:
Thirty-three patients were included in this study. In the assessment of PD type, new lesions developed in 15 patients (45%), which was correlated with a poorer PPS (HR 6.14, p = 0.0028). In addition, patients who did not receive any treatments after PD (n = 14, 42%) or patients with metastasis (n = 27, 82%) were correlated with a poorer PPS (HR 4.29, p = 0.014 and HR 7.16, p = 0.039, respectively). By contrast, clinical benefits or the number of treatment courses were not associated with PPS.

Conclusions:
This study demonstrated that PD type, additional treatments after PD and disease extent influenced the PPS of ASTS patients treated with trabectedin. These findings should be considered for use as new markers in future ASTS clinical trials.
The Stanmore METS Distal Femoral Replacement Modular System for primary bone tumours and metastatic disease – a single centre experience.

Mr. William Aston\textsuperscript{1}, Ms C Wigley\textsuperscript{1}, Mr O Onwuka\textsuperscript{1}, Mr A Akinsulire\textsuperscript{1}, Mr Panos Gikas\textsuperscript{1}, Mr Craig Gerrand\textsuperscript{1}, Mr R Pollock\textsuperscript{1}
\textsuperscript{1}Royal National Orthopaedic Hospital, Stanmore, United Kingdom

Introduction
A single centre experience using the METS Distal Femoral Replacement.

Methods
Kaplan Meier analysis was performed for death and revision for any reason. Reasons for revision were further classified by the Henderson Classification\textsuperscript{1}

Results
103 METS Distal Femoral Replacements were performed between the 1st February 2010 and the 15th Feb 2016, 51 Female and 52 Male patients. Age range at diagnosis was 14-90 (mean 51). BMI ranged from 17-49 with a mean of 26. 60 left and 42 right replacements. The primary indication for all patients was bone tumour, of which 40 were for metastatic disease, 29 Osteosarcoma, 16 chondrosarcoma and 18 other primary bone tumours.

There were 102 rotating hinges and 1 fixed hinge, 95% of which utilised a Hydroxyapatite coated collar. Follow up ranged from 0-107 months (Mean 41.11).
51 patients died at an average of 19.9 months and there were 13 revisions (13%) for all indications at an average of 46.7 months. Reasons for revision as classified by Henderson were; type 1 Soft Tissue Failure – 2(2%), type 2 Aseptic Loosening – 3(3%), type 3 Structural Failure– 2(2%). type 4 Infection – 4(4%) and type 5 Tumour progression – 2(2%).

Discussion
Rates of complications with massive endoprostheses are high compared to primary or revision arthroplasty. Infection for example in the largest series is quoted at 11\%\textsuperscript{4}. In this patient population and with medium term follow up we have demonstrated an infection rate of 4\%.
The complication rates according to Henderson compare well to other reported series of distal femoral prostheses\textsuperscript{1,5,6,7}.
The Kaplan Meier survivorship curves demonstrate that in the majority of patients the implant survives the patient.

Conclusion
The Stanmore METS system is a versatile and adaptive system and has benefits in terms of modularity and being immediately available in this challenging patient population.
Bayley Walker Proximal Humeral Reconstruction – The Stanmore Experience

Mr. William Aston1, Mrs. Heledd Havard1, Mr. M Tofighi1, Mr. Tim Briggs1, Mr Panos Gikas1, Mr Andrew Johnston1, Mr R Pollock1, Mr Craig Gerrand1
1Royal National Orthopaedic Hospital, Stanmore, United Kingdom

Introduction:
Tumours of the proximal humerus continue to pose significant surgical challenges both in terms of resection and reconstructive options. The anatomy of the proximal humerus is complex with both capsular and tendon attachments contributing to the biomechanical stability of the shoulder, yet allowing a high degree of functional motion. Resection of tumours or metastases in this area often requires sacrifice of these structures to ensure clear margins and thus necessitates the use of a constrained implant when planning reconstruction.

Early prostheses were associated with high complication rates and poor functional outcome, often serving as little more than a spacer. Evolution of the Bayley-Walker prosthesis in 2006 saw a design modification with the introduction of an O ring - providing additional constraint to the prosthesis. Despite this adaptation, dislocation remains a recognised complication.

Methods:
We reviewed 44 Bayley-Walker proximal humeral reconstructions performed in 43 patients between April 2010 and January 2018. Our aim was to define the dislocation rate associated with this prosthesis in comparison to dislocation rates prior to design modification.

Results:
Surgery was performed as a primary procedure in 42 cases with one previously failed nail and one recurrence following curettage. Overall complication rate was 34% consisting of 3 cases of aseptic loosening (7%), 3 infections (7%), two periprosthetic fractures (5%) and 7 dislocations (16%). Overall reoperation rate was 16% and overall patient survival was 43%.

Of the seven dislocations, only one had resulted in breakage of the O-ring. Five patients underwent revision (proximal humeral body only) with no change in the rotation of the components.

Conclusion:
Since introduction of the O ring modification, dislocation rates have reduced from 26% to 16% however reconstruction remains a challenge and further design modifications should be considered.
Prevalence and Risk Factors for Falls in Patients Treated for Lower Extremity Sarcoma

Ms. Samantha Foo\textsuperscript{2}, Mrs. Sherron Furtado\textsuperscript{1}, Mr. Craig Gerrand\textsuperscript{1}
\textsuperscript{1}Royal National Orthopaedic Hospital NHS Trust, Stanmore, Middlesex, United Kingdom, \textsuperscript{2}University College London, Stanmore, Middlesex, United Kingdom

Introduction:
After multimodal treatment for bone or soft tissue sarcoma, patients have physical disabilities which can predispose them to falls and their complications. The objective of this study was to investigate the prevalence of falls and risk factors for falls in patients treated for lower extremity sarcoma.

Methods:
This was a prospective study in a single centre. During clinic visits, enrolled patients completed falls, functional outcome and quality of life (QoL) questionnaires. A small sub-set underwent gait analysis at the RNOH motor learning lab. Demographics, clinical variables and QoL were compared between fallers and non-fallers. Differences in falls risk and the relationship between falls risk and collected variables were also investigated.

Results:
Out of 52 patients, 21 reported at least one fall. Poor physical function was a significant predictor of falls (p=0.003) and so was the length of treatment (p<0.001). Decreased balance (p=0.034) and fear of falling (p=0.023) were significantly associated with falls. Patients with sarcoma sites located above the knee had higher falls risk (p=0.021). Fallers had significantly poorer QoL (p=0.011) compared to non-fallers.

Conclusion:
This is the first known study investigating falls in patients treated for sarcomas. Although not commonly reported or assessed, falls in patients treated for lower extremity sarcoma are prevalent. The factors associated and related to falls identified in this study highlights patients at higher risk which can guide clinicians during follow-up. Implementation of appropriate falls management plans can reduce falls and could subsequently contribute to improved QoL among sarcoma survivors.
Telescope allograft augmentation technique for a short residual proximal femur in megaprostheses in children

Mr. Eric Staals¹, Mr. Hindiskere Suraj², Mr. Riccardo Zucchini³, Mr. Gianmarco Tuzzato¹, Mr. Tommaso Frisoni³, Mr. Andrea Sambri¹, Mr. Davide Maria Donati¹, Mr. Marco Manfrini¹
¹IRCCS Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction:
Reconstruction of the distal femur in children can be particularly challenging. Extensive tumor resections or revision surgeries can result in a short residual femur stump, causing difficulties in the fixation of an endoprosthetic replacement with a standard intramedullary stem. In these cases, we use massive cylindrical, also called ‘telescope’, allografts to reestablish the length of the proximal bone. This study, describes the surgical technique, and analyzes our experience with this reconstruction technique in young patients.

Materials:
We retrospectively reviewed the records and radiographs of 15 patients under the age of 18 years, who underwent distal femoral megaprostheses with augmentation of a short proximal femur by means of a telescope allograft. In ten patients this technique was applied during revision surgery of a failed distal femur megaprostheses, in 5 cases for primary limb salvage surgery after distal femur bone tumor resection. The histological diagnosis was osteosarcoma for all cases. The study period was 2008-2019 and the follow-up period was on average 47 months (range 4-128 months).

Results:
Mean age of the patients was 13 years (range 7-18). Residual femur was on average .. cm (range ). Mean telescope allograft length was 65mm and the overlap between allograft and host bone was on average 19mm. All allografts united with the host bone, on average after 5,6 months. All but one stem was retained, one patient developed aseptic loosening after 6 years, and was revised using another telescope allograft technique.

Conclusion:
Telescope augmentation technique, using a cylindrical massive allograft, is useful for distal femoral reconstruction with a megaprostheses, when there is a short residual proximal femur. It helps in rebuilding bone stock and avoids the need for expensive custom implants. In children, we obtained excellent allograft integration in all cases, and long term implant fixation.
Por-Ag Silver coated mega-prosthesis in non oncological patients: a retrospective analysis.

Mr. Federico Sacchetti¹, Mr. Lorenzo Andreani¹, Mr. Simone Colangeli¹, Mr. Antonio D'Arienzo¹, Mr. Francesco Muratori², Mr. Rodolfo Capanna¹
¹Università di Pisa, Pisa, Italy, ²Università di Firenze, Firenze, Italy

Introduction:
Modular endoprosthesis, are one of the preferred choice of reconstruction when a large amount of bone gap results after tumor resections. Megaendoprostheses are increasingly used with the same goals in non-oncologic surgery. The overall periprosthetic joint infection rate is much higher in megaendoprostheses implantation than in standard prosthesis surgeries. Silver has always been considered as a promising material to coat prosthesis since it has an high antimicrobial activity coupled with a low human toxicity. This is a retrospective study about a series of 142 modular prostheses of lower limbs in non-oncological patients.

Methods:
An analysis of the database of patients who underwent megaendoprostheses implantation between January 2001 and December 2017 in the Department of Orthopaedic Surgery and Traumatology of Pisa, Lausanne and Florence was performed. The end-point of the survival analysis was the prosthesis failure due to infections as Henderson et al. defined.

Results:
In all 142 cases, a Megasystem-C® had been used. 38 patients (27%) underwent implantation of a silver-coated modular prosthesis and 104 patients underwent implantation of a titanium megaendoprostheses. The survival analysis showed an overall infections-free survival of 86% at 5 years and 77% at 10 years. The Cox regression model about infections-free survival analysis showed an hazard ratio (HR) of 2,5 regarding the presence of previous infection in patient’s history; Por-Ag prosthesis implantation showed an HR of 0,72 (CI 95%: 0,26-2,05; p: 0,54); previous irradiation had an HR of 1,6 (CI 95%: 0,4-7,1; p:0,51).

Conclusion:
Our results confirm how a previous infection could be an important risk factor considering infection failures. Surprisingly previous irradiation, age, gender and surgical site didn’t change failures risk. Our results don’t confirm the power of silver coated prosthesis to reduce infection risk in a non-oncological population. A positive trend in survival curves can be shown until 20 months of follow-up.
Treatment of Oligometastatic Leiomyosarcoma of the Ankle: Case Report

Mrs. Sara Goncalves¹, Mr. António Siilva¹,², Mr. João Freitas², Mr. Rúben Fonseca², Mr. Paulo F. Tavares², Mrs. Margarida Borrego¹, Mr. José M. Casanova²

¹Department of Radiotherapy, Coimbra University Hospital, Coimbra, Portugal, ²Bone and Soft Tissue Tumor Unit, Coimbra University Hospital, Coimbra, Portugal

Introduction:
Leiomyosarcoma is one of the most common subtypes of soft tissue sarcoma. Usually metastasizes to the lung and bone metastases are rare. The decision of how to treat oligometastization is complex and should always be discussed in multidisciplinary teams.

Methods:
Description of a clinical case of oligometastatic leiomyosarcoma treated with surgery and adjuvant radiotherapy.

Results:
Female patient, 63 years old, diagnosed with leyomiosarcoma of the left ankle in September of 2016, treated with surgery and adjuvant radiotherapy with 60Gy/30fr that completed in 18/01/2017. Remaining in clinical and radiologic surveillance. PET/CT scan (30/07/2018) described “an osteolitic hipermetabolic lesion on the right external femoral condyle, suspect of metastasis.”

MRI of the knee (18/08/2018) described an T2 hiperintense lesion on the anterior portion of the lateral condyle of the right femur, measuring 28x29x18mm, suspect of secondary location, with irregularity and rupture of the cortical without soft tissue component.

On multidisciplinary meeting it was decided to do surgery and adjuvant radiotherapy. Surgical resection of the right distal femur with reconstruction with MUTARS endoprosthesis was performed on 18/09/2018. The histopathologic report was compatible with fusocelular high grade sarcoma, leiomyosarcoma´s metastasis, with complete excision of the lesion. The inferior third of the right thigh was irradiated with 50Gy/25fr between 09/01/2019 and 12/02/2019, without significant side effects. After the treatment, the patient presented mild pericicatricial fibrosis and skin pigmentation.

Until august/2020 the patient remained without evidence of disease. A PET/CT (05/08/2020) showed a suspect lesion on the left adrenal gland, confirmed by biopsy that was leiomyosarcoma’s metastasis. The patient did ADIC+Ifosfamide (09/2020-01/2021) and a left adrenalectomy (25/03/2021). PET/CT (13/05/2021) showed no evidence of recurrence or active disease.

Conclusion:
Surgery with adjuvant radiotherapy was a successful treatment to the leiomyosarcoma’s oligometastization to the femur. The patient remains without local recurrence and currently shows no active disease.
Ewing’s sarcoma of the calcaneus treated by limb sparing surgery with calcanectomy and reconstruction with a composite of an allograft and a vascularized osteocutaneous fibula graft.

Christian Bonde², Werner Herbert Hettwer¹, Mr. Michael Mørk Petersen¹, Lisa Toft Jensen¹
¹Departments of Orthopedics (Musculoskeletal Tumor Section) Rigshospitalet, University of Copenhagen, Copenhagen, Denmark,
²Department of Plastic Surgery, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark

Introduction:
Primary malignant bone tumors of the calcaneus are very seldom, and due to poor possibilities to do surgery with wide margins in this region and limited options for reconstruction after calcanectomy many orthopedic oncologists use amputation as the preferred surgical treatment in such cases. We present two cases of Ewing’s sarcoma of the calcaneus treated with calcanectomy and reconstruction with a composite of an allograft and a vascularized osteocutaneous fibula graft.

Patients and Methods:
Two girls almost 6 years old (case 1) and 16 years old (case 2) at the time of calcanectomy in respectively August 2012 and October 2013. Both patients received pre- and post-operative chemotherapy.
In both cases removal of the calcaneus was performed using a combined medial and lateral incision. In case 1 a femoral head allograft was fitted to replace the removed calcaneus, and in case 2 a calcaneus allograft was used. In both cases, with the aim of obtaining arthrodesis, the allograft was fixed to the talus and cuboid bone with screws. A distally pedicled osteocutaneous flap was used for reconstruction of soft tissue, and a 5-6 cm piece of vascularized fibula bone was fitted into the allograft and fixed using staples.

Results:
Arthrodesis between talus and the graft healed and full weight-bearing was allowed in both cases 8-9 months postoperatively. At follow-up 6½ and 4½ years after surgery both patients were without local recurrence or metastases, and they were both pain-free and able to walk using normal footwear without any walking-aids.
Can Holistic Personalised Models of Rehabilitation improve Survivorship Outcomes after Treatment for Lower Extremity Sarcomas? – A Preliminary Efficacy Study

Mrs. Sherron Furtado1, Ms. Silvia Del Din2, Ms. Jan Lecouturier3, Mr. Rana Zia Ur Rehman2, Mr. Kenneth Rankin4, Ms. Lynn Rochester2, Mr. Craig Gerrand1

1Royal National Orthopaedic Hospital NHS Trust, Stanmore, Middlesex, United Kingdom, 2Institute of Neuroscience, Newcastle University, Newcastle Upon Tyne, United Kingdom, 3Institute of Health and Society, Newcastle University, Newcastle Upon Tyne, United Kingdom, 4Northern Institute of Cancer Institute, Newcastle University, Newcastle Upon Tyne, United Kingdom

Introduction:
Treatments for sarcoma lead to a wide ranging physical and psycho-social deficits, yet rehabilitation is variable. A personalised holistic evidence-based rehabilitation delivery might be useful. Our aim was to investigate whether personalised rehabilitation programmes (PRPs) are effective in patients treated for sarcomas.

Methods:
11 patients treated for lower extremity sarcoma were enrolled. Patients underwent rehabilitation problem-solving (RPS) assessments using impairment (Musculoskeletal Tumour Society System (MSTS)), disability (Toronto Extremity Salvage Score (TESS)), quality of life-cancer survivors (QoL-CS)), modified re-integration into normal living (mRNL), balance, gait and community ambulatory (walking) activity assessments using Axivity AX3. Based on domains affected; PRPs were developed for each patient. Outcome scores were compared pre and post PRP delivery.

Results:
Patients’ mean age was 50.3±18.7 years. 5 had bone sarcomas and 6 soft tissue sarcomas located in the above knee region (8) and below knee region (3), and treated with limb sparing surgery (8) and amputation (3). PRPs significantly improved mRNL scores, gait and ambulatory activity (p<0.05). mRNL scores increased from 64.8±17.5 to 73.9±21.1, p=0.019* (scores difference=9.10); swing time reduced from 0.5±0.1 to 0.4±0.8, p=0.032* (scores difference=0.09); mean walking bout length time increased from 17.8±4.0 to 19.9±3.4, p=0.029* (scores difference=2.13) (Figure 1); (scores difference=-0.04). The PRPs did not change balance, MSTS, TESS and QoL-CS.

Conclusion:
These preliminary results support the efficacy of PRPs in musculoskeletal oncology. Patients experienced better re-integration into their normal living, improved gait and ambulatory activity. There is a need for intervening at multiple clinic follow-ups to optimise patient outcomes.
Does surgical margin effect the survival rate of osteosarcoma?

Prof. Dr. Nevzat Dabak1, M.D. Furkan Erdogan1, Mr. Sina Coskun2

1Ondokuz Mayis University Hospital Department of Orthopedics and Traumatology, Samsun, Turkey, 2Samsun Training And Research Hospital Department of Orthopedics and Traumatology, Samsun, Turkey

Introduction:
The aim of this study was to evaluate the clinical outcomes and prognostic factors, especially the surgical margin, affecting the survival rates of patients undergoing medical and surgical treatment for osteosarcoma in our hospital.

Patients and Methods:
Fifty-four patients who underwent medical and surgical treatment for osteosarcoma in our hospital between 2005-2019 were retrospectively evaluated. Pre-operative factors such as sex, age, tumor size and localization, histopathological type, stage, response to neoadjuvant therapy, surgical treatment, adjuvant therapy and postoperative complications such as metastasis and local recurrence were obtained. Kaplan-Meier test, Cox regression test and log-rank statistical methods were used to compare survival rates.

Results:
Of the 54 cases, 30 were male, 24 were female, and the mean age was 19.8 years. The mean follow-up period was 54 months. The effect of gender and age on survival was not statistically significant. When histopathologic subtypes were examined, chondroblastic type osteosarcoma with the lowest 5-year survival was observed. The survival rate of patients with a tumor volume of 200 ml or greater was lower than those with a tumor volume of <200 ml. In terms of survival rate, the survival rate of patients with a surgical margin of more than 2 mm was poorer than the patients with a surgical margin of less than 2 mm. When we compared these surgical margin groups in terms of metastasis, there was a significant difference, but there was no difference in terms of local recurrence. There was no statistically significant difference between postoperative early and late complication groups in term of survival rate.

Conclusion:
Prognosis in the treatment of osteosarcoma are associated with individual factors, tumor biology and treatment modality. In our study, surgical margin is the major factor affecting the survival rate of patients who underwent surgery.
Adjuvant radiotherapy on skin grafts: experience of a Radiotherapy department

Mrs. Sara Goncalves¹, Mrs. Luísa Rolim¹, Mr. Tomás Cabral Dinis¹, Mr. João Casalta-Lopes¹, Mr. António Silva¹, Mr. Miguel Jacobetty¹, Mr. João Freitas², Mr. Rúben Fonseca², Ms Joana Rodrigues², Mr. Paulo F. Tavares², Mrs. Margarida Borrego¹, Mr. José M. Casanova²

¹Department of Radiotherapy, Coimbra University Hospital, Coimbra, Portugal, ²Bone and Soft Tissue Tumor Unit, Coimbra University Hospital, Coimbra, Portugal

Introduction:
Wound complications are the most common side effect after limb-sparing surgery and adjuvant radiotherapy. There are few data on the tolerance of skin grafts to adjuvant radiation. This study aims to evaluate tolerance of skin grafts to radiotherapy and possible contributing factors.

Methods:
Retrospective analysis of patients with skin grafts treated with adjuvant radiotherapy between 2002-2019 in a radiotherapy department.

Results:
Included 19 patients: median age 59 years; Karnofsky ≥90% in 57.9%; 31.6% had hypertension; 10.5% diabetes and 31.6% smoking habits. Tumor characteristics: 73.7% in lower extremity; cT1-2(73.7%); median size 5cm; 68.4% were superficial; most frequent histologies were liposarcoma, myxofibrosarcoma and leiomyosarcoma(15.8% to all).
Chemotherapy setting: 36.8% neoadjuvant; 5.3% adjuvant; 5.3% concomitant with radiotherapy.
Skin grafts were used in the primary surgery in 42.1%, 42.1% in recurrence’s excision, 15.8% due to previous complications; 84,2% had radical resection and 15,8% debridement; R1 in 57.9%; free grafts in 73.7%. Surgical complications in 26.3%: wound dehiscence(10.5%); graft necrosis(5.3%); infection(5.3%); hematoma(5.3%); 10.5% needed posterior debridement surgery with graft.
Median time surgery-radiotherapy was 82 days; radiotherapy dose was 60Gy/30fr(47.4%) and 66Gy/33fr(26.3%); and one patient interrupted treatment at 45Gy. Bolus were used in 5.3%; all treatments were 3D-CRT except in 1 patient (VMAT).
All patients presented radiodermatitis, 15.8% dry and 31.6% moist desquamation; 5.3% graft dehiscence; 36.8% edema.
Late toxicity: 5.3% lost the graft, 36.8% fibrosis, 10.5% radiation ulcer. One patient underwent 6 surgeries due to graft complications.
A longer surgery-radiotherapy time was significantly associated with fewer acute complications (p=0.039), but not with late toxicity.
No significant correlation between chemotherapy, surgical complications, graft origin, radiation dose, tumor size, patient comorbidities and acute or late toxicity was observed.

Conclusions:
There were no unexpected complications of radiotherapy. Longer surgery-radiotherapy time was significantly associated with fewer acute complications. Therefore, this should be considered when determining radiotherapy timing.
Evaluation of effectiveness and safety of microwave ablation as a minimally invasive treatment alternative for vertebral tumors

Mr. Hendricus Nijland¹, Mr. Jinwen Zhu², Mr. Dingjun Hao², Mr. Guilin Huang², Mr. Tian Ming Yang², Mr Paul Jutte¹

¹University Medical Center Groningen, Groningen, Netherlands, ²HongHui hospital, Xi’an, China

Introduction:
Treatment of bone tumors is normally done in an invasive manner. This comes with risk of short- and long-term complications. Primary results of minimally invasive treatment alternatives are hopeful. Microwave ablation (MWA) is an example of this. Local application of high temperatures leads to coagulation and instant cell death. It is already used on a small scale in clinical treatment of long bone tumors. Literature on effectiveness and safety for use in vertebral bodies is still lacking. The aim of the current study is to extend this knowledge.

Method:
MWA was applied with different settings for wattage and time in both ex-vivo and in-vivo sheep vertebral bodies to determine ablation halo dimensions. Furthermore, distribution of heat through the bone was measured at 5 and 10mm from the ablation needle and compared to a model of thermally induced cell death. Finally, safety was evaluated by temperature measurements at sensitive structures (e.g. spinal cord, nerve root).

Results:
Halo size (=ablated area) is significantly dependent of both time and wattage. The major increase in halo size is seen within the first three minutes of ablation. This corresponds to the temperature at 5- and 10mm from the needle, which mainly increases during the first four minutes. Ablations with wattage levels >30W lead to instant damage to the spinal cord (local temperature >60°C). For ablations with 20- or 30W a maximum time of three to four minutes is considered safe.

Conclusion:
MWA is a promising, minimally invasive approach for treatment of vertebral tumors. However, given its aggressive character caution is advised regarding ablation settings. The first step towards clinical implementation of MWA in vertebral bodies should be to extend knowledge on effectiveness and safety in human bone, first by experiments in long bone.
Feasibility of using the Patient Specific Functional Score to guide Inpatient Rehabilitation after Surgery for Musculoskeletal tumours.

Mrs. Sherron Furtado¹, Ms. Abigail McCarthy¹, Mr. Craig Gerrand¹, Ms. Agnieszka Kowalska¹
¹Royal National Orthopaedic Hospital NHS Trust, Stanmore, Middlesex, United Kingdom

Introduction:
Following complex surgery, patients require tailored rehabilitation support to regain functional skills, muscle strength and independence. Patient Specific Functional Score (PSFS) can be used to identify goals personal to patients, inform tailored rehabilitation as is simple to administer.

Methods:
This is a prospective feasibility study to investigate the feasibility of using PSFS as a clinical tool to monitor and inform inpatient rehabilitation post-operatively in patients treated for musculoskeletal tumours. Inpatients were asked to identify goals using PSFS during their post-operative admission on initial assessment and discharge. Patients were asked to state current level of difficulty associated with each activity, with possible scores ranging from 0 to 10. Analysis was completed using SPSS software. Initial and discharge scores were represented as summary values and Wilcoxon Signed Rank test measured differences in pre and post scores.

Results:
Interim analysis from ten participants, 58.9 ± 21.8 (range 21-90) years; 6 men and 4 women were undertaken. 4 patients had undergone proximal femoral replacement, 2 pelvic surgeries, 2 spinal surgeries, 1 distal femoral replacement and 1 soft tissue excision. Most patients focused their goals around personal hygiene, transfers, mobility and stairs. PSFS scores were significantly higher at discharge [8.2 ± 1.9], after completion of PSFS guided rehabilitation compared to initial assessment [0.6 ± 1.0] [n=9,Z=-2.668,p=0.008**].

Conclusion:
Early results show the PSFS is feasible to use, easy to administer, useful in setting goals and priorities jointly with patients treated for musculoskeletal tumours and also promotes an individualised approach to rehabilitation.
Preliminary results of two stage intercalary diaphysis bone loss reconstruction combining Capanna technique and Masquelet induced membrane: the “Capasquelet” Technique.

Mr. Vincent Crenn¹, Mr. Alexis Combal¹, Mr. François Gouin², Mr. Yoann Varenne², Mr Denis Waast¹, Mr Franck Duteille¹
¹Chu Nantes, Nantes, France, ²Centre Leon Berard, Lyon, France

Introduction:
We describe an innovative technique of two stage bone loss reconstruction combining two described techniques: the Capanna allograft with inlay vascularized fibula and the induced membrane technique known as the Masquelet technique. We performed this surgery on three patients with at least 10 centimeters femoral diaphysis bone loss, and aim to analyze radiological bone healing delay and complications.

Methods:
One osteosarcoma with a pathologic fracture, one Ewing Sarcoma and one traumatic bone loss on an open fracture were operated in Nantes with this technique between 2018 and 2019, with a minimum follow-up of 6 months. We used an induced membrane technique with a spacer on a medullary nail in the first stage, followed in the second stage with a fibular inlay vascularized graft in a femoral allograft into the induced membrane. Stabilization of the combined graft reconstruction was done using an LCP plate.

Results:
Patient mean age was 29.6 (18-44), mean resection length was 173 mm (100-240), homolateral vascularized fibula autograft length was 220 mm (150-280), second stage surgery reconstruction duration was 403 minutes ( 350-460). Delay between the two stages was 17 weeks (8-23). Consolidation on both sides was done at five months (4-6). Full weight bearing was possible at 4,3 months (4-5). One revision surgery was done for one patient at three weeks for hematoma evacuation.

Conclusion:
Short bone healing time and early full weight bearing with this combined technique show promising results compared to literature. Osteoinductive role of the induced membrane could possibly play a positive role on the graft. This technique could be used in case of adjuvant radiation therapy to preserve the fibula graft and improve healing possibilities, in pathological fracture to restore bone length more easily, or in pure traumatic conditions. Longer follow-up is needed to better assess complications, and functional results.
Service Evaluation of Adult Orthopaedic Oncology Inpatient Rehabilitation Programme

Ms. Fiona Matthews1, Ms. Kate Scanlan1, Ms. Abby McCarthy1, Mrs. Sherron Furtado1, Mr Craig Gerrand1

1Royal National Orthopaedic Hospital NHS Trust, Stanmore, Middlesex, United Kingdom

Background:
A one week Inpatient Rehabilitation Programme [IRP] is offered following surgery for musculoskeletal tumours. In 2014, a Quality Improvement Development and Innovation Scheme [QIDIS] report set guidance for rehabilitation and in 2017, a related project demonstrated significant short-term improvement in outcomes following the IRP. Experiences of patients and staff about IRP have not been investigated. Our aim was to review patient experience and views of staff regarding Adult Orthopaedic Oncology Inpatient Rehabilitation Programme [IRP] at the Royal National Orthopaedic Hospital [RNOH].

Methods:
Thirty-five patients attending IRP in 2018 were invited to a focus group. Semi structured interviews were held with staff involved in IRP. Once data collection was completed, information was collated using thematic analysis.

Results:
Six participants consented to giving feedback. Interviews were recorded and themes identified. Ten staff interviews were completed. Patients underwent pelvic surgery (2), proximal femoral replacement (3), proximal tibial replacement (1). Diagnoses were chondrosarcoma (1), metastatic disease (3) benign tumours (2).

Patient feedback
Areas working well -
• Appropriate timing of IRP
• IRP increased independence and confidence
• Increased guidance with rehabilitation
Areas to improve –
• Information at pre-assessment
• Access to psychology
• Resources in multiple formats
• Discharge support & longer term functional expectations

Staff feedback
The week should be individualised. Optimisation could be achieved through pre-assessment, a goal orientated self-management approach, cohorting to enable discussion and education.

Conclusion:
IRP is invaluable in improving confidence, independence and function of patients following surgery for musculoskeletal tumours. The week should provide an individualised approach through pre-assessment, goal setting and self-management strategies.
Functional outcome and QOL after sarcomas of the foot and ankle region. Is early amputation justified?

Mr. Gerhard M Hobusch1, Mrs. Maria Anna Smolle2, Mrs. Carmen Trost1, Mr. Jörg Friesenbichler2, Mr. Marko Bergovec2, Mrs. Reinhard Windhager1, Mrs. Andreas Leithner2
1Medical University of Vienna, Department of Orthopedic and Trauma Surgery, Vienna, Austria, 2Medical University of Graz, Department of Orthopaedics and Trauma, Graz, Vienna

Introduction and Purposes:
For many surgeons most sarcomas of the ankle region (e.g. distal tibia, calcaneus, distal fibula) are clear indications for below knee amputations, based on reported high complications rates for reconstructions and a well-known good quality of life with exoprostheses. Therefore, the aim of the present study was to investigate the quality of life, patient satisfaction, and functional outcome.

Materials and Methods:
Out of 86 patients alive (62 Vienna 1977-2018/24 Graz 1998-2018) with sarcoma of the foot and ankle region 35 patients (40%; mean age (60 y), 18 male (51.4 %), 17 female (48.6 %)) were available for TESS, EQ-5D-5L, UCLA, MSTS and FLZ assessment. The patients were grouped into three groups: 1) n=14 resection with minor structure change (soft tissue resection, skin graft); 2) n = 12 resection with major structure changes (bone resection, free muscle slap) and 3) n=9 transtibial amputation. Chi-squared, descriptive statistics and non-parametric median comparison (p=0.05; CI 0.95%) were performed for statistical analysis.

Results:
Scores showed the following median values as well as non-parametric comparisons (group 1/ group 2/ group 3): TESS (p=0.59) (90/83/72); UCLA (p=0.533) (6.6/5.3/5.1); FLZ (p=0.890) (240/240/246); The EQ-5D-5L Score (p=0.50) (77/74/63). Further single values like EQ-5D-5L-anxiety: (p=0.339) (1.5/1.8/1.5) and EQ-5D-5L-self-care (p=0.19) (1,3/1,2/2,0) (both leftsided); MSTS (p=0.02) (26/21/20), MSTS-function (p=0.01) (4,64/3,40/3,43) and gait (0,08) (4,4/3,4/3,9). showed significant differences.

Conclusion:
Limb salvage surgery at the ankle region should be carefully considered and discussed with sarcoma patients expecting major structural changes, since functional and QoL outcome may not differ from amputees. Still amputees may appear superior in certain functional as well as QoL outcome. However, quantitative methods have limitations in small patient cohorts. These results were not unexpected and demonstrate the need of qualitative studies. Hence, Patient-Reported-Outcomes (PRO) research with triangulation measurement methods is necessary.
Service Evaluation of Therapy Management after Proximal Femoral Replacement for Metastatic Bone Disease – A Retrospective Analysis of 10 cases

Ms. Anjali Vaghela¹, Ms. Hannah Hughes, Mrs. Sherron Furtado¹
¹Royal National Orthopaedic Hospital NHS Trust, Stanmore, Middlesex, United Kingdom

Background:
Metastatic bone disease (MBD) of the proximal femur occurs in 10% of patients with cancer and requires surgical treatment. Surgical management aims to provide stable fixation allowing immediate weight-bearing and return to function. Patients who undergo proximal femoral replacement (PFR) for MBD often have an increased length of stay (LOS) and reduced one year survival compared to sarcoma patients. The MBD therapy pathway was therefore reviewed to identify factors contributing to increased LOS.

Methods:
A Retrospective analysis of 10 patients undergoing PFR for MBD was completed. Medical notes were reviewed. Demographics, functional milestones and activities of daily living (ADLs) achieved during admission, LOS, medical complications were analysed.

Results:
Mean age of patients was 63±17 (23-80) years. 60% male and 40% female. The diagnoses were metastatic prostate cancer (2), breast cancer (2), squamous cell (2), renal cell (3) and cancer of unknown primary origin (1). 50% of patients presented with pathological femoral fractures. Mean post-operative hospital LOS was 16±9 (4-31) days. On average patients achieved functional milestones of bed exercises on day 2, sit on edge of bed (SOEB) day 3, sit-to-stand day 4, walking day 5, slide-board exercises day 7 and stairs day 13. ADLs significant to patients’ return to normal living e.g. dressing, was achieved on day 9, toilet transfers day 10 and personal hygiene tasks day 12. Patients were discharged from therapies on day 14±9 (3-28). Patients also suffered from post-operative medical complications including sepsis, deep vein thrombosis and low haemoglobin.

Conclusion:
This project provides invaluable information about reasons for an increased LOS in patients undergoing PFR for MBD; including time taken to achieve their functional milestones and ADLs. It is hypothesised this may be due to a complex medical pathway. Delays are evident when compared to current RNOH guidelines, emphasising the need for specific MBD guidelines.
Lumbar Bone Metastases Of Synovial Sarcoma Treated With Stereotactic Body Radiation Therapy and Trabectedin

Mrs. Sara Gonçalves¹, Mr. António Silva¹², Mr. João Freitas², Mr. Rúben Fonseca², Mr. Paulo F. Tavares², Mrs. Margarida Borrego³, Mr. José M. Casanova²
¹Department of Radiotherapy, Coimbra University Hospital, Coimbra, Portugal, ²Bone and Soft Tissue Tumor Unit, Coimbra University Hospital, Coimbra, Portugal

Introduction:
Stereotactic Body Radiation Therapy (SBRT) consists of highly conformal large dose per fraction delivery increasing the biological effective doses beyond conventional fractionation, which is potentially beneficial in sarcomas. Trabectedin is a second line chemotherapy in advanced soft tissue sarcomas. There is not much data on the concomitant use of both but some of it indicates it may be beneficial.

Methods:
Clinical case description of synovial sarcoma bone metastasis treated with SBRT and trabectedin.

Results:
Male, 49 years old, Karnofsky 90%, with synoviossarcoma of right leg posterior tibial nerve diagnosed in 2017 after R+ excision of the lesion, treated with adjuvant radiotherapy. In July 2018 was detected a pulmonary lesion in the upper left lobe suspect of metastization, excised in August of 2018. Completed adjuvant chemotherapy in April 2019. Thoracic CT for reevaluation showed no suspect lesions. Because of intense lumbar pain he did a spine CT (02/10/2019) that showed a L3 lesion, confirmed by lumbar MRI (04/10/2019) as a metastatic expansive lesion on L3 body with epidural soft tissue compressing the dural sac. He did not present neurologic symptoms.
In the multidisciplinary meeting was decided to do radiotherapy and chemotherapy with trabectedin. He was treated with SBRT (24Gy/3fr) concomitantly with trabectedin (16-18/10/2019) without acute side effects. Clinical evaluation (6 weeks after SBRT): controlled pain with minimal analgesia, without neurologic symptoms. After treatment, lumbar MRI showed tumoral infiltration of L3. It was done decompression and excision of posterior arc (17/01/20), and posterior corporectomy (13/02/20) of L3. The pathological study showed morphological and immunohistochemical changes compatible with synoviossarcoma. He maintained treatment with trabectedin. Posterior imaging showed progression of disease with multiple metastasis: bone, muscular and pulmonar. The patient died on 27/08/2020.

Conclusion:
SBRT with concomitant trabectedin showed initially clinical good response, but without radiological or pathological response.
Prognosis and clinical outcomes of extra-thoracic solitary fibrous tumours

Ms. Sachi Shah¹, Mr. Amir Gahanbani Ardakani, Mr. Tim Briggs, Mr. Rob Pollock, Mr. Panos Gikas

¹Royal National Orthopaedic Hospital, United Kingdom

Introduction:
Solitary fibrous tumours (SFT) are rare spindle cell neoplasms which have been classified into thoracic and extra-thoracic. Traditionally, extra-thoracic SFT (ESFT) have been thought to have lower rates of malignancy compared to thoracic SFT. However, there is evidence that ESFT may behave more aggressively like the thoracic SFT counterpart.

The Royal National Orthopaedic Hospital is a tertiary referral centre for soft tissue sarcoma and we have examined our experience with these rare SFTs to clarify their prognosis and clinical outcomes. Our objective was to review histopathological data of ESFT and relate them to clinical outcomes.

Study Design & Methods:
All patients with a histopathological diagnosis of 'Solitary Fibrous Tumour' who presented to the Royal National Orthopaedic Hospital between 2006 and 2019 were reviewed. Demographics, pathological data (biopsy and resection), clinical data as well as treatment (surgical and oncological) were recorded and analysed. Follow-up data (including local recurrence, metastases, survival months) were recorded and analysed for cases up to 2017.

Results:
A total of 95 cases were reviewed. Of those, 28/95 cases had malignant histopathological findings. Of the malignant SFT, 15/28 cases had 'non-malignant' diagnoses on biopsy and malignant findings were picked up after complete resection. Local recurrence as well as metastatic disease were more common in malignant cases.

Conclusion:
The World Health Organisation classify these tumours as 'intermediate and rarely metastasising'. Our experience has shown that ESFTs have a higher rate of malignant behaviour than traditionally described. Histopathological data should be carefully examined for malignant features and these patients should be followed up and managed similarly to other high grade soft tissue tumours.
First use of Closed Incisional Negative Pressure Wound Therapy in oncological orthopaedic patients

Ms. Livia Gabriele\textsuperscript{1}, Mr. Gabriele Gariffo\textsuperscript{1}, Ms. Elisabetta Neri\textsuperscript{1}, Mr. Stefano Grossi\textsuperscript{1}, Mr. Matteo Ceccoli\textsuperscript{1}, Mr. Federico Sacchetti\textsuperscript{1}, Ms. Sheila Shytaj\textsuperscript{1}, Mr. Fabio Cosseddu\textsuperscript{1}, Mr. Antonio D’Arienzo\textsuperscript{1}, Mr. Lorenzo Andreani\textsuperscript{1}, Mr. Rodolfo Capanna\textsuperscript{1}

\textsuperscript{1}Università di Pisa - Aoup Cisanello Hospital, Pisa, Italy

Introductions:
Incisional negative-pressure wound therapy is recently spreading in orthopaedic surgery thanks to the evidence of reducing wound complications (dehiscence, sieroma and surgical site infections), especially in high risk patients. The aim of this study is to report our experience of surgical wound healing using NPWT devices compared to standard patch medications in a population of oncological orthopedic patients affected by musculoskeletal primitive and secondary neoplasia, involving bone and soft tissues, both benign and malignant surgically treated.

Methods:
We compare two groups of 26 oncological patients underwent surgical removal. After surgery the control group received standard medications, the ciNPWT group was treated with ciNPWT systems, negative-pressure wound therapy on sutured wound area for 14 days.

Results:
The primary outcome of our study is to compare the percentage of post-surgery wound site complications using ciNPWT device opposite to standard patch medications. In the control group, 4 patients (15.4%) presented sieroma, 2 (7.7%) dehiscence and 2 (7.7%) dehiscence and hematoma. In ciNPWT group occurred sieroma and dehiscence in 2 patients (7.7%). In total 30.7% of control group and 7.7% of ciNPWT group manifested wound site complications 2 weeks after surgery.
As secondary endpoint we evaluated final wound healing 8 weeks after surgery. We registered 4 (15.4%) delayed healing in control group, complete wound healing in all (100%) members of ciNPWT group.
The last outcome we considered was length of stay (LOS) in hospital between the two groups. LOS we reported was 6.3 days in control group opposite to 5.1 days in ciNPWT group.

Conclusions:
We concluded ciNPWT device can be beneficial in minimizing the incidence of short-term surgical site complications and decreasing length of stay in high risk patients as oncological orthopedic ones. However, further studies and longer follow up are necessary to confirm our results.
Evaluation of effectiveness and safety of microwave ablation as a minimally invasive treatment alternative for long bone tumors

Mr. Hendricus Nijland\textsuperscript{1}, Mr. Jinwen Zhu\textsuperscript{2}, Mr. Dingjun Hao\textsuperscript{2}, Mr. Guilin Huang\textsuperscript{2}, Mr. Tian Ming Yang\textsuperscript{2}, Mr. Paul Jutte\textsuperscript{1}

\textsuperscript{1}University Medical Center Groningen, Netherlands, \textsuperscript{2}HongHui hospital, Xi’an, China

Introduction:
Microwave ablation (MWA) is a minimally invasive treatment alternative for bone tumors. Local application of high temperatures leads to coagulation and instant cell death. MWA is already used on a small scale with hopeful results. However, literature on effectiveness and safety is limited and settings are empirically determined. Our aim is to extend knowledge on MWA in long bone and to build a diagram of expected halo size (ablated area) for different settings.

Method:
MWA was applied with different wattage and time settings in ex-vivo and in-vivo sheep long bones to determine macroscopic halo size. Microscopic analysis and MR images were used to validate macroscopic halo measurement. Furthermore, distribution of heat through the bone was measured at 10- and 15mm from the ablation needle and compared to halo size. Follow-up was divided in a 1-week and a 6-week group.

Results:
Halo size is significantly dependent of both time and wattage. Halo size gradually increases over time, with the largest increase in the first six minutes. After 12 minutes of ablation, halos reach up to 40cm\textsuperscript{3}. However, there is substantial variability in size. Temperature at 10- and 15mm from the needle mainly increases in the first four minutes, but keeps rising afterwards up to 65°C at 10mm and 63°C at 15mm.

One week after MWA a large reactive zone was seen around the needle path in macroscopic analysis. On MRI this area could not be differentiated from the rest of the halo. After six weeks halo size on MRI was significantly smaller compared to after one week. Macroscopically it was seen that tissue in the reactive area seems to recover.

Conclusion:
MWA is a promising, minimally invasive approach for treatment of long bone tumors. Results are still hard to predict. Recovery of tissue around the halo edge occurs over time.
Usage of absorbable attachment tubes in megaendoprosthetic reconstructions – a proof of principle

Ms. Wiebke Guder¹, Mr. Jendrik Hardes¹, Mr. Lars Erik Podleska¹, Mr. Markus Nottrott¹, Mr. Arne Streitbürger²

¹University Hospital Essen, Department for musculoskeletal oncology, Essen, Germany, ²University Hospital Essen, Klinik für Unfall-, Hand- und Wiederherstellungschirurgie, Essen, Germany

Introduction:
Existing literature suggests that use of an attachment tube when implanting a megaendoprosthesis reduces wound-cavity size, infection rates and may improve functional outcomes. But in event of an implant-associated infection, it also proves difficult to explant due to ingrowth of surrounding tissues - which might lead to nerve or vascular damage – and might maintain an infection in case of incomplete removal. Therefore, an absorbable attachment tube may be able to provide the advantages of reducing dead space and improving function without the long-term complications. In the absence of existing data on absorbable attachment tubes, it is the objective of this study to present our intermediate-term results achieved using a partially absorbable prolene mesh (ULTRAPRO®) in lieu of a conventional attachment tube.

Methods:
Interim analysis of prospectively collected data of thirty-eight patients who underwent implantation of a megaendoprosthesis using a partially absorbable prolene mesh.

Results:
A partially absorbable prolene mesh was used in thirty-eight patients. Implantation site was proximal femur (n=17; 44.7%), proximal humerus (n=10; 26.3%) and prox. tibia (n=4; 10.5%). Mean patient age at the time of operation was 42.9 years (range 7-87). Two patients had implant-retaining lavage revisions (n=2; 5.3%). One patient had to undergo secondary mid-thigh amputation due to soft tissue failure (n=1; 2.6%). One patient developed a deep implant-associated infection (n=1, 2.6%) with staphylococcus epidermidis and vancomycin-resistant enterococcus faecalis. Postoperative mobilization progressed without complications and postoperative functional outcomes didn’t vary compared to our non-absorbable attachment tube collective.

Conclusions:
The usage of a partially absorbable attachment tube in this collective is promising at short to intermediate term follow-up. The implant-associated infection rates are low with 2.6% and another 7.9% who suffered from attachment tube unrelated complications. Functional outcomes and progress of mobilization were not impaired, thus warranting further investigation and development of (partially) absorbable attachment tubes.
SURVIVAL ANALYSIS OF MYXOID LIPOSARCOMA: A RETROSPECTIVE EVALUATION OVER 20 YEARS

Mr. Pau Machado Granados, Ms ANA PEIRO IBAÑEZ, Ms LAURA TRULLOLS TARRAGO, Ms JUDIT MARTINEZ ZARAGOZA, Mr ROGER ROJAS SAYOL, Mr ISIDRE GRACIA ALEGRIA

1Hospital De La Santa Creu i Sant Pau, BARCELONA, España

Introduction:
Myxoid liposarcoma (MLS) is a malignant musculoskeletal tumor characterized by lipomatous differentiation with a myxoid stroma. The purpose of this study is to review the clinical information for patients treated for MLS at our institution and analyze the metastasis-free survival, local recurrence-free survival and overall survival.

Materials and Methods:
An institutional database of sarcomas was queried for patients who were treated for MLS at our institution between 1997-2017. A total of 60 patients with extremity myxoid liposarcoma were identified. Survival curves were constructed using Kaplan–Meier analysis, and multivariate statistics were performed using the Cox-proportional hazards regression.

Results:
The groups of cancer stages are divided in I, II and III with a 36.7%, 46.7% and 16.7% respectively. Treatments with radiation therapy and chemotherapy was 95% and 38.3% respectively. The 25% of these patients proceeded from other medical centers and received a second look surgery. The 83.3% of our surgeries had an R0 resection against the 16.7% that had a R1 resection. Five-year distant metastasis-free survival, local recurrence-free survival, and overall survival were 87.5%(95% CI: 76.0–93.5), 85.5%(95% CI: 74.0–92.5) and 91.0%(95% CI: 82.3–97.5) respectively. On multivariate analysis, the second look surgery is significantly associated with an increase of local recurrence. Hazard ratio for recurrence-free survival is 99.13(95% CI: 6.90–1423), p=0.001. On univariate analysis, five-year local recurrence-free survival in second look patients was 52.5%(95% CI:26.5-75) and 86.5%(95% CI:79.5-100) in patients with primary surgery.

Conclusions:
Our study supports similar rates of metastasis-free survival, local recurrence-free survival and overall survival of myxoid liposarcoma as literature reviews. The group that needed a second look surgery due to a whoops surgery is strongly related to an increase of local recurrence. A further research with a multicentric study would be necessary to improve our results.
The combination of amygdalin with some anti-cancer and anti-parasitic drugs against MG63 and Saos2.

Mr. Davut Aydın², Mr. Ali Aydın³, Mr. Saban Tekin⁴, Mr. Burak Ozturan¹,⁵
¹Medeniyet University, Istanbul, Turkey, ²Ministry of Health, Kayseri State Hospital, Orthopedics and Traumatology, Kayseri, Turkey, ³Ministry of Health, Tuzla State Hospital, Central Laboratory, Istanbul, Turkey, ⁴University of Health Sciences, Medical Biology, Istanbul, Turkey, ⁵Goztepe Prof. Dr. Suleyman Yalcin City Hospital, Istanbul, Turkey

Introduction:
Osteosarcoma has a poor prognosis and survival rate due to the fact that almost no radiotherapy is applied, poor chemotherapy, high recurrence ability, and high metastasis potential. One of the strategies to solve these problems is to develop new therapeutic systems. Nowadays, the importance of drug combinations in cancer treatment is increasing. As an important plant metabolite, amygdalin is known to have very different structural properties that can interact with biomolecules uniquely. Amygdalin, a cyanogenic glycoside, has been used in pharmacological studies for many years. In this project, the antiproliferative effects of amygdalin alone and in binary or triple combinations with some anticancer drugs (Cisplatin, 5-fluorouracil, Oxaliplatin, Camptothecin), antiparasitic drugs (Metronidazole and Miltefosine), and an anti-inflammatory drug (Colchicine) was examined using human bone osteosarcoma cell line (MG-63, Saos2) and normal cell line (FL).

Methods:
Cell proliferation assay was evaluated by MTT assay. Known IC50 values of the drugs used to obtain the optimum combination ratio were taken into consideration and the recommended combination ratios used in the Chou-Talalay method.

Results
The interaction between amygdalin and other drugs was experimentally demonstrated. Amygdaline and metronidazole, camptothecin, colchicine, oxaliplatin and 5-fluorouracil binary drug combinations in osteosarcoma MG63 cells have been shown to have a synergistic effect. Interestingly, the combinations of the amygdalin and other drugs not exhibited a synergistic effect in osteosarcoma Saos2 cells.

Conclusion:
In MG63, the strong synergistic effect seen in the combination of amygdaline with metronidazole, camptothecin, colchicine, oxaliplatin, and 5-fluorouracil double drug shows that these pairs can be used in the treatment of cancer. The synergistic effect caused by amygdalin decreases toxicity by increasing drug yield. In Saos2, amygdaline antagonism with other drugs prevents the use of these pairs together. Overall, the efficacy of amygdalin in the treatment of osteosarcoma should be assessed by in vivo tests.
10 years experience with the Xpand non-invasive expandable prosthesis

Mr. Yair Gortzak1,2, Mr. Omri Merose1,2, Mr. Solomon Dadia1,2, Mr. Yehuda Kollender1,2, Mr. Dror Levin1,2, Mr. Ortal Segal1,2, Mr. Alexander Nirkin1, Mr. Amir Sternheim1,2

1Tel Aviv Sourasky Medical Center, Tel Aviv, Israel, 2Sackler School of Medicine, Tel Aviv University, Tel Aviv, Israel

Introduction:
The non-invasive expandable Xpand endprosthesis has been in use for approximately 15 years. We summarize our 10 year experience with this implant in the setting of limb sparing surgery due to a primary bone sarcoma of the lower limb and evaluate the surgical and functional outcome of the patient group.

Methods:
20 patients had 27 prostheses implanted between the years 2007-2019. The study group consists of 10 males and 10 females. Average age at Xpand implantation was 10 years and 13 of 20 had the Xpand implanted at time of tumor resection. There were 15 Osteosarcomas and 5 Ewing’s sarcomas, involving 15 distal femurs, 3 proximal femurs and 3 proxima tibiae.

Results:
Six patients reached skeletal maturity, with no LLD at final follow up, with an average lengthening of 5.3 cm, and 78 months follow up. One patient was revised because maximum length was reached with the original implant. Their MSTS score averages 26 (23-27).

In 14 patients that did not reach skeletal maturity, 20 implants were used over time. Revision was necessary to continue lengthening in 3 patients, of which two became infected after a 2nd and 3 revision and ended up with an arthrodesis and an LLD of 9 and 5 cm respectively. Five patients experienced a mechanical failure and have not reached skeletal maturity and have not been revised yet. they were lengthened by an average of 2 cm (1.7-2.3) until failure occured.

Five patients died of disease, without LLD and an average lengthening of 1.3 cm. One patient experienced an early local recurrence and underwent an amputation. MSTS score in this group averages 21 (7-27).

Conclusions:
Proper leg length and function with the Xpand prosthesis is feasible and permits good function at maturity provided no complications occur. Mechanical failure is a problem not solved yet.
Outcomes following endoprosthetic replacement with cemented stems for proximal tibia tumors

Mr. Antoine Chalopin¹, Mr. Bader Tayara¹, Mr. Anas Nooh¹, Mr. Robert Turcotte¹
¹Mcgill University Health Center, Montreal, Canada

Purpose:
The proximal tibia is the second most common site for primary skeletal sarcomas. Modular endoprostheses are commonly used to reconstruct these defects. Studies focusing on the long term results of such prostheses are infrequent. Proximal tibia replacements are commonly associated with post-operative complications and poor functional results. We investigated the functional outcome and the complication rate after such procedure.

Methods:
Sixteen patients who had proximal tibia tumors resection and modular endoprosthetic reconstruction were identified in our clinical database between 1991 and 2019. Cementing was done according to the French paradox. Prospective sarcoma database and medical files were reviewed to identify the oncologic and functional outcomes (Musculoskeletal Tumor Society Score (MSTS) and Toronto Extremity Salvage Score (TESS)) and the incidence of complications according to the Henderson classification. All patients had a modular endoprosthetic system (MRS (Modular Replacement System) and the GMRS (Global Modular Replacement System) (Stryker Orthopaedics, Mahwah, NJ, USA)). Median age was 29.5 years (range: 13-80) and median follow-up time was 8.13 years (range: 1-19).

Results:
The overall five year and ten year survival rates for the patients were 74.5% and 63.4% respectively. The mean MSTS was 28.3 (range: 23-33) and the mean TESS was 85.2 (range: 65.2-99.1). The mean extension lag was 13.5° (range: 0 to 60°), the mean flexion was 105° (range, 20 to 135°). There was one superficial wound healing disturbance (Henderson type 1B). One patient required the bushings to be changed (Henderson type III). There was no aseptic loosening (Henderson type II) or mechanical failure. There were 2 deep infections (Henderson type IV) which 1 required two-stage revision.

Conclusion:
These results confirm that limb salvage with endoprosthetic replacement for proximal tibia tumors can achieve good functional results. The use of cemented implants according with the French paradox has shown a benefit with no aseptic loosening.
Reconstruction in Bony Tumours of the Foot and Ankle

Mr. Vijay Titus
Christian Medical College Vellore, Vellore, India

Intro:
Bony tumours of Foot and Ankle are not very common and many varied reconstruction options are present which are often perplexing as to which is the best one to choose for which case and when to do fusion.

Methods:
We reviewed records of all Foot Tumors from 2015 to 2017, those who had long time since last visit were clinically and radiologically reassessed, a MSTS scoring was done. We had 21 tumors, 12 male and 13 right side, age ranging from 14 to 54 yrs. There were 8 Distal Tibia, 6 Talus, 3 Calcaneal. There were 5 Osteo Sarcoma, 3 Ewings Sarcoma and 7 GCTs. There were 7 BoneGrafting (all Distal Tibia GCT One with Fibula and plate and Bone Substitutes) 6 Megaprosthesi$$^$$s including one Metatarsal, 4 fusions (more acceptable in Asian countries) (4 Ankle and one Metatarsal and 3 Fibular Graft, 4 Double Fibular Grafts and 3 Vascularized Fib Graft. There were 3 plates and 5 screws only DoubleFibula ankle fusions. There were 3 Flaps done for tumors in the foot. There were one medial malleolus reconstruction done with proximal Fibula.

Results:
All patients were followed up for minimum 2 yr, No nerve palsies there were 1 case of resurgery due to Non vascularized graft fracture, 1 case of sensory plantar deficits which recovered partially, one case local recurrence, reoperated, no amputations, no tendon injury. There was 1 supf infection and 1 deep infection which needed a wash out with antibiotics. There were 2 cases of skin necrosis needing only OPD resuturing. The MSTS scoring system was followed and an average score was 90 % was achieved and all except one returned to pre tumor status

Conclusions:
FootAnkle tumors are not so common tumors and when correct Reconstruction option used the results are gratifying.
Quantitative measurements of adaptive bone remodeling around the Cemented Zimmer® Segmental stem after tumor resection arthroplasty using dual-energy X-ray absorptiometry.

Mrs. Christina Holm1, Peter Frederik Horstmann1, Michael Mork Petersen1, Michala Skovlund Sørensen1

1Department of Orthopaedic Surgery, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark

Introduction:
Limb salvage surgery is currently offered to more than 90% of patients with bone or soft tissue sarcomas and to a greater extent also to patients with metastatic bone disease. The aim of the present study was to evaluate the adaptive remodeling of the periprosthetic cortical bone after insertion of a tumor prosthesis with a cemented stem.

Methods:
A prospective study of 21 patients (F/M=12/9), mean age 55 years (range 15-81) with metastatic bone disease (n=9), sarcomas (n=8) or aggressive benign tumors (n=4) who underwent bone tumor resection and reconstruction with a tumor prosthesis (Zimmer® Segmental 130 mm straight fluted cemented stem with trabecular metal (TM) collars) in the proximal femur (n=10), distal femur (n=9) or proximal tibia (n=2). Measurements of bone mineral density (BMD) were done postoperatively and after 3, 6, and 12 months of the periprosthetic bone and in both ankles by using dual-energy X-ray absorptiometry. BMD (/g/cm2) was measured in 4 regions of interest around the cemented stem and in one region of interest 1 cm proximal from the ankle joint. Repeated measures ANOVA and students paired t-test was used to evaluate BMD changes over time.

Results:
At 1-year follow-up, BMD compared to the postoperative value was seen in all 4 regions of interest with a statistically significant bone loss of 8-15%. The bone loss was most pronounced (14-15%) in the 2 regions of interest closest to the TM collar and lowest (8%) adjacent to the tip of the stem. After 1 year the decrease in BMD of the ankle on the affected extremity was 9% and the contralateral ankle was close to baseline.

Conclusion:
The periprosthetic BMD around the cemented 130 mm Segmental stem decreased significantly during the first postoperative year and is considered caused by a combination of stress shielding and immobilization.
Chondroblastomas in children and adolescents: Revision of 54 cases

Ms. Laia Brunet¹, Ms. Judit Martínez², Mr. Ferran Torner³, Ms. Mariona Sunyol³, Mr. Isidro Gracia², Ms. Ana Peiró², Mr. Pau Machado Franados²

¹Fundació Althaia, Manresa, Spain, ²Hospital de la Santa Creu i Sant Pau, Barcelona, Spain, ³Hospital Sant Joan de Déu, Esplugues, Spain

Introduction:
Chondroblastomas are an uncommon type of benign primary tumor of cartilaginous origin. They are usually localized in the epiphyysis of long bones in children and adolescents, predominantly males. They have a potential to local recurrence, but low metastatic risk. Clinically they present with pain, seldom with a palpable mass or pathologic fracture. The usual treatment of choice is surgical excision, and the definitive diagnoses is based on histopathology.

Methods:
We present a retrospective study about patients treated in Hospital Sant Joan de Déu (Barcelona) and Hospital de la Santa Creu i Sant Pau (Barcelona) between 1988 and 2018. We revised epidemiologic data and choices of treatment.

Results:
54 patients were followed with an age range from 6 to 26. The most frequent locations were the proximal epiphyysis of the humerus and the distal epiphyysis of the femur, followed by the proximal metaphyseal-epiphyseal region of the tibia, and the calcaneus. Initial presentation was pain, some patients presented with a limp and range of motion limitation. MRI in most cases showed an expansive lesion with well defined limits, hyperintense in T2 signal. 45 cases were treated with curetage of the lesion, usually associated with bone substitute. Six cases were treated with radiofrequency. Local recurrence was observed in five patients, which was surgically treated. Histopathology predominantly showed proliferation of mononucleated cells of chondroblastic appearance. Almost half of the cases had positivity for protein S-100 in tumor cells on immunohistochemical study.

Conclusion:
The most frequent location of chondroblastomas is the epiphysis of long bones, but it can affect other regions, like the calcaneus. Gold standard is curetage of the lesions and bony substitute in situ. Despite their potential local recurrence, in our series only five recurrence cases were observed. It is believed a correct surgical technique is essential to obtain satisfactory outcomes.
Critical analysis of Mirels score in preventing pathological fracture in long bone metastasis.

Mr. Christophe Carlier¹, Mr. Vincent Crenn¹, Mr. François Gouin¹, Mr. Philippe Rosset³, Mr. Mickael Ropars², Mr. Charlie Bouthors⁴, Mr. Frederic Saillant⁴, Mr. Paul Bonneviale⁵

¹Chu Nantes, Nantes, France, ²CHU Rennes, Rennes, France, ³CHU Tours, Tours, France, ⁴APHP, Paris, France, ⁵CHU Toulouse, Toulouse, France

Introduction:
The Mirels score is the most widely used decision-making tool in the therapeutic management of fracture risk metastases in long bones. The objective of this study was to carry out a detailed critical analysis of the different items of this score, and to evaluate other clinical and biological risk factors.

Methods:
Based on a multicenter retrospective study analyzing the data collected for 245 patients with long bone metastases, the distribution of each criterion of the Mirels and Katagiri scores between a group of metastatic fracture (MF) operated (n = 126) and a group of metastatic impending fracture (MIF) managed preventively (n = 119) was compared.

Results:
The Mirels score is little different between the MIF group and MF (respectively 9.50 vs 9.78). Large lesions and upper extremity location were significantly more frequent in the fracture-stage population (MF) (p = 0.003 and p = 0.021). The WHO score 3 or 4, an albumin of less than 35 g / l and a CRP of more than 10 mg / l are factors associated with fracture risk (respectively p <0.05, p = 0.019, p = 0.01).

Conclusion:
As pointed out in literature, the Mirels score does not have a sufficient prognostic value to predict the risk of fracture in a precise way: it underestimate upper-extremity localization. It should be supplemented by a greater weight of some of the items that constitute it and clinical and biological data of the patient.
Introduction:
The present study focuses on the patient’s experience of the immediate time following amputation and influence on the patient’s current quality of life after primary limb salvage surgery. Studies show that limb salvage surgery is correlated with higher complication rates, more operative interventions than amputations and might lead to less function after secondary amputation than primary. Having had secondary amputation, patients might retrospectively choose differently.

Methods:
The data was collected and analysed through semi-structured interviews, which were recorded and then transcribed. As a standardized questionnaire, the “Prosthetic Limb Users Survey of Mobility (Plus M_12)” was used. The Mayring content analysis method and descriptive statistics were applied to evaluate using quantitative and qualitative methods.

Results:
Amputation is seen as an improvement after a long course of disease with very little quality of life. How patients see the process in retrospect depends on their (1) personality; eg. their attitude is: “I want to die with both legs” [IP2]; they never adapt to the situation afterwards. Amputees with a positive attitude get quality of life back: [...] than I go out on the dock and hop into the lake [...]” [IP1].
However, the (2) treating physician’s view on amputation also plays a major role. The conscious and unconscious ways he presents this option influence the patient’s perception. This leads to the theory, that if psychological and functional implications can be minimized, a lot of pain would be avoided, if the option for earlier amputation had been shown. Still the patient has to agree with amputation or the quality of life after will suffer.

Conclusion:
The results should ascertain the best point in time for amputation and identify supporting that subsequently increase quality of life. The surgical option of ablation might be mentioned earlier in the course of recurrent complications when counseling patients.
Complications after pelvic reconstruction: allograft vs custom-made prosthesis

Mr. Fabio Cosseddu1, Mr. Lorenzo Andreani1, Mr. Federico Sacchetti1, Mr. Antonio D’Arienzo1, Mr. Lorenzo Andreani1, Mr. Paolo Domenico Parchi1, Mr. Rodolfo Capanna1
1Azienda Ospedaliera Universitaria Pisana, Italy

Reconstruction after pelvic resection represents a challenging issue in orthopedic surgery, especially when the integrity of periacetabular region is compromised. The aim of this study is to retrospectively compare periacetabular reconstructions with massive allograft and custom made (CM) prostheses in patients resected for pelvic tumors at our Institute, recording the complications rate and providing a review of literature.

The literature analysis, in compliance with 2015 Prisma Statement, was carried out on Pubmed portal. The casuistry collected from literature and our casuistry were both divided in two groups: one containing massive allograft reconstructions and one including reconstructions with CM prosthesis. For each group we recorded number of patients, mean follow up, Musculoskeletal Tumor Society Score (MSTS), rate and type of complications.

Of our 37 patients, 31 had a massive allograft and 6 had a CM prosthesis; the mean follow up was 28 months. Patients treated with allograft had a 61,7% mean MSTS and the following complications rates: 19% deep infection, 19% dislocation, 3% loosening. Patients who received a CM prosthesis had an 80% mean MSTS and the following complications rates: 0% deep infection, 17% dislocation, 0% loosening.

Reviewing the literature, we collected 42 papers and 518 patients. The 195 patients treated with allograft had a 67, 4% mean MSTS, 25% deep infection, 17% dislocation and 10% loosening; the follow up range was 2-102 months. The remaining 323 patients, reconstructed with a CM prosthesis had a 58, 4% mean MSTS and experienced the following complications: 14% deep infection, 14% dislocation, 4% loosening; the follow up range was 2-120 months.

Both literature and our experience corroborate the valence of massive allograft and CM prosthesis in periacetabular reconstructions. However the use of CM prosthesis seems to be more promising considering the lower rate of infective and mechanical complications and the better functional results.
Early physiotherapeutic rehabilitation of children and young adults with bone cancer of the lower extremities.

Ms. Alexandra Steinbauer¹,², Ms. Marie Hortig¹,², Mr. Ernst Eber¹, Mr. Martin Benesch¹,²
¹Univ. Klinik für Kinder- und Jugendheilkunde Graz, Graz, Austria, ²Klinische Abteilung für pädiatrische Hämostase-Onkologie, Graz, Austria

Primary bone cancers of the lower extremities among children and young adults do not only pose an existential threat to the patient but may also have a devastating impact on the individual’s quality of life. Depending on multiple factors such as size and location of the tumor, amputative or extremity-preserving treatment strategies may be chosen. Irrespective of the selected therapeutic procedure, the arising consequences pose a significant challenge on the physical, psychological and societal level of the patient. In order to enable the patient to achieve the highest possible functional status after surgery, rehabilitation measures demand highly interdisciplinary interventions and a closely orchestrated patient management. In this setting, physiotherapeutic rehabilitation is essential for successful remobilisation and constitutes a highly complex and challenging task for patients and parents. Based on the heterogeneous nature of patients and circumstances, “one-size-fits-all” approaches hold little promise and there is a definite need for individually tailored rehabilitation concepts. To cope with this challenge the physiotherapeutic team at the Division of Pediatric Hematology and Oncology in Graz establishes patient-specific rehabilitation strategies in close cooperation with all other relevant medical professions.
3-years follow up results after reconstruction of the pelvic ring by the metal-polymer endoprosthesis after I-III types internal hemipelvectomy

Mr. Anatolii Diedkov¹, Mr. Victor Kostiuk², Mr. Bogdan Maksimenko³, Mr. Sergey Diedkov¹

¹National Cancer Institute, Kiev, Ukraine

Introduction:
Surgical treatment of giant cell tumor (GCT) remains a problematic issue due to the significant risk of recurrence in conservative surgery and high complications after radical resections. Targeted therapy had a potential to solve this problem, but recent studies shown conflicting results. We compared such treatment in the era before targeted therapy (in the retrospective group) and with the neoadjuvant denosumab in the prospective group.

Materials and Methods:
We studied the results of treatment of patients with GCT of two groups who underwent intralesional surgery. Were included 49 patients with GCT who received 6 injection of denosumab (120 mg) as neoadjuvant therapy. Median follow-up was 45.8 months. Then patients underwent curettage with liquid nitrogen and bone cement plastic. In the retrospective group were included 81 patient who were treated with the same surgical method but without denosumab in period from 1998 to 2012 (median follow-up 76.3 months).

Results:
In all 46 patients was achieved positive effect of neoadjuvant therapy (decreased pain intensity after 2 week of treatment). In this group was 7 local recurrences (15,2 %) from 6 to 13 months after surgery. For patients with other localizations and recurrence - repeated courses denosumab followed by curettage. In retrospective group were 22 recurrences (27,2%) from 5 to 21 months (p=0.04)  There was no evidence of malignant transformation in the main group and one case in retrospective group.

Conclusions:
According to our analysis the conservative treatment of GCT with denosumab may significantly reduce local relapse rate in patients after curettage and does not impact to malignant transformation rate.
Biomechanical comparison of bone recycling methods in biological reconstructions.

Mr. Osman Emre Aycan, Mr. Kaan Erol, Mr. Bugra Alpan, Mr. Harzem Ozger

1Baltalimani Bone Diseases Training And Research Hospital, Istanbul, Turkey, 2Mehmet Ali Aydinlar University, Maslak Acibadem Hospital, Istanbul, Turkey, 3Istanbul Orthopaedic Oncology Group, Istanbul, Turkey

Introduction:
Reimplantation of recycled tumoral bone segments is gaining popularity in limb salvage surgery. Pasteurisation, autoclaving, irradiation, and liquid nitrogen freezing methods are most commonly used recycling methods. We sought to analyse the biomechanical comparison of four recycling methods and frozen allograft method on cortical bone.

Materials and Method:
Fresh ovine femurs which are at 1 year of age, with 2 mm cortical thickness and 25 cm length were used. 21 samples were used for each evaluated method and control group. The samples were pasteurized, autoclaved, irradiated and frozen at liquid nitrogen (-180°) as defined in the literature. For the to mimick the frozen allograft method the samples were kept at -80° for two weeks then thawed and prepared for tests. Control group was directly prepared for the tests. The evaluation groups were evenly distributed into three groups and each group was destined to compression, distraction and torsion tests in MTS Bionix 858.

Results:
Modulus and failure stress tests between the recycled bones and control group showed significant differences. Strain to failure was found lower in autoclaved and irradiated groups. Modulus was significantly lower in autoclaved and pasteurized groups. Liquid nitrogen freezing and frozen allograft method did not show difference by means of torsion, three point compression and compression tests. The histopathological evaluation demonstrated viable tissues in frozen allograft method and control group.

Conclusion:
When the immediate mechanical properties after recycling of the cortical bone are taken into consideration liquid nitrogen freezing method was not different than frozen allograft method. Autoclaving had the worst biomechanical properties. Irradiation and pasteurization had similar properties which were better than autoclaving but worse than liquid nitrogen freezing.
Do axial giant cell tumours have a worse outcome than those in the extremities?

Mr. Jakob Bollmann1, Mrs. Jessica Lange1, Mr. Burkhard Lehner1, Mr. Georg Walter Omlor1
1Center of Orthopedics, Traumatology, and Spinal Cord Injury, Heidelberg University Hospital, Heidelberg, Germany

Introduction:
Giant cell tumours of the bone (GCT) are usually localised in the extremities and known for aggressive growth and high local recurrence rates. Axial GCTs (spine and pelvis, Fig. 1) are rare and little is known about clinical outcome, functional outcome and patient satisfaction. The aim of this study was to evaluate if axial GCTs have a worse outcome than GCTs in the extremities.

Methods:
This retrospective cohort study includes 99 patients with GCT who were treated at our department between 2001 and 2017. 90 patients had a GCT in the extremities (40 male, 50 female; mean age at diagnosis: 35; mean follow-up: 119 months) and 9 patients had an axial GCT (7 spine, 2 pelvis; 3 male, 6 female; mean age at diagnosis: 26; mean follow-up: 80 months). Analysis of recurrences, metastases, complications, histological mitosis rates and Campanacci grade (I – III) was performed using Fisher-exact-tests and Mann-Whitney-U-tests. A general function outcome score (GFOS, 0=poor to 3=very good) was generated through validated localization-specific outcome scores. GFOS and patient satisfaction (0-10) were compared in both groups.

Results:
98 patients received surgical treatment. One patient (axial GCT) was treated conservatively. Axial (AX) GCT showed no difference to GCT of the extremities (EX) in local recurrence rate (AX 1/8 vs. EX 30/90; p=0.43), metastasis rate (AX 1/9 vs. EX 4/90; p=0.39,), postoperative complication rate (AX 2/8 vs. EX 11/90; p=0.29), Campanacci grade (AX 2.89 vs. EX 2.57; p=0.074), functional outcome (mean GFOS: AX 2.71 vs. EX 2.42; p=0.28) and patient satisfaction (AX 7.7 vs. EX 7.9; p=0.8). In both groups, a high mitotic rate was an indicator of a significantly higher local recurrence rate (p=0.005).

Conclusion:
Axial GCTs show good outcome parameters and are not worse to those in the extremities. Nevertheless, to reduce high recurrence rates, surgical treatment remains challenging.
Long-term outcome and patient related outcome measurements in patients with modular distal femoral and proximal tibial megaprostheses

Mr. Burkhard Lehner1, Mr. Georg Walter Omlor1, Mr. Korbinian Heubisch1, Mr. Sebastian Gippert1, Mr. Christian Merle1, Mr. Jakob Bollmann1

1Center of Orthopedics, Traumatology, and Spinal Cord Injury, Heidelberg University Hospital, Heidelberg, Germany

Introduction:
Limb sparing surgery with modular megaprostheses in patients with a tumour around the knee or with extensive bone damage in revision arthroplasty is a clinical challenge. Available data of long-term outcome and patient related outcome measurements (PROMS) is limited and heterogenous. Aim of the study was to evaluate long-term patient survival, implant survival, complications and PROMS in patients receiving a modular megaprosthesis around the knee.

Methods:
This retrospective cohort study includes 118 patients (mean age 39 years, 72 male, 46 female, 104 tumour patients, 14 revision arthroplasty) with a minimum follow-up of 5 years. The mean follow-up was 8 years. 3 patients were lost to follow-up. Explorative data analysis of patient survival, implant survival, implant specific complications and PROMS was performed. Kaplan-Meier analysis and Multivariate Cox regression were used to evaluate overall survival rates.

Results:
The mean follow-up 8-year overall survival rate was 82%. Patients with osteosarcoma had a better survival rate than patients with metastases (HR 7.28, p<0.001), revision arthroplasty (HR 4.13, p=0.007) or malignant soft tissue tumour (HR 3.47, p=0.021). 8-year implant survival rate for any kind of revision surgery was 39% (±35%-45%). Main reason for revision was mechanical complications (35%), aseptic loosening (34%) and infection (28%). Long-term limb salvage could be achieved in 92%. High BMI was a negative predictive factor for revision surgery. Gender, localization, anchoring technology and resection length had no significant influence in implant survival. Mean KOOS of 17(±6,6)/28 and mean Oxford Knee Score of 33(±9,9)/48 showed good functional outcome. Analysis of QoL demonstrated good physical function (PCS 42±5,9) and persistent mental stress (MCS 35±7,7).

Conclusion:
Implantation of modular megaprostheses around the knee due to a tumour or in revision arthroplasty is a reliable option for limb salvage with good clinical outcome and acceptable implant specific complications.
Limb-saving treatment of bone metastases in the lower extremity using a modular implant system

**Mr. Georg Walter Omlor**, Mr. Jakob Bollmann, Mr. Korbinian Heubisch, Mr. Sebastian Gippert, Mr. Christian Merle, Mr. Burkhard Lehner

1 Center of Orthopedics, Traumatology, and Spinal Cord Injury, Heidelberg University Hospital, Heidelberg, Germany

Introduction:
Modular tumor endoprostheses (MTEPs) are increasingly used for cases with bone metastases in the lower extremity, encouraged by longer live expectancies due to improved multimodal oncological treatment. Information on clinical outcome of MTEPs in these patients, however, is missing. Therefore, the present study analysed this subgroup of patients to define clinical outcome with survival and complication rates.

Methods:
This retrospective cohort study includes 84 consecutive patients (mean age 59, 41 male, 41 female) who received a MTEP between 1997 and 2013 due to bone metastases of the femur or tibia. Mean follow-up was 34 months. 2 patients were lost to follow-up. Kaplan-Meyer survival analysis was used to estimate the survival of patients and implants. The log-rank-test was used to compare the survival of subgroups by tumor entity.

Results:
The main tumor entities were kidney cancer (n=27), breast cancer (n=20), and lung cancer (n=12). 25 patients had other entities. 38 patients had pathological fractures and 7 had failed previous osteosynthesis. Improved mobilization and joint function were found postoperatively. Mean patient survival rate after 34 months was 33% (CI:23-43) for all entities. Survival of patients with lung cancer (0%) was significantly reduced compared to breast cancer (10%; CI:2-26; p<0.001). Kidney cancer demonstrated the best overall survival (58%; CI:36-75). At last follow-up, 75 (92%) patients had died due to their tumor disease.

The mean revision rate after 34 months was 16%. Reasons for revision were infection of the implant (n=4), recurrent hip dislocation (n=4), wound healing complications (n=2) and implant failure (n=2). Implant survival estimates were 93% (CI:90-96) at 3 years and 81% (CI:77-85) at 5 years.

Conclusion:
The present study demonstrates that MTEPs offer an effective treatment option with comparably low complication rates and good implant survival in patients with progressed metastatic disease allowing for early mobilization and immediate joint function.
Does Navigation Assisted Tumour Surgery Improve Margins in Pelvic Chondrosarcomas?

Mr. Vineet Kurisunkal¹, Mr. Bilal Kapanci², Mr. Jonathan Stevenson¹, Mr. Michael Parry¹, Mr. Lee Jeys¹
¹The Royal Orthopaedic Hospital, Birmingham, United Kingdom

Introduction:
Chondrosarcoma’s are largely considered to be resistant to chemotherapy and radiotherapy hence surgical resection remains the mainstay of treatment. Margin negative excision remains the gold standard of treatment in chondrosarcomas which often becomes challenging in the pelvis owing to the complex 3-dimensional anatomy. We believe that navigation assisted surgery would help the surgeon accomplish these goals in tumour surgery especially of the pelvis. The present study aims to assess the accuracy of computer navigation in achieving negative margins for limb salvage in pelvic chondrosarcomas when compared to a non-navigated group.

Methods:
Between January 2008 to May 2019, sixty-two consecutive patients with pelvic chondrosarcomas who underwent limb salvage were identified retrospectively from a prospectively maintained surgical database. They contained an equal proportion of non-navigated cases (31) and navigated cases (31). There were 44 (73.3%) male patients compared to 18 females with 40 cases over the age of 60yrs. All identified cases were assessed for grade of chondrosarcoma, site in pelvis, type of resection and reconstruction, margin status, local and distant recurrence.

Results:
Surgical margins achieved using navigation assistance was wide in 71% (22) of the cases when compared to 45% (14) in the non-navigated group with a significant decrease in our intralesional and marginal rates which were 22 percent in the navigation group compared to 48 percent in the non-navigated group.

Conclusion:
Use of computer navigation helps to attain safe oncological margins when performing complex limb salvage procedures for pelvic chondrosarcomas as seen in our data.
Hydrogen-peroxide reduces cell viability and induces apoptosis in chondrosarcoma and osteosarcoma derived cell lines

Mr. Georg Walter Omlor¹, Mrs. Astrid Schenker¹, Mr. Jakob Bollmann¹, Mr. Jörg Fellenberg¹, Mr. Burkhard Lehner¹
¹Center of Orthopedics, Traumatology and Spinal Cord Injury, Heidelberg University Hospital, Heidelberg, Germany

Introduction:
Cell toxic adjuncts like hydrogen-peroxide have been proposed to reduce the risk for recurrence after surgical treatment of bone- and soft-tissue tumors. Effectiveness was proven for giant cell tumor cells in a recent in vitro model. The aim of the present study was to analyze hydrogen-peroxide effects on other tumor entities like chondrosarcoma and osteosarcoma cells.

Methods:
Six commercially available osteosarcoma cell lines (MG63, MNNG HOS, 143B, U2OS, CAL-72, Saos-2), two commercially available chondrosarcoma cell lines (SW1553, CAL-78) and three self-established cell lines (Chondro-A, Chondro-H, Chondro-I) were used. 50,000 cells were seeded per well. Osteosarcoma cell lines were cultured in Dulbecco’s Modified Eagle’s Medium (DMEM), chondrosarcoma cell lines in Roswell Park Memorial Institute Medium (RPMI-Medium) with or without the addition of hydrogen-peroxide. A tumor cavity with remaining scattered osteosarcoma or chondrosarcoma cells was simulated in vitro and flushed with highly concentrated ready to use 3%-hydrogen-peroxide-solution (988 mM) for 3s, 1min or 3min and further incubated for 24h in DMEM or RPMI-Medium without hydrogen-peroxide to allow tumor cell recovery. Low-dose but long-term hydrogen-peroxide treatment was performed with 0.5mM, 1mM and 2mM hydrogen-peroxide solution for 4h. Cell viability was measured by propidium iodide staining (2.5µg/ml) and subsequent flow cytometric quantification of positive cells. Induction of apoptosis was quantified using the caspase-3 substrate NucView-488 for flow cytometry.

Results:
Hydrogen-peroxide significantly reduced cell viability of both osteosarcoma and chondrosarcoma cells to less than 23% without significant differences between the two tumor entities. Quantification of caspase-3 activation verified the apoptotic nature of hydrogen-peroxide induced cell death. High dose use was already effective after 3s without statistically significant difference to 1min or 3min application time. Longer (4h) but low dose application had similar effects.

Conclusion:
Hydrogen-peroxide significantly diminished osteosarcoma and chondrosarcoma cells in vitro, which supports additional use of this adjunct in clinical routine.
Management of bone and soft-tissue sarcomas during pregnancy: A single centre’s 36-year experience

Mr. Vineet Kurisunkal1, Mr. Jonathan Stevenson1, Mr. Michael Parry1, Mr. Lee Jeys1, Mr. Mohammad Khattak
1The Royal Orthopaedic Hospital, Birmingham, United Kingdom

Aims:
To describe the management of sarcomas during pregnancy and assess their oncological outcomes

Method:
Patients diagnosed with either bone or soft-tissue sarcomas during pregnancy or who had malignant progression of their initial diagnosis during pregnancy were identified retrospectively from our oncology database over 36 years (1983-2019). All information pertinent to their management was collected, including maternal and neonatal outcomes.

Results:
A total of 22 pregnant patients were identified; nine with bone sarcoma, eight with soft-tissue sarcoma and five with metastatic progression of their bone or soft-tissue sarcoma. Detailed discussions between the sarcoma multidisciplinary team (MDT) and obstetric teams took place throughout each patient’s pregnancy. Five underwent a termination of pregnancy. Five underwent surgery during pregnancy with no maternal or neonatal complications reported. Eight were induced early to allow for staging and definitive management without any neonatal complications. Maternal one-year and five-year survival rates for bone sarcomas were 100% and 62.5% respectively and 100% and 71.4% respectively for soft-tissue sarcomas.

Conclusion:
The management of bone and soft-tissue sarcomas during pregnancy is not associated with worse neonatal or maternal outcomes, with comparable maternal survival rates seen in the non-pregnant population.
Giant cell tumor of bone of the distal radius – Clinical outcomes after intralesional surgery

Ms. Lizz Van der Heijden¹, Ms Sjaan Bindt¹, Mr Maurizio Scorianz², Mr Max Gibbons³, Mr Domenico Andrea Campanacci², Mr Michiel Van de Sande¹
¹Leiden University Medical Center, Leiden, Netherlands, ²Azienda Ospedaliero Universitaria Careggi/CTO, Florence, Italy, ³Nuffield Orthopaedic Centre, Oxford, United Kingdom

Introduction:
Treatment of giant cell tumor of bone (GCTB) has changed since the introduction of denosumab from a surgical towards a multidisciplinary approach. In advanced GCTB, denosumab creates an ossified rim surrounding the soft tissue component, to facilitate intralesional surgery. However, similar to sometimes higher recurrence-rates were reported after denosumab. In this retrospective multicentre study, we evaluated oncological, surgical and functional outcomes after intralesional surgery for distal radius GCTB.

Methods:
We reviewed 35 patients with intralesional surgery for distal radius GCTB in three tertiary centres for orthopaedic oncology (1990–2016); three were excluded (two missing data, one follow-up <1year). We included 32 patients. Median age was 30 years (17-62). Median follow-up was 5 years (1-23). Nine had soft tissue extension (28%), four pathologic fracture (13%). Four underwent curettage only, 28 curettage with adjuvants including phenol, liquid nitrogen and/or PMMA. Thirteen had denosumab.

Results:
Recurrence-rate was 100% (4/4) after isolated curettage and 46% (13/28) after curettage with adjuvants. Median time to recurrence was 16 months (4-28). Recurrences were treated with curettage (1), curettage with adjuvants (11) or resection (5). Four had further recurrences, and were cured after curettage with adjuvants (1), resection (2), three soft-tissue excisions (1). Eighty-eight percent (28/32) was cured after repeated curettage.
Six patients had median 12 months neoadjuvant denosumab (5-15) AND 6 months adjuvant denosumab; 2 developed recurrence (33%). Seven patients had median 6 months neoadjuvant denosumab (4-10); 4 developed recurrence (57%). There were no pulmonary metastases.
Complication-rate was 9% (3/32) and included EPL-rupture treated with tendon repair (1), pain treated with tendon release (1), infection treated with antibiotics (1).
At final follow-up, median MSTS was 28 (24-30).

Conclusion:
Curettage with adjuvants resulted in a relatively high recurrence-rate for distal radius GCTB, also when additional denosumab was indicated. The large majority of patients was cured after repeated curettage.
Treatment of NTRK fusion-positive infantile fibrosarcomas with NTRK-inhibitors in two female patients

Ms. Victoria Katharina Tesch¹, Ms. Karina Maria Steiner¹, Mr. Thomas Perwein¹, Mr. Marko Bergovec², Mr. Alexander Pilhatsch³, Mrs. Bernadette Liegl-Atzwanger⁴, Mr. Wolfgang Schwinger¹, Mr. Markus G Seidel¹, Mr. Herwig Lackner¹, Mr. Martin Benesch¹

¹Division of Pediatric Hematology and Oncology, Department of Pediatrics and Adolescent Medicine, Medical University of Graz, Graz, Austria, ²Department of Orthopedics and Trauma, Medical University of Graz, Graz, Austria, ³Division of Pediatric Radiology, Department of Radiology, Medical University of Graz, Graz, Austria, ⁴Diagnostic and Research Institute of Pathology, Medical University of Graz, Graz, Austria

Introduction:
Infantile fibrosarcoma (IFS), a rare malignant mesenchymal tumor is characterized by fusion of Neurotrophic-Tyrosine-Receptor-Kinases (NTRKs) genes that act as oncogenic promoters and occur in up to 100%. We present the 2-year follow-up of two female patients (age 1 and 6) with NTRK-positive IFS, who were simultaneously treated with chemotherapy and TRK-inhibitors (Entrectinib or Larotrectinib).

Methods:
Retrospective chart review.

Case presentation 1:
A 5-month-old female presented with a painless soft-tissue mass in the left forearm (2.7 x 0.7 cm). Biopsy revealed IFS harboring ETV6-NTRK3 gene fusion. Staging examinations were negative. Partial remission after six cycles of chemotherapy including vincristine/vinblastine, actinomycin D and cyclophosphamide was considered inadequate to avoid subsequent mutilating surgery leading to initiation of Entrectinib. Complete sustained remission was achieved after six months of monotherapy. Entrectinib was continued for another year after achievement of complete remission. Thrombopenia was the only side effect during Entrectinib treatment.

Case presentation 2:
A 5-year-old girl was admitted with a large retroperitoneal mass (12 x 7.2 x 8.7 cm, volume 390 ml) arising from paravertebral soft tissue with infiltration of several vertebral bodies. Biopsy revealed IFS with a TFG-NTRK3 gene fusion. Chemotherapy was started according to the CWS Guidance and included ifosfamide, vincristine and doxorubicin or actinomycin. Due to the critical site and large tumor size Larotrectinib was given concomitantly from diagnosis. Following remarkable reduction of tumor volume (390 ml vs. 13 ml) after 8 weeks, proton radiotherapy was performed. Since PET-CT scan at the end of therapy was still positive, Larotrectinib will be continued for another year after the end of chemotherapy. Larotrectinib was well tolerated without any side effect.

Conclusion:
NTRK inhibitor therapy in NTRK fusion-positive infantile fibrosarcomas contribute to a remarkable reduction of tumor volumes with only mild adverse effects. However, the optimal treatment duration needs to be defined.
Customized jigs in joint sparing resection and massive allograft reconstruction

Mr. Maurizio Scorianz¹, Vittorio Vecchi³, Guido Scoccianti¹, Francesco Muratori³, Filippo Frenos¹, Davide Matera¹, Giovanni Beltrami², Domenico Andrea Campanacci¹
¹Orthopedic Oncology and Reconstructive Surgery - Careggi Universitary Hospital, Florence, Italy, ²Pediatric Orthopedic Oncology - Careggi Universitary Hospital, Florence, Italy

Introduction:
The aims of limb salvage using massive allograft are obtaining safe margins, preserving bone stock and shaping the massive allograft to the resected host bone.
Our study reviews the results of patients treated in our institution with a joint sparing resection guided by a custom-made jig followed by a biological reconstruction with a massive allograft shaped to the bone defect.

Methods:
Between December 2017 and October 2019, we performed six joint sparing resections using custom made jigs to perform the resection of the tumor and to shape the massive allograft to the resultant bone defect digitally planned before surgery. Custom made jigs were developed through an MRI and CT fusion of the bone segment of the patient and a CT of the allograft. The tumor was a parosteal osteosarcoma in 4 cases and an adamantinoma in 2 cases. The resection involved the proximal tibia in 4 cases and the distal femur in 2 cases. Mean follow up was 11 months (min 1 – max 23).

Results:
Free resection margins were obtained in all the patients treated with this technology.
One patient developed a complication 12 months after the first surgery of the tibia consisting in the rupture of the plate due to nonunion of the allograft. The complication was treated with the apposition of autologous bone graft in the nonunion site and performing a new osteosynthesis. No local recurrence was observed, all patients were NED at the last follow up. Mean MSTS at the last follow up was 25 (min 20 – max 30).

Conclusion:
In our study custom made jigs were crucial in obtaining a free surgical margin in joint sparing resections and to match the massive allograft to the bone defect.
The impact of surgical procedures on the outcome after resection of soft tissue sarcoma

Mr. Kevin Döring¹, Mr. Christoph Stihsen¹, Mr. Joannis Panotopoulos¹, Mrs. Alexandra Kaider¹, Mr. Reinhard Windhager¹, Mr. Philipp Funovics¹

¹Medical University of Vienna, Vienna, Austria

Introduction:
Soft tissue sarcoma (STS) is a rare primary malign neoplasm. The current management for high grade STS consists of surgical resection followed by radiotherapy, while (neo-)adjuvant chemotherapy might be applied in specific STS subtypes. In surgery, different methods of reconstruction might be taken for best functional outcome of the affected extremity. The aim of this study was to investigate the impact of different “extended procedures” of STS on survival of a large series.

Patients and Methods:
As a single-center retrospective cohort analysis, we evaluated 437 patients who were treated for STS between 1967 and 2006. This included 208 female and 229 male patients with a mean age of 49.4 years. The resection cohort consisted of 297 subjects (68%), the reconstruction group of 140 patients (32%). The reconstruction group was further differentiated into different modes of reconstruction, including endoprosthesis (32 patients), vascular (38 patients), nerve (17 patients), soft tissue (74 patients) and bone reconstruction (20 patients) groups. The mean follow up was 88.6 months.

Results:
The overall survival (OS) of the resection group was 85%, 61% and 51% at one, five and ten years, compared to 87%, 58% and 46% of the reconstruction group. The endoprosthetic reconstruction group showed the worst outcome, with a cumulative survival of 74%, 45% and 35% at one, five and ten years (p=0.05), while the bone reconstruction group showed the best outcome with a cumulative survival of 100%, 70% and 70% at one, five and ten years (p=0.03).

Conclusion:
This study showed no differences in survival parameters for patients treated with reconstruction after extensive resection, an aggressive approach in terms of wide resection followed by extensive reconstruction should be accepted in borderline cases.
Reverse Total Shoulder versus Allograft Prosthetic Composites Following Proximal Humerus Tumor Resection

Dr. Kamil Amer¹, Ms. Jennifer Thomson², Dr. Joseph Ippolito³, Dr. Kathleen Beebe¹, Dr. Francis Patterson³, Mr. Joseph Ippolito³
¹Rutgers, New Jersey Medical School, Newark, United States, ²Hackensack Meridian Health, Hackensack, United States

Introduction:
The proximal humerus is a common location for primary and metastatic tumors of bone. The increasing longevity of patients with metastatic disease coupled with higher-than-expected failure rates after internal fixation and radiotherapy has led to several options for proximal humeral resection and reconstruction. The most commonly used reconstructive techniques after proximal humeral resection include allograft and endoprosthetic reconstruction. The optimal method for reconstruction following proximal humerus tumor resection remains controversial. The objective of this study was to analyze and compare treatment outcomes between patients treated with Allograft Prosthetic Composite (APC) versus reverse shoulder arthroplasty (rTSA).

Methods:
From 1993-2019, 15 patients (Mean age 56±8; 10 females, 5 males) with proximal humerus tumors were treated with either APC or rTSA. Patient charts were evaluated for all patient characteristics, complications, primary malignancy, use of chemotherapy. The mean follow-up was 48.3 months.

Results:
Patients (10 female, 5 male) were treated with APC (8) and rTSA (7). Diagnoses included Chondrosarcoma (5), Metastatic Disease (3), Osteosarcoma (2), Pleomorphic Sarcoma (2), and Myeloma (1). All patients with metastatic disease were treated with rTSA. Patients with APC were younger than those with rTSA (47.7 vs. 61.3; p<0.05). Patients treated with APC sustained only non-oncologic complication (2 nonunion, 1 infection), while rTSA patients sustained only local recurrence (2). Mean resection length prior to APC (15cm) was larger than in rTSA. No significant difference was detected with regards to outcome or complication rates in patients treated with or without chemotherapy.

Conclusions:
Both APC and rTSA remain viable options for reconstruction after proximal humerus tumor resection. Considerations of patient age, resection length, and post-resection retention of soft-tissue structures play a role in clinical decision-making.
Intramedullary Stabilized Two-Staged Reimplantation Following Megaprosthetic Infection at the Knee: A Consecutive Series of 25 patients

Mr. Joseph Ippolito¹, Ms. Jennifer Thomson¹, Dr. Kamil Amer¹, Dr. Francis Patterson², Dr. Kathleen Beebe¹
¹Rutgers, New Jersey Medical School, Newark, United States, ²Hackensack Meridian Health, Hackensack, United States

Background:
Following deep infection of megaprostheses at the knee, subsequent radical debridement in a two-stage reimplantation protocol can create large defects which may be unstable with traditional antibiotic spacers. Intramedullary stabilized antibiotic spacers provide greater stability during antibiotic therapy prior to reimplantation.

Methods:
From 1998-2018, 25 patients (10 male, 15 female) were treated for megaprosthetic infection at the knee following oncologic (11) or non-oncologic treatment (14). Following debridement, defects were stabilized with antibiotic impregnated PMMA and intramedullary nails and underwent a standardized protocol of antibiotic treatment, repeat cultures, and trending of inflammatory markers. Success was defined by reimplantation without additional infection-related complications requiring reoperation.

Results:
Successful reimplantation was achieved in nineteen (76%) patients. Mean defect size was larger in oncologic than non-oncologic patients [27.7±6.3cm vs. 13.1±6.2 cm; p<0.0001]. Mean time to infection was longer in oncologic patients but not statistically significant [62.3±72.0 vs. 19.5±17.8; p=0.067]. Limb retention rates were comparable for oncologic versus non-oncologic patients [81.8% (9/11) versus 93.3% (14/15); OR 3.9; 95% CI, 0.7 to 20.8; p=0.112].

Conclusions:
Following radical debridement for infection, staged management of large segmental defects at the hip and knee with antibiotic cement and temporary intramedullary stabilization results in a 76% success-rate of limb salvage with infection control. Use of intramedullary nails for the stabilization of large tumor-like defects during two-staged revision results in 76% successful infection resolution and 88% limb-retention rate.
An Orthoplastics Approach to Extremity Reconstruction Following Oncologic Resection Decreases Number of Return Trips to Operating Room

Ms. Jennifer Thomson1, Ms. Margaret Dalena1, Dr. Haripriya Ayyala1, Dr. Joseph Ippolito1, Mr. Nicholas Oleck1, Dr. Ramazi Datiashvilli1, Dr. Kathleen Beebe1, Dr. Edward Lee1, Mr. Joseph Ippolito1

1Rutgers, New Jersey Medical School, Newark, United States

Purpose:
A multidisciplinary approach following tumor resection is an emerging trend in orthopaedic oncology. In this study, the authors evaluate outcomes and complications following orthopedic tumor resection and investigate the impact of an orthoplastics approach on patient outcomes.

Methods:
Patients who underwent lower extremity tumor resection with involvement of a plastic surgery team between 2000-2017 were retrospectively reviewed. Reconstruction was considered primary if plastic surgery was involved concurrently with the orthopedic team for immediate reconstruction, or secondary if plastic surgery occurred at a later date. Comparisons between primary and secondary reconstruction groups were made utilizing Pearson’s $\chi^2$ and t-test, with $p<0.05$ as the degree of statistical significance.

Results:
Thirty-four patients underwent primary reconstruction and 10 underwent secondary reconstruction. In the primary group, 22 tumors involved bone, 4 soft tissue, and 8 had bone and soft tissue involvement. In the secondary group, 8 involved bone and 2 had bone and soft tissue involvement. There was no significant difference in mean tumor resection volume between primary and secondary reconstruction [559 ± 939.4 versus 464± 593; $p=0.7750$]. A total of 42 complications were experienced in the primary reconstruction group, and 26 complications in the secondary reconstruction group. Major complications were significantly lower in patients with primary plastic surgery involvement [OR 0.37; $p=0.034$]. There was no significant difference in rates of minor complications between the two cohorts ($p=0.1959$) [Table 2]. Patients in the primary reconstruction cohort required significantly fewer returns to the operating room [1.61 versus 2.58, $p < 0.01$].

Conclusion:
A combined ortho-plastics approach to lower extremity reconstruction following tumor resection is a safe and effective alternative to traditional multi-stage reconstruction, resulting in a lower number of return trips to the operating room.
Reconstruction Methods Following Pelvic Resection: A Systematic Review of Options

Ms. Jennifer Thomson¹, Dr. Joseph Ippolito¹, Dr. Kamil Amer¹, Dr. Kathleen Beebe¹, Mr. Joseph Ippolito¹
¹Rutgers, New Jersey Medical School, Newark, United States

Introduction:
The objective of this study was to perform a systematic review of the literature investigating outcomes following pelvic resection by method of reconstruction, as well as by resection type as described by Enneking and Dunham.

Methods:
A review of the literature was conducted of studies reporting on outcomes of reconstruction following pelvic tumor resection prior to December 2019. After review, 28 studies (695 patients) met inclusion criteria.

Results:
Mean follow-up was 60 ± 31 months. Most common reconstructive options included Stem and cup following Type II resection, autograft reconstruction following Type I + II resection, and saddle prosthesis following Type II + III resection, APC following type I-III resection, and custom prostheses following type I-IV resection. Overall recurrence rate was 17.5%, while non-oncologic complication rate was 35%. Significant (p=0.005) variability exists with regard to non-oncologic complication rates by method of reconstruction: Saddle (43.3%), Stem and Cup (45.5%), Custom (34.2%), APC (32.3%), Autograft (27.1%). Patients with stem and cup prostheses had highest rate of soft-tissue complication [OR 5.1; 95% CI, 2.4-10.3]. Patients with APC had lowest rates of aseptic loosening or nonunion [OR 0.13; 95% CI, 0.01-0.70], but highest rates of mechanical failure [OR 3.3; 95% CI, 1.5-7.0]. Patients with Autograft had lowest rate of deep infection [OR 0.32; 95% CI, 0.18-0.55]. Mean MSTS score by reconstruction method was as follows: Autograft (78%), Stem and Cup (70%), Custom (61%), and Saddle Prostheses (52%).

Conclusions:
Numerous viable options exist for reconstruction following pelvic resection and may be guided by anatomic location, disease characteristics, and surgeon preference. Saddle prostheses have the poorest functional outcome and second highest rate of non-oncologic complications. Data regarding stem and cup design is limited by shorter-term follow-up than other methods of reconstruction. Autograft reconstruction was associated with the highest MSTS scores and lowest non-oncologic complication rates.
Sarcopenia as Evaluated by Psoas Cross-Sectional Area is a Predictor of Complication Following Treatment of Lower Extremity Metastatic Disease

Dr. Joseph Ippolito¹, Ms. Jennifer Thomson¹, Dr. Zachary Cavanaugh¹, Dr. Kamil Amer¹, Dr. Kathleen Beebe¹, Dr. Francis Patterson², Mr. Joseph Ippolito¹

¹Rutgers, New Jersey Medical School, Newark, United States, ²Hackensack Meridian Health, Hackensack, United States

Background:
Surgical decision-making in patients with metastatic disease is multifactorial and made on an individual basis. Previous studies have evaluated the role of sarcopenia as measured by psoas cross sectional area (PCA) as a predictor of complication following orthopaedic surgery. The objective of this study was to report on outcomes following treatment of metastatic disease at the lower extremity assess the PCA among patients with and without non-oncologic complication.

Patients and Methods:
Patients (104) treated surgically for metastatic disease to the femur or tibia from 2001-2017 were retrospectively reviewed. Patient information including age, gender, diagnosis, method of surgical treatment, and complication type was collected for analysis. Psoas cross-sectional area was measured on axial CT cuts at the L4-L5 disc level which were obtained perioperatively.

Results:
Seventy-three (36 male, 37 female) patients had perioperative CT scans reviewable to assess psoas cross-sectional area and were treated by endoprosthesis (41) or plate/nail fixation (32) at the femur (70) or tibia (4). Mean age was 61.8±14.4 years old. Mean follow-up was 21.5± 27.1 months. Most common diagnoses were breast (24), renal (15), prostate (8), and lung (7) cancer. Nearly half of patients (46%) presented with displaced pathologic fractures. Overall complication rate was 16% and comparable following endoprosthesis or plate/nail fixation (p=0.455) and by pathologic diagnosis (p=0.977). Psoas cross sectional area was significantly smaller in patients who sustained non-oncologic complications for both males [1310cm² vs. 1816cm²; p=0.024] and females [819cm² vs. 1298cm²; p<0.001].

Conclusions:
 Patients with sarcopenia as measured by psoas cross sectional area may be at increased risk for complication postoperatively and should be counseled accordingly. Future larger scale studies to investigate the utility of psoas cross sectional area as a measure of sarcopenia are warranted prior to the broad application of these findings.
What is the Role of Arthroscopy in PVNS? A consecutive series of 53 patients treated for PVNS of the Knee.

Mrs. Jennifer Thomson¹, Dr. Kiauntee Murray¹, Dr. Joseph Ippolito¹, Mr. Luis Guinand¹, Dr. Kathleen Beebe¹, Dr. Francis Patterson², Mr. Joseph Ippolito¹

¹Rutgers, New Jersey Medical School, Newark, United States, ²Hackensack Meridian Health, Hackensack, United States

Introduction:
Pigmented Villonodular Synovitis (PVNS) is an uncommon proliferative condition which commonly affects the knee. Treatment options include arthroscopic synovectomy, open synovectomy, or a combination of the two. The objective of this study was to analyze outcomes by treatment type and anatomic location.

Methods:
From 2002-2019, 53 patients (Mean age 42±14; 39 females, 14 males) were treated for PVNS at the knee by either arthroscopic or open synovectomy with or without arthroscopic assistance. Patient charts were evaluated for tumor volume, recurrence and infection rates. Mean follow-up was 33 months.

Results:
Patients were diagnosed with diffuse (31) PVNS (DPVNS) or localized (22) PVNS (LPVNS). Mean tumor volume was 18cm³ for patients with LPVNS versus 228cm³ for DPVNS. Patients with DPVNS were treated with open synovectomy with or without arthroscopic assistance. Arthroscopy alone was only utilized in (8) patients with LPVNS and resulted in no local recurrence or other complications. Patients who suffered recurrence had a higher mean tumor volume [57.5±93.9 versus 139.8±166.9; p=0.039]. Patients with DPVNS had a significantly increased risk for recurrence, regardless of treatment [35.5% versus 4.5%; p=0.002]. Most (2/3) patients with DPVNS who underwent arthroscopic-assisted synovectomy with disease both anteriorly and posteriorly suffered recurrence, while DPVNS patients treated only with open synovectomy had a 31% recurrence rate. No difference in rate of infection by treatment was detected (p=0.610).

Conclusions:
A variety of treatment options exist for patients with PVNS of the knee and should be guided by anatomic and disease considerations. Patients with DPVNS and larger tumor volume are at greatest risk for recurrence, regardless of treatment method. Patients with arthroscopic treatment alone for LPVNS of a mean volume of 15cm³ had no local recurrence or other complications. Arthroscopic-assisted synovectomy in patients with DPVNS anteriorly and posteriorly may increase local recurrence risk.
Endoprosthetic replacement of growing patients with bone sarcoma

Ms. Marieke De Vaal¹, Mr. Niklas Deventer¹, Mr. Georg Gosheger¹, Mr. Sebastian Bockholt¹, Mr. Tymoteusz Budny¹, Mr. Timo Lübben¹

¹Universitätsklinikum Münster, Münster, Germany

Introduction:
In growing children with bone sarcomas of the lower extremity that require removal of the growth plate, an expandable endoprosthesis for reconstruction is commonly used. This study aimed to evaluate postoperative complications and the functional outcomes of these patients.

Methods:
This study retrospectively analyzed postoperative outcomes and postoperative complications for 55 children with bone tumors of the lower extremity that underwent a reconstruction with an expandable prosthesis in Universitätsklinikum Münster, Germany between 2003 and 2018.
We used the ISOLS classification system to distinguish the different types of complications after endoprosthetic reconstruction. The range of motion (ROM) and the Musculoskeletal Tumor Society (MSTS) score were applied to evaluate functional outcomes at the most recent follow-up.

Results:
A total of 55 cases were included. Mean patient age was 9.5 years (range 4-17). Mean follow-up was 76.8 months (range 1-185). The growth module was not implanted in 19 of the 55 cases (9 metastases, 2 patient’s wish, 1 aseptic loosening, 2 no limb length discrepancy, 3 temporary hemiepiphysiodesis other extremity, 2 not clear).
In 53% of the remaining 36 cases, a postoperative complication occurred (9 infection, 4 mechanical failure/breakage of the implant, 1 local recurrence, 2 aseptic loosening, 1 Periprosthetic fracture, 4 Patients lost to follow-up).

Conclusion:
An expandable prosthesis can offer good function however, these results show that there is a relatively high complication rate after reconstruction with an expandable prosthesis. Therefore, we recommend an adequate patient selection.
Caring for patients with primary malignant bone and soft tissue tumors - a qualitative survey of their needs during and after inpatient treatment

Ms. Sandra Hacker1, Ms. Anna-Theresia Kourimsky1, Ms. Carmen Trost1, Mr. Philipp Theodor Funovics1, Mr. Joannis Panotopoulos1, Ms. Reinhard Windhager1, Mr. Gerhard Martin Hobusch1

1Medical University Vienna, Vienna, Austria

Introduction:
During inpatient treatment the first line of communication are the nurses. They identify potential conflicts and problems for patients with primary malignant bone and soft tissue tumors – also in the aftercare at home. The idea of an ‘one way suits all’ process is neither appropriate nor efficient and the interest of improving the quality of care of these patients is growing.

Methods:
To raise the needs of these patients, semi-structured interviews with 10 patients in a period of one month were held. Mayring content analysis was used for evaluation.

Results:
The crucial point is the information transfer in the doctor-patient communication. Waiting for medical information, the discussion of results (e.g. histology, surgery, blood) and the further procedure leaves patients in the dark. They are bothered by the uncertainty, which sometimes takes not only hours but days. In addition, patients also experience the communication between departments (e.g. Orthopedics and Oncology) as dissatisfying and criticize the long wait for stays at rehabilitation facilities.

Conclusion:
Evaluating hospitalization the focus is often on the nurse - patient relationship. The interviewed patients retrospectively attach less weight to this relationship than expected. The factor of time plays a major role in all facets. It runs like a thread through the hospitalization – actually throughout the whole course of the disease. Waiting for examinations, waiting for results, waiting for information about the further procedure - the time that elapses waiting for information is plagued by uncertainty. Making this situation as tolerable as possible is a next step in caring for patients with primary malignant bone and soft tissue tumors.
Outcomes of Cemented Distal Femoral Replacement Using “Line to Line” Technique With All-Polyethylene Tibial Implant for Tumors

Mr. Bader Tayara¹, Mr. Anas Nooh¹, Mr. Antoine Chalopin¹, Mrs. Krista Goulding¹, Mr. Robert Turcotte¹

¹Mcgill University, Montreal, Canada

Background:
Both cemented and cementless stemmed endoprosthetic implants have been used to reconstruct large skeletal defects after tumor resection with similar outcomes. In this study, we examined the oncologic, clinical, and functional outcomes in patients undergoing distal femur replacement using the French paradox technique.

Methods:
A total of 125 patients who underwent distal femur replacement between 1990 and 2019 using the line-to-line cementation technique were reviewed. Implant failure was recorded as per Henderson’s classification. Functional outcomes were analyzed using the Musculoskeletal Tumor Society and Toronto Extremity Salvage Score scoring systems. The mean follow-up was 84 (1-350) months.

Results:
Aseptic loosening of the femoral stem was recorded in one patient at 21-years of follow-up. Twenty of 125 patients required bushing exchange for polyethylene wear, all after 10 years. Six tibial bearing component fractures were recorded in four patients while one femoral stem component Morse taper fractured. Two all-polyethylene cemented tibial implants were revised for polyethylene granuloma. Deep surgical site infection occurred in 13 patients, while six patients experienced local recurrence. Kaplan-Meier estimates for implant survival for all-cause revision were 85% at 1 year and 70% at 5 years. These estimates for femur or tibia loosening as an end point were 96% at 10 years and 90% at 15 years. The mean Musculoskeletal Tumor Society and Toronto Extremity Salvage Score scores at the last follow-up were 76% and 74%, respectively. Thirty-five patients died of disease progression.

Conclusion:
The line-to-line cementation technique, used with all-polyethylene tibial implants, demonstrates low incidence of aseptic loosening at medium and long-term follow-ups.
Biological reconstruction after resection of primary malignant bone tumors

Mr. Frank Traub1, Ms. Isabell Sperrhake2, Mrs. Saskia Sachsenmaier3
1Center for Orthopaedic and Trauma Surgery, University Hospital of Johannes Gutenberg-University, Mainz, Germany, 2University Hospital of Eberhard Karls University, Tuebingen, Germany

Background:
The prognosis of patients with primary malignant bone tumors improved and thus the proportion of limp sparing resections and reconstruction procedures has steadily increased. Whenever possible, biological reconstruction techniques should be used with the aim to achieve permanent reintegration and modelling while maintaining the functionality of the donor site.

Objectives:
This study reports on the indication, methods, functional outcome and problems of fibula transplants for defect reconstruction after resection of malignant bone tumors in the long bones of the extremities.

Study Design & Methods:
From our prospective database we were able to evaluate 20 patients (8f, 12m) in whom resection of a malignant bone tumor of the extremities was performed and defect reconstruction with a fibular graft was performed. Patients with an Ewing’s sarcoma and osteosarcoma were treated according to the actual protocol.

Results:
A reconstruction was performed 3 times on the humerus, 12 times on the femur and 5 times on the tibia. Osteosarcoma and Ewing sarcoma were the most common tumors (10 and 6 cases). The other entities were chondrosarcoma and adamantinoma. In all patients, an R0 resection was achieved, and local tumor recurrence did not occur. 17 of the 20 grafts united in an average period of 4.9 months (range 3–8) after transfer. Weight bearing was increased depending on the postoperative radiographic findings in all patients. The full load on the affected limb was released after 4–14 months (median 8 months). Patients with a Ewing sarcoma receives additional radiotherapy (3 cases) and showed a delayed unionen or developed a pseudarthrosis.

Conclusions:
Good functional and durable results can be obtained by using fibula grafts for the reconstruction of metadiaphyseal defects of the long bones. In the upper extremity the functional results are excellent. Radiotherapy in the multimodal setting increases the risk for graft or fixation failure.
No improvement of failure rate after resection of primary bone tumors and reconstruction with second-generation mega-prostheses.

Mrs. Christina Holm1, Ms. Michala Skovlund Sørensen1, Ms. Müjgan Yilmaz1, Mr. Michael Moerk Petersen1
1University Hospital, Rigshospitalet, Copenhagen, Denmark

Previous multicenter studies reports variable outcome and revision rates after mega-prosthetic reconstructions for bone sarcomas in the lower extremities. Purpose of present study was to evaluate if 1) use of second-generation mega-prostheses result in lower cumulative incidence of major- and minor revision and also limb amputation compared to our first generation prostheses and 2) if the overall patient survival in a population based cohort of sarcoma patients has changed over time.

A retrospective study of 72 consecutive patients (F/M=30/42), mean age 44 (range 7-84) years with bone or soft tissue sarcomas (n=67) or aggressive benign bone tumors (n=5) having surgery between 2006 and 2016 with bone resection and reconstruction with mega-prostheses. Kaplan-Meier survival analysis was used for evaluation of overall patient survival. The Aalen-Johansson estimator was used to assess the cumulated incidence of major- and minor revisions and also limb amputation. Grays test and log-rank test were used to assess differences between groups. Functional outcome was evaluated using MSTS score.

Forty-seven patients were alive at follow-up. Twenty-eight patients (39%) underwent revision for all causes. Overall 10-year patient survival was 61% (95%CI 48-74%) with no difference over time (p=0.9). Ten-year incidence of major- and minor revision was 18% (CI: 9%-28%) and 25% (CI: 14%-36%) respectively with no difference between first and second-generation prostheses (p=0.9 and p=0.2 respectively). Ten-year incidence of amputation was 11% (95%CI: 3%-18%) with no difference between first and second-generation prostheses (p=0.9). Mean MSTS score was 20 (67%) (range 6-30).

Our results are comparable to other findings, with regards to limb and prosthesis survival, and also functional outcome. We found no difference in risk of revisions or limb amputation compared to our previously published findings (Holm et al. Int Orthop 2018;42:1175-81). For future evaluations of tumor prostheses we advocate using competing risk analyzes in order to achieve valid estimates.
Damage of the Metal-on-Metal coupling in modular tumour endoprostheses (MUTARS®)

Mr. Burkhard Lehner¹, Mrs. Therese Bormann², Mr. Jakob Bollmann¹, Mr. Sebastian Jäger², Mr. Jan Philippe Kretzer², Mr. Georg Walter Omlor¹

¹ Center of Orthopedics, Traumatology, and Spinal Cord Injury, Heidelberg University Hospital, Heidelberg, Germany, ² Laboratory of Biomechanics and Implant Research, Center for Orthopedics, Trauma Surgery and Spinal Cord Injury, Heidelberg University Hospital, Heidelberg, Germany

Introduction:
Nowadays limb salvage in patients with malignant bone tumours is often achievable using modular tumour endoprostheses. Compared with primary knee arthroplasty the revision rate of modular endoprostheses is higher and often multiple revisions are necessary, because of infection and mechanical complications like aseptic loosening, periprosthetic fractures and damage to the coupling mechanism. For better understanding the implant associated mechanical complications we analysed and classified the occurring signs of wear on the Metal-on-Metal coupling (MOM) in explanted MUTARS® tumour endoprostheses around the knee.

Methods:
In this study 44 explants from our institutional explant register were included. The implantations were performed between 1997 and 2017, the explantations between 2001 and 2018. The mean implant survival was 2.8 years (±3.4; 0.04-14.3). To evaluate the wear of the MOM-coupling mechanism abrasion of the pin and bushing surface (fig. 1) was assessed with a score (similar to Hood- and Goldberg-Score) from 0 (no abrasion) to 3 (strong abrasion). The assessment was performed visually after cleaning.

Results:
The coupling mechanism showed a conspicuous damage pattern with partly strong traces of abrasion both on the sliding and bushing surface at a median of 1.9 points. With moderate or strong abrasion (scoring 2 or 3), distinct notches could be seen on the heads of the pins. Light abrasion (scoring 1) of the MOM-coupling was observed after short standing time up to 5 months. One coupling showed a pin fracture, four others showed a broken bushing. Occasionally, further damage such as fissures on the bushings or mechanical deformation of the pin occurred. A low correlation between the coupling abrasion and the implant standing time was seen.

Conclusion:
Despite good results of modular MUTARS® endoprostheses the coupling mechanism still shows relevant error potential. The exact analysis of the damage mechanisms could lead to improvement of the biomechanical coupling concept.
3D printed patient-specific implants in bone tumour surgery. Are we really innovative? Xenotransplantation in XIX and XX century - a historical prelude to modern bone tumour surgery

Mr. Bartłomiej Szostakowski¹

¹Maria Skłodowska-Curie Institute – Oncology Centre, Warsaw, Poland

Bone tumours have been affecting people from the beginning of humankind. It appears that triggers for the disease are embedded deep within the human evolutionary past. The earliest known case of osteosarcoma had been found in South African fossil from a Swartkrans Cave in a toe belonging to an early human ancestor dated to 1.8–1.6 million years old.

Historically, amputations were considered to be the primary and only treatment of bone tumours. Not many are aware that XIX marked the development of first patient-specific implants manufactured from elephant’s ivory and ox bone that were successfully used to replace diseased parts of the human skeleton to include large joints like hip, knee and shoulder laying the foundations for modern 3D printed custom implants in bone tumour surgery.

Historical review of patient specific xenograft implants used in bone tumour surgery that proved to be equally successful to modern 3D printed implants. Does the implant material matters? History reveals the truth.
Clinico-pathological analysis, recurrence and surgical treatment in a single series of 58 chondroblastomas

Mrs. Matteo Innocenti, Mrs. Camilla Secciani, Mr. Davide Guido, Mr. Francesco Muratori, Mr. Guido Scoccianti, Mr. Giovanni Beltrami, Mr. Rodolfo Capanna, Mr. Domenico Andrea Campanacci

Introduction:
Chondroblastoma is a rare benign cartilaginous tumour of the youth, mostly localized in the epiphysis of long bone. Curettage associated with filling with bone grafts is the main treatment. Resection is reserved for extensive chondroblastomas with destruction of the epiphysis. Recurrence ranges from 10-35%. Chondroblastoma can exceptionally give malignant transformation and metastases. The aim of our study was to review a series of 58 chondroblastomas analyzing clinico-pathological characteristics, surgical treatment and the incidence of recurrence.

Methods:
45 male and 13 female (average age of 19 years), treated between March 2002 and June 2019, were retrospectively evaluated with a mean follow-up of 86.7 months (3 - 211mo). The most frequent epiphyseal sites were: 15 proximal humerus, 12 distal femoral, 12 proximal tibia. Surgical treatment was curettage and filling in 53 patients, while 5 patients underwent resection. Criotherapy was used in 5 cases, phenol in 10 cases. The functional results were evaluated with the MSTS score.

Results:
Recurrence was 5.1% and recurrence free survival was 38.6 months (9 - 108mo). No post-surgical complications and distant metastases were observed at the last follow-up. In one case a new malignant tumour (Ewing’s sarcoma) appeared after 30 months from the surgical treatment. The median MSTS score observed was 27.6 (2 - 30). This score was lower in patients who had local recurrence of disease (MSTS 17.3).

Conclusion:
Curettage associated with bone filling is the best treatment, resection in case of articular cartilage involvement. The recurrence rate was surprisingly low (5.1%) despite its local aggressiveness. Metastases and malignant transformation are exceptional.
EMSOS study on Desmoplastic Fibroma of Bone - The right setting for the wrong tumor?

Mr. Frank Traub1, Mr. Mikel San Julián Aranguren2, Mr. G. Ulrich Exner4, Mr. Andreas Leithner5, Mr. Santiago Lozano-Calderon6, Mr. Dimosthenis Andreou7

1University Hospital of Johannes Gutenberg-University, Mainz, Germany, 2Department of Orthopaedic Surgery, University Hospital of Eberhard Karls University, Tuebingen, Germany, 3Clinica Universidad de Navarra, Pamplona, Spain, 4Orthopaedic Center Zuerich, Zuerich, Switzerland, 5Department of Orthopaedics and Trauma, Medical University, Graz, Austria, 6Massachusetts General Hospital, Harvard Medical School, Boston, United States, 7Department of General Orthopaedics and Tumour Orthopaedics, University Hospital, Muenster, Germany

Desmoplastic Fibroma of bone is a exceedingly rare and locally aggressive benign bone tumor. In 2013, the WHO described the microscopic appearance of desmoplastic fibroma as being composed of slender, spindle to stellate cells with minimal cytological atypia and abundant collagenous matrix. The reported incidence of this tumor is 2.5 cases for every population of 100 million. Radiographically, DF typically displays a well-demarcated lytic pattern or extensive bone destruction with a moth-eaten appearance, and it characteristically lacks matrix calcification or sclerotic margins while often showing internal pseudotrabeculation.

Currently only a few case reports and a very small number of case series about the DFB have been published. For this reason, this multi-institutional EMSOS study was initiated. The aim was to collect a large series of this rare tumor and to identify clinical and therapeutic effects.

Methods:
Within the framework of an EMSOS study, the data were collected retrospectively from the participating centres.

Result:
In total, the data of patients from 6 centers could be collected and evaluated. 9 men and 5 women aged 14-66 years (33.5) were treated with the diagnosis DFB from 1992-2013. In half of the cases the femur was affected followed by the tibia (n=2) and the radius (n=2). Other affected bones were ribs, fibula and talus. Most often a wide resection was performed and the defect was biologically reconstructed. In all cases in whithout an R0 resection a local relapse occurred (5/15). On average, the follow-up was 10.5 years (17 - 317 months). In one patient, 26 years after an R0 resection, a low grade osteosarcoma was found at the former tumor site.

Conclusion:
Wide surgical excision, is the treatment modality of choice. Patients undergoing intra-lesional or marginal resection need to be advised of the possibility of local recurrence and the need for long-term surveillance.
Prognostic Significance of Texture Analysis of Magnetic Resonance Images in Primary Osteosarcoma

Mr. Christoph J. Laux1, Mr. Sandro M. Hodel1, Mrs. Beata Bode-Lesniewska2, Mr. Benjamin Fritz3, Mr. Daniel A. Müller1
1Department of Orthopaedics, Balgrist University Hospital, Zürich, Switzerland, 2Institute of Pathology and Molecular Pathology, University Hospital Zurich, Zurich, Switzerland, 3Department of Radiology, Balgrist University Hospital, Zurich, Switzerland

Introduction:
The histopathological response to neoadjuvant chemotherapy is the best-established prognostic factor in primary osteosarcoma. However, patients with poor response to neoadjuvant chemotherapy cannot be identified prior to histopathological examination of the resected specimen and risk stratification thus is only possible after surgical tumour removal. Texture analysis is an emerging tool enhancing the diagnostic performance of medical imaging. This study aims to investigate the prognostic performance of MRI texture analysis in order to earlier identify patients at risk of poor outcome.

Methods:
Native T1-weighted MR images of 25 patients with conventional high-grade osteosarcoma prior to neoadjuvant chemotherapy were analysed retrospectively. A three-dimensional quantitative texture analysis was performed after manually defining volumes of interests. The texture analysis features were fitted into a statistical model for unsupervised machine learning in order to predict histological subtype, response to neoadjuvant chemotherapy and long-term survival.

Results:
The model predicted a good response to chemotherapy (Salzer-Kuntschik grades I to III) with a sensitivity of 56 % and a specificity of 63 % (PPV 71 %, NPV 45 %). A disease-specific event within 2 years after surgery was predicted with a sensitivity of 50 % and a specificity of 67 % (PPV 40 %, NPV 75 %). Histological subtypes failed to be reliably predicted.

Conclusion:
Our statistical model showed a moderate predictive performance, especially when attempting to predict long-term outcome. This, however, is probably due to the small sample size. Therefore, larger series are needed to confirm the prognostic value of texture analysis in primary osteosarcoma.
Custom made 3D printed prosthetic replacement following bone tumor resections of the distal radius - one-center experience

Mr. Bartłomiej Szostakowski1, Mr. Tomasz Goryn1, Mr. Andrzej Pienkowski1, Mr. Piotr Rutkowski1
1Maria Skłodowska-Curie Institute – Oncology Centre, Warsaw, Poland

Introduction:
The distal radius is a relatively common skeletal site for primary bone tumors. En bloc resection of the distal radius in locally aggressive tumors or malignant lesions necessitates immediate reconstruction. Complex anatomy, proximity of adjacent tendons and delicate neurovascular structures, as well as the poor soft tissue envelope makes such reconstructions particularly challenging. Our retrospective review describes reconstruction of the distal radius with a custom made 3D printed MUTARS monoblock prosthetic replacement.

Methods:
A single institution retrospective review of 5 consecutive distal radius reconstructions with 3D printed prosthetic replacement, implanted between 2016 and 2018. Position of the implant, stability of the reconstruction and functional results were evaluated.

Results:
There were 3 males with GCTB Campanacci III, 1 male with osteosarcoma and 1 female with bone leiomyosarcoma. During follow up one major complication occurred that necessitated 2 revisions and additional reconstruction with a Rush pin. Implant position and stability in other patients was satisfactory although in all cases certain degree of flexion loss was observed.

Conclusions:
Reconstruction with a 3D printed monoblock patient specific implant after resection of the distal radius in locally aggressive tumors or malignant lesions appears to be ideal solution where straightforward, technically non demanding, stable and painless reconstruction is needed however certain degree of limited flexion has to be accepted by the patient in return for stability.
Expert Opinions about sports activity after Tumorendoprotheses - Do they differ in different parts of the world?

Mr. Gerhard M Hobusch1, Mr. Florian Keusch3, Mr. Michael Joyce2, Mr. Reinhard Windhager1
1Medical University of Vienna, Department of Orthopedic and Trauma Surgery, Vienna, Austria, 2Cleveland Clinic, Cleveland, United States, 3University of Mannheim, Department of Sociology, Germany

Introduction:
Recent online Sports survey results among orthopaedic surgeons have shown that there is a consensus about benefits of some light impact activity. The fear of disaster and need to do another surgery is a realistic concern that might be a reason for limitation in the intensity and kind of postoperative mobility workout. Do Surgeons in different continents recommend different sports and activity levels and do they fear differently?

Methods:
A web survey with members of three international professional organizations of tumor- and reconstructive surgeons between September 2016 and January 2018. Members were invited via personalized emails (EMSOS & ISOLS) or the membership email list (MSTS), and up to four reminders were sent. The questionnaire included 26 questions. A total of 149 surgeons started the survey, and 76 finished the entire survey (AAPOR RR2 EMSOS: 12.3%; ISOLS: 21.9%; MSTS: n/a).

Results:
The median recommended UCLA activity level in Europe and America was 7 in Asian-Pacific countries 5.5 (p=0.002). More Surgeons from Europe and Asian-Pacific countries were allowing sports with prior experience (p=0.03). 50% European surgeons, whereas 73% Asian-pacifics and 83% of Americans feared a periprosthetic fracture (p=0.0006), witnessing of complications was equal. Certain sports were recommended, allowed or not recommended at all very differently between Europe, North- and South America and Asian-pacific countries.

Conclusion:
Recommendations between continents differ between each other. Data of this survey could stimulate an open dialogue between members of different continents and different cultural spheres.
Follow-up in bone sarcoma care: a cross-sectional European study

Mr. Louren Goedhart, Mr. Andreas Leithner, Mr. Joris Ploegmakers, Mr. Paul Jutte
1University Medical Center Groningen, Netherlands, 2University Hospital Graz, Austria

Introduction
Follow-up of high-grade bone sarcoma patients with repeated radiological imaging is aimed to detect recurrent disease or distant metastasis at an early stage. However, repeated radiological imaging exposes (mostly young) patients to ionizing radiation with the risk of late stochastic effects. This study aims to assess follow-up procedures in terms of frequency and type of imaging modalities in bone tumour centres all across Europe for comparison and improvement of knowledge as a first step towards a common EMSOS guideline.

Methods
Data was obtained through several follow-up protocols and a digital questionnaire returned by EMSOS members of bone tumour centres all across Europe.

Results
All participating bone tumour centres attained a minimum follow-up period of ten years. Variations were seen in the national guidelines regarding follow-up intervals and the use of repeated imaging with ionizing radiation. A local and chest X-ray were obtained at 50% of the responding clinics every outpatient follow-up visit.

Conclusion
This study is a first step towards general consensus regarding follow-up of patients with high-grade bone sarcomas. The frequency of routinely repeated imaging with ionizing radiation during follow-up should be as low as reasonably possible, routine use of a CT scan is discouraged. Intensification of repeated imaging should be considered in selected high-risk patients.
Bone union in frozen autograft and free vascularized fibula combination after intercalary resections in skeletally immature patients.

Mr. Osman Emre Aycan, Mr. Bugra Alpan, Mr. Natig Valiyev, Mr. Harzem Ozger
1Baltalimani Bone Diseases Training And Research Hospital, Istanbul, Turkey, 2Mehmet Ali Aydinlar University, Orthopaedics and Traumatology Department, Istanbul, Turkey, 3Istanbul Orthopaedic Oncology Group, Istanbul, Turkey

Objective:
The combination of free vascularized fibular graft (FVFG) and recycled bone segments with various recycling methods is reported. With the frozen autograft and FVFG combination (Frozen Hotdog) a mechanically stable biological reconstruction in long term is targeted. We sought to evaluate the long term radiological and functional results of bone union in intercalary biological reconstructions of skeletally immature patients.

Patients and Method:
Radiological and clinical data of randomized 36 (21M/15F) skeletally immature patients who underwent “Frozen Hotdog” method following intercalary resection of malignant bone tumors around the knee between 2008-2017. The mean age was 11.9±3.3. Immediate postoperative x-ray; 3rd, 6th, 9th, 12th, 24th months x-ray, 12th and 24th months CT were evaluated for union at metaphyseal end, diaphyseal end, FVFG to cryopreserved bone. MSTS at each follow-up was noted.

Results:
Distal femur most common localization (69.4%), Osteosarcoma most common lesion (75%). Mean metaphyseal end union was 3.3 (1-7) months, mean diaphyseal end union was 7.1 (3-19) months, mean FVFG to cryopreserved bone union was 12.2 (6-24) months. Bone union at metaphyseal end was significantly related with smaller age (p=0.011). No relation was demonstrated between the age and diaphyseal end union. Metaphyseal end bone union and 12th mo MSTS was significantly related with sufficient apposition of the bone segment at postoperative x-rays.(p=0.029) Proximal tibial reconstructions showed better diaphyseal union at 12th months. Mean MSTS at 12th month was 73.4% and 24th month was 86%.

Conclusion:
“Frozen Hot-Dog” is an effective method in lower extremity, to fill the large intercalary defects for joint sparing. The union rate of this technique is quite satisfactory with good to excellent functional results. Although the consolidation and union of the cryopreserved bone is demanding, the “Frozen Hot-Dog Method” allow patients, heal with their own extremities and avoid implant related complications.
Survival differences for rural and low-income soft tissue sarcoma patients in a country with universal healthcare – A 23-year population-based study

Mr. Anthony Bozzo¹, Dr Michelle Ghert¹, Dr Greg Pond¹, Dr Hsien Seow¹
¹Macortho, Hamilton, Canada

Background:
Population-based studies from the United States have reported that sarcoma patients living in rural areas or belonging to lower socioeconomic classes experience worse overall survival; however, the evidence is not clear for universal healthcare systems where financial resources should theoretically not affect access to standard of care. The purpose of this study was to determine the survival outcomes of soft-tissue sarcoma (STS) patients treated in Ontario, Canada over 23 years and determine if the patient’s geographic location or income quintile are associated with survival.

Methods:
We performed a population-based cohort study using linked administrative databases of patients diagnosed with STS between 1993 – 2015. The Kaplan-Meier method was used to estimate 2, 5, 10, 15 and 20-year survival stratified by age, stage and location of tumor. We estimated survival outcomes based on the patient’s geographic location and income quintile. The Log-Rank test was used to detect significant differences between groups. If groups were significantly different, a Cox proportional hazards model was used to test for interaction effects with other patient variables.

Results:
We identified 8,896 patients with biopsy-confirmed STS during the 23-year study period. Overall survival following STS diagnosis was 70% at 2 years, 59% at 5 years, 50% at 10 years, 43% at 15 years, and 38% at 20 years. Living in a rural location (p=0.0028) and belonging to the lowest income quintile (p<0.0001) were independently associated with lower overall survival following STS diagnosis. These findings were robust to tests of interaction with each other, age, gender, location of tumor and stage of disease.

Conclusion:
This population-based cohort study of 8,896 STS patients treated in Ontario, Canada over 23 years reveals that patients living in a rural area and belonging to the lowest income quintile are at risk for decreased survival following STS diagnosis.
Predictors of high vs low intensity surveillance after soft-tissue sarcoma surgery: A 23-year population-based cohort study in Ontario, Canada

Mr. Anthony Bozzo¹, Dr Michelle Ghert¹, Dr Greg Pond¹, Dr Hsien Seow¹
¹Macortho, Hamilton, Canada

Background
To date, the post-operative surveillance of STS patients has not been studied at a population level. The purpose of this study was to investigate a population-based database of sarcoma patients collected over 23 years in order to determine the prevalence of high-intensity and low-intensity surveillance regimens, and any association between intensity of surveillance and patient or systemic factors.

Methods
Patients were included if they had a biopsy confirmed sarcoma between 1993-2015, underwent surgery, survived at least one year from the date of surgery. We used a logistic regression model and a random forest model to determine associations between surveillance strategy and patient factors such as age, gender, income quintile, Charlson score, location of tumor, rurality, and systemic therapy, or systemic factors such as year of diagnosis and health region.

Results
We identified 2,230 patients with biopsy-confirmed soft tissue sarcoma who underwent surgery during the 23-year study period and survived at least one year. The proportion of STS patients being followed with high-intensity surveillance is 31.3% while 15.1% of STS patients are followed with low intensity surveillance. The remaining 51.6% of STS patients are followed with surveillance regimens that fall outside these classifications. The use of high intensity surveillance increased 22% over the study period while low intensity surveillance remained constant. Factors associated with high-intensity surveillance in both models are systemic treatment, Charlson score, recent year of surgery, and health region.

Conclusion
High-intensity post-operative surveillance of sarcoma patients is becoming more common over time and is associated with advanced disease in sicker patients. This is the first population-based study of sarcoma surveillance and the first to show variation in surveillance strategy over time, as well as by healthcare region within a universal healthcare system. Rural location and low income quintile were not found to be barriers to high intensity surveillance.
Evaluation of 18 years experience with growing endoprosthesis in children and adolescents with primary malignant bone tumors

Mr. Andrzej Szafranski, Mr. Bartosz Pachuta, Mrs. Magdalena Rychlowska-Pruszynska

1Institute of Mother & Child, Warsaw, Poland, 2The Childrens Memorial Health Institute, Warsaw, Poland

Aim:
Metaanalysis of the patients treated in the Institute of Mother and Child in last 18 years.

Methods:
In the period 2000-2018 283 children with primary bone tumors were treated. They were 143 boys and 140 girls. The age of the patient was from 4 to 25 years old. Median was 13 yrs. old. The treatment was begun from neoadjuvant chemotherapy. After achievement the regression or stabilization of primary lesion, the patients were qualified to surgery procedures. It was excision of the tumor end reconstruction by the using of the growing endoprosthesis in spite of young age of the patients. After that adjuvant chemotherapy was used with or without metastasis treatment.

Results:
In this study the own department experience in implantation of variety types of expandable endoprosthesis were shown. The defects and advantages of each type of expandable endoprosthesis were introduced. The all data were displayed as peer analysis of the patients with variety types of endoprosthesis.

Conclusions:
As the summary the authors published the guidelines according the handling of, service the variety types of expandable endoprostheses. Instead of conclusions (authors’ experience) Recommendations for non-invasive limb lengthening: Ø careful qualification to operation Ø implantation receiver in soft tissue no more 2 cm depth Ø start with lengthening procedure quickly after operation Ø repeated procedures in short time intervals (50 impulses) Ø Lengthening procedure in ambulatory manner Ø avoiding of general narcosis Ø risk minimalization of infection in endoprosthesis area
Rotationplasty as a surgical option in lower extremity bone tumors.

Mr. W. Peter Bekkering
1Princess Máxima Center For Paediatric Oncology, Utrecht, Netherlands

Purpose:
Rotationplasty is a durable and biologic reconstructive option after resection of lower-extremity sarcomas in skeletally immature patients. Rotationplasty is an alternative to amputation, allograft reconstruction, and endoprosthetic reconstruction, avoiding issues of phantom pain, limb-length discrepancy, and endoprosthetic complications (loosening, infection, and wear).

Due to technical innovations in limb-salvage, the role of ablative surgery like an amputation or rotationplasty has become smaller. The question is therefore is a rotationplasty still a viable option when limb-salvage is possible.

Method:
This presentation will discuss functional and emotional outcome issues after rotationplasty. Answers have been acquired through literature study and personal experiences with this surgical procedure.

Results:
A rotationplasty has clear disadvantages concerning cosmetically and emotional outcome however there are still evident functional advantages in comparison to amputation and limb-salvage options.

Conclusion:
Rotationplasty is still a viable surgical option in the treatment of children with lower extremity bone tumors. Therefore, the choice for the surgical intervention should not only be made based on the oncological, surgical and functional aspects but also on the personal preferences of patient and parents.
Implementation Shared Decision Making in malignant bone cancer surgery.

Mr. W. Peter Bekkering

Princess Máxima Center For Paediatric Oncology, Utrecht, Netherlands

Purpose:
Guidelines in paediatric oncology care encourage health-care providers to share relevant information with patients/parents to enable their active participation in decision making. In malignant bone tumour surgery where the decision concerns a surgical intervention with a wide range of consequences, involvement of the patient and parents in the final decision is of great importance. To enable participation of patients and parents in the surgical decision it is important to inform them extensively about the surgical options and all the pro’s and con’s of these options.

Method:
To implement Shared Decision Making (SDM) in malignant bone cancer surgery a digital decision aid has been produced containing information, visual material and animations about the surgical options and SDM. For the past year we tried to implement SDM in the decision making process of children with a malignant bone tumour of the leg in the Princess Máxima Centre for Paediatric Oncology.

Results:
The introduction of SDM in daily practice has been a complicated process, several logistic, personal and emotional limitations has been indicated and will be discussed during this presentation.

Conclusion:
The implementation will be effectuated this year. The evaluation of the SDM process and the decision aid will continue during the next years.
What are common pitfalls, radiological features and prognostic factors of parosteal osteosarcoma?

Mr. Mustafa Sungur1, Mr. Osman Emre Aycan1, Mr. Bugra Alpan2, Mr. Natig Valiyev2, Mr. Mustafa Sungur3

1Istanbul Orthopedic Oncology Group, Istanbul, Turkey, 2Acibadem Maslak Hospital, Department of Orthopedics and Traumatology, Istanbul, Turkey, 3Acibadem University Atakent Hospital, Department of Orthopedics and Traumatology, Turkey

Introduction:
The aim of this study is to evaluate the significance of MRI findings, surgical margins, previous interventions and their effects on oncological and functional outcomes in parosteal osteosarcoma.

Methods:
Twenty-seven patients (8 male/19 female) operated with the diagnosis of primary parosteal osteosarcoma in our institution were retrospectively reviewed. The epidemiological data, biopsy method, misdiagnosis/improper interventions and delay in diagnosis were noted. Maximum circumferential and longitudinal extension, intramedullary involvement and neurovascular extensions in MRI sections were evaluated. Resection type (segmental intraarticular/segmental intercalary/hemicortical), reconstruction type (biologic/non-biologic) and surgical margins were noted. Functional and oncological results at last follow-up were assessed.

Results:
The mean age was 31.6 (12-73) years; median follow-up was 63 (15-270) months. The most common site was distal femur. Percutaneous biopsies in elsewhere centers were related with increased number of re-biopsies and misdiagnosis/improper interventions (p<0.001, p=0.044). Intramedullary involvement rate was related with maximum circumferential extension and maximum longitudinal extension (p=0.006, p=0.005). The intramedullary involvement ratio of ≤10% suggested no recurrence or metastasis. Mean MSTS score was 81.1% (60-100%). Neurovascular involvement was related with metastatic disease, deep infections and complication related surgeries (p=0.017, p=0.002, p=0.005). The most common resection type was segmental intraarticular resection (63%). Hemicortical resections with biological reconstructions had the best MSTS scores (p=0.002). Higher maximum circumferential extension rate, maximum longitudinal extension, intramedullary involvement rate of the lesion and neurovascular involvement were related with lower MSTS scores (p=0.003, p=0.028, p=0.038, p=0.022). Five year overall survival was 95.5%, local recurrence-free survival was 77.2% and metastasis-free survival was 69.4%.

Conclusion:
The lesion’s extent of intramedullary involvement, neurovascular bundle proximity and maximum periosteal circumferential extension on MRI should be considered when planning the surgery. The evaluation of maximum circumferential extension on MRI is crucial for the resection margins. Hemicortical resection and biological reconstruction should be considered whenever possible.
The use of PRECICE(R) nail in the management of limb length discrepancy following biological reconstruction with frozen hotdog technique

Mr. Mustafa Sungur1, Mr. Bugra Alpan2, Mr. Osman Emre Aycan1, Mr. Natig Valiyev2, Mr. Mustafa Sungur3

1Istanbul Orthopedic Oncology Group, Istanbul, Turkey, 2Acibadem Maslak Hospital, Department of Orthopedics and Traumatology, Istanbul, Turkey, 3Acibadem University Atakent Hospital, Department of Orthopedics and Traumatology, Istanbul, Turkey

Introduction:
Combined use of cryodestructed bone and vascularized fibula (frozen hotdog) is an effective intercalary biological reconstruction method. However, limb length discrepancy (LLD) is an inevitable complication of limb salvage in the growing child. This paper is aimed at presenting femoral lengthening experience with PRECICE® device in frozen hotdog patients. Patients & Methods:

Four patients (M/F: 3/1), who underwent primary limb salvage for distal femur osteosarcoma with frozen hotdog technique, were retrospectively reviewed. Mean age was 10.8 (9-13) years and length of resected segment was 195 (150-250) mm at index procedure. Mean limb length discrepancy was 7 (4-10) cm after a mean follow-up of 63 (34-110) months. Excellent bone healing had been achieved in 3 patients while one of them had chronic nonunion. Results: A mean lengthening of 42 (38-48) mm was performed with subtrochanteric osteotomy using the PRECICE® nail in 3 patients, who showed excellent healing of primary reconstruction. Distraction rate was 1 mm/day and consolidation index was 1,83 months/cm. Distal locking screw was revised in one patient due to osteolysis. One patient underwent nail removal and closed plate fixation due to fracture at the distal end of the nail, after full consolidation. Mean MSTS was 26 (25-27) at the last follow-up. Pre-distracted PRECICE® was used for acute compression of the nonunion site in the fourth patient. However, bone healing could not be achieved after 3 cycles of compression-distraction-observation over an 18-month period. No implant-related complication occurred in any of the four. Conclusion: PRECICE® is effective and reliable for the management of LLD associated with frozen hotdog reconstruction, which involves challenging morphological and biological changes related to recycled bone and hypertrophied fibula. The failure in chronic nonunion case cannot be attributed to the device since it performed the desired compression-distraction effect.
Treatment of chondrosarcoma. Prognostic factors and treatment options based on patients’ age, localization, size and grade of tumor in a review of 45 cases.

Mr. Paul Ruckenstuhl1, Mr Sven Märdian1
1Center For Musculoskeletal Surgery, Charite Berlin, Germany

INTRODUCTION:
Chondrosarcoma is the second most frequent primary malignant bone tumor. The treatment of chondrosarcoma is difficult and mainly based on surgery. It is well known that the grade of tumor as well as the patients’ age, the localization and the size of tumor influences the prognosis. In this present study, we retrospectively analyzed our chondrosarcoma patients to draw conclusion on treatment options.

METHODS:
We included a total of 45 chondrosarcoma patients with a mean age of 55 years (24<60y, 21>60y) between 2006 and 2013 with a minimum follow up of 5 years. All patients received surgical treatment. Thirteen patients received marginal resection and 32 patients received wide resection of the tumor. The size of the tumor at the time of diagnosis ranged from 35 to 140mm with a mean of 91mm. Twenty-four (53%) chondrosarcomas were located on the extremities and 21 (47%) on the axial skeleton. In 21 (47%) patients the lesion was classified as G1, in 19 cases as class G2 and in 5 cases as class G3 tumors.

RESULTS:
Patients younger than 60y showed a significant lower rate of tumor recurrence. The overall recurrence rate was 29% (13 patients). Tumors smaller than 8mm (40%) showed a significant lower rate of local recurrence but also a significant lower grade of tumor compared to tumors bigger than 8mm. No significant differences were seen between tumors of the extremities or the axial skeleton regarding the rate of recurrence.

CONCLUSION:
The baseline therapy of chondrosarcoma remains surgery. Risk factors as grading, patients’ age, location and tumor size significantly influence overall survival. No significant results were found, whether tumors of extremities or of the axial skeleton showing a higher risk for recurrence but chondrosarcomas of the pelvis presented a significant higher risk of local recurrence and need a more aggressive treatment regime.
Complications of limb salvage surgery in childhood tumors and recommended solutions

Mr. Mustafa Sungur1, Mr. Bugra Alpan2, Mr. Mustafa Sungur3, Mr. Natig Valiyev2

1İstanbul Orthopedic Oncology Group, İstanbul, Turkey, 2Acibadem Maslak Hospital, Department of Orthopedics and Traumatology, İstanbul, Turkey, 3Acibadem University Atakent Hospital, Department of Orthopedics and Traumatology, İstanbul, Turkey

Introduction: Complications of pediatric limb salvage surgery (LSS) for malignant bone tumors can be classified and treated as age-dependent and age-independent. We aimed to review the complication profile and management strategies in the skeletally immature.

Methods: Retrospective analysis was done on 163 patients (M/F: 83/80) who underwent LSS for osteosarcoma or Ewing's sarcoma (126/37 respectively) between 1990-2017. Mean age was 12 (1-16) years and mean follow-up was 59,5 (2-290) months. The most common anatomical sites were femur (86) and tibia (51). All patients received preoperative chemotherapy and underwent surgery with the intent of wide resection. Osseous reconstruction was biological in 94 and non-biological in 69 while 60 (37%) underwent soft tissue reconstruction in the index procedure.

Results: The most common complication was limb length discrepancy (LLD) with a mean of 2,4 (0,0-15,0) cm. LLD was observed in 76 (47%) patients. Bone healing problems and graft fractures were observed in 35 (21%), wound problems in 26 (16%), mechanical prosthesis failure in 26 (16%), deep infection in 9 (6%), local recurrence (LR) in 13 (8%), and compartment syndrome in 3 (2%). The patients underwent a mean of 0,8 (0-6) major additional surgical intervention for complications. Ten patients underwent lengthening surgery with either external fixator or magnetic motorized intramedullary nail. Shoe lift was used for all remaining LLD. Amputation was required in 3 patients due to LR while the remaining was treated with radiotherapy and local resection. Pseudoarthrosis was accepted as sequela in 3. Complications associated with all age groups were treated similar to adult patients. Mean MSTS was 22 (5-30) and the oncological status was NED in 69, DOD in 40 and CDF in 30.

Conclusion: LLD remains the most important age-dependent pediatric LSS complication while LR is the most devastating yet age-independent complication. Management starts preoperatively and varies from simple conservative measures to extremely complicated and sophisticated surgical procedures.
Experience of interstitial permanent $^{125}$I brachytherapy for extremity soft tissue sarcomas.

Mr. Hong Duan$^1$, Mr. Xiang Fang$^1$
$^1$West China Hospital, Sichuan University, China

AIMS:
Soft tissue sarcomas are uncommon, but relatively aggressive tumours. Although surgical resection remains the primary therapeutic modality for all localised tumours, brachytherapy combined with function-preserving excision is a popular treatment for extremity soft tissue sarcomas. The objective of this study was to evaluate the effect of interstitial permanent brachytherapy using $^{125}$I seeds in patients undergoing the combined modality in the management of soft tissue sarcomas at our institution.

MATERIALS AND METHODS:
Between January 2007 and January 2012, 110 adult patients aged 18-86 years (median = 44 years) with extremity soft tissue sarcomas and who underwent interstitial permanent brachytherapy as part of the local treatment were included in this study. Treatment included wide local excision of the tumour and brachytherapy using a permanent $^{125}$I implantation. Complications were assessed in terms of wound complication and peripheral nerve damage.

RESULTS:
After a median follow-up of 43.7 months, the local control, disease-free survival and overall survival for the entire cohort studied were 74, 54 and 77%, respectively. The actual rates of wound complications requiring reoperation and nerve damage were 4.5 and 1.8%, respectively.

CONCLUSIONS:
We conclude that interstitial permanent brachytherapy with $^{125}$I after function-preserving surgery results in a satisfactory outcome in patients with extremity soft tissue sarcomas and the complication rate is low.

KEYWORDS:
Extremity; $^{125}$I; interstitial brachytherapy; radiotherapy; soft tissue sarcoma
Giant cell tumor of bone with cartilage matrix: A clinicopathological study of 17 cases.


Introduction:
Giant cell tumor of bone (GCT) is a benign locally aggressive neoplasm composed of mononuclear cells admixed with innumerable osteoclast-type giant cells. H3F3A gene mutations producing mutant histone protein product H3.3 have been identified in 96% of GCT; mutant H3.3 is reliably demonstrated by immunohistochemistry. GCT may contain woven bone and rarely, neoplastic cartilage nodules which causes diagnostic challenges with aggressive neoplasms such as osteosarcoma.

Methods:
We describe the features of GCT with cartilage matrix and report the next-generation sequencing (NGS) findings in a subset of tumors.

Results: 18 cases of GCT with cartilage matrix form the cohort: 8 males and 10 females, 8 to 55 (mean 24) years old. Tumors involved the fibula (6), femur (6), and 3rd metatarsal, patella, tibia, humerus, S1, and scapula (one case each). Tumors were radiolucent, circumscribed, lytic, and expansile. All contained classic GCT, foci of cartilage matrix, and trabeculae of woven bone. Immunohistochemistry showed diffuse staining for H3.3 in 8/9 cases and 1 case was positive for S100 and SOX9 in the cartilage areas. NGS showed mutation in H3F3A gene in 6/6 cases. On follow-up, 3 patients who underwent resection showed no disease after 60, 12, and 7 months, respectively. Three patients had recurrences 10, 12, and 27 months after curettage; there were no metastases.

Conclusion:
GCT with cartilage matrix is uncommon. The cartilage matrix is associated with woven bone suggesting the neoplastic cells may differentiate into chondrocyte-like and osteoblast-like cells. Recognition of this neoplasm is important to prevent misdiagnosis and overtreatment of affected patients.
Surgical strategy for benign lesions in proximal femur: internal fixation or endoprosthetic replacement

Mr. Hong Duan, Mr. Wenli Zhang, Mr. Senlin Lei

West China Hospital, Sichuan University, China

Purpose:
The purpose of this study was to explore the indications for the two most frequently applied surgical procedures for benign lesions in the proximal femur.

Methods:
We retrospectively reviewed 142 patients with benign lesions in the proximal femur from January 2010 to January 2015. Internal fixation (IF) was adopted in 110 patients, while endoprosthetic replacement (EPR) was applied in 32 patients. Clinical data, including operation time, blood loss, hospitalization time, and hospitalization expenses, were compared between the groups. Limb mobilization was evaluated by the Musculoskeletal Tumor Society Score-93 (MSTS-93) and Harris Hip Score (HHS). Local recurrences and complications were statistically compared.

Results:
The average follow-up was 66 months (range 32–84 months). In the EPR group, operation time and hospitalization time were significantly shorter (p < 0.05 and p < 0.05, respectively), while blood loss and hospitalization expenses were significantly higher (p < 0.05 and p < 0.05, respectively). Functional outcomes of the MSTS-93 and HHS were higher at the three-week follow-up in the EPR group (p < 0.001 and p < 0.001, respectively) but lower at 6 months (p = 0.031 and p = 0.042, respectively). No differences were observed in the two scores at three months (p = 0.261 and p = 0.134, respectively). Local recurrence and complication rates were similar in the two groups (p = 0.895 and p = 0.942, respectively).

Conclusion:
The strategy for benign proximal femur lesions should depend on the site, size, initial diagnosis, and thinning degree of cortical bone. IF and EPR both result in satisfactory local control and functional and radiological results, while EPR is more suitable for aggressive and recurrent lesions and serves as an effective measure after IF failure.

Keywords:
Improved virtual surgical planning with 3D-multimodality image for malignant giant pelvic tumors

Mr. Hong Duan, Mr. Wenli Zhang, Mr. Xiang Fang, Mr. Senlin Lei
West China Hospital, Sichuan University, China

Purpose:
We sought to assess the early clinical outcome of 3D-multimodality image (3DMMI) based virtual surgical planning for resection and reconstruction of malignant giant pelvic tumors.

Materials and methods:
In this retrospective case-control study, surgery was planned and performed with 3DMMI-based patient-specific instruments (PSI) in 13 patients with giant pelvic malignancy, and without 3DMMI-based PSI in the other 13 patients. In the 3DMMI group, 3DMMI taking advantages of computed tomography (CT), contrast-enhanced computed tomography angiography (CTA), contrast-enhanced magnetic resonance imaging (MRI), contrast-enhanced magnetic resonance neurography (MRN) and that revealing the whole tumor and all adjacent vital structures was utilized, based on which virtual surgical planning was conducted and the corresponding PSI was then designed. The median follow-up was 8 (3-24) months. The median age at operation was 37.5 (17-64) years. The mean tumor size in maximum diameter was 13.3 cm. Surgical margins, intraoperative and postoperative complications, duration of surgery, intraoperative blood loss were analyzed.

Results:
In the non-3DMMI group, the margins were wide in six patients (6/13), marginal in four (4/13), wide-contaminated in two (2/13), and intralional in one (1/13). In the 3DMMI group, the margins were wide in ten patients (10/13), marginal in three (3/13) and no wide-contaminated or intralional margin. 3DMMI group achieved shorter duration of surgery (p=0.354) and lower intraoperative blood loss (p=0.044) than the non-3DMMI group.

Conclusions:
The 3DMMI-based technique is advantageous to obtain negative surgical margin and decrease surgical complications related to critical structures injury for malignant giant pelvic tumor.

Keywords: surgical planning, 3D-multimodality image, pelvic tumor, patient-specific instruments, surgical margin
Surgical management of metastatic lesions of the proximal femur with pathological fractures using intramedullary nailing or endoprosthetic replacement

Mr. Hong Duan¹, Mr. Wenli Zhang¹, Mr. Xiang Fang¹, Mr. Senlin Lei¹
¹West China Hospital, Sichuan University, China

Introduction and Purposes:
Endoprosthetic replacement (EPR) and intramedullary nailing (IMN) are two most commonly applied surgical methods used to treat proximal metastatic lesions; however, the indications remain controversial. This study aimed to evaluate the clinical, functional and oncological outcomes of patients who underwent EPR compared to IMN for the treatment of proximal femur metastases to investigate the surgical indication.

Materials and Methods:
88 patients with proximal femur pathological fractures secondary to metastatic tumors admitted between January 2005 and December 2014 to West China Hospital were retrospectively studied. 57 patients were treated with EPR and 31 patients, with IMN. Surgery time, blood loss, hospital stay, Musculoskeletal Tumor Society score (MSTS), survival, recurrence and complications were analyzed.

Results:
The median follow up period was 12.9 (3.98) months. The median survival time in EPR was 10.0 months and 7.5 months in IMN. Surgery time was 142.6±22.7 min in EPR group and 98.7±19.5 min in IMN group (P<0.001). Significantly less blood loss was observed in IMN group (345.2±66.4 ml) than in EPR group (631.5±103.6 ml; P<0.001). The median hospital stay in EPR group was 8 days and 5 days in IMN group (P<0.001). Local recurrence rate was 10.5% (6/57) in EPR group and 25.8% (8/31) in IMN group (P=0.074). Complication rates were 10.5% (6/57) in EPR group and 29.0% (9/31) in IMN group (P=0.038). MSTS score was higher in IMN compared with EPR at 6 weeks postoperatively (P<0.001), while EPR group demonstrated a higher score at 6 months postoperatively (P<0.001).

Conclusions:
EPR has better functional outcomes and higher life quality with lower complication rates in the long term. IMN is best indicated for extremely limited patient’s life expectancy.
Chondrosarcoma of the Pelvis: surgical management options and outcomes of 41 cases

Mr. Hong Duan¹, Mr. Wenli Zhang¹, Mr. Xiang Fang¹, Mr. Zeping Yu¹
¹West China Hospital, Sichuan University, China

Background
Treatment of chondrosarcoma of the pelvis is challenging for the orthopedic oncologists due to its low rates of survival and high rates of local recurrence. Therefore, we report on our investigation in a large series of 41 cases in our center, providing oncologic and functional outcomes of surgical approaches to chondrosarcoma.

Methods
A retrospective study was performed in 41 patients with localized pelvic chondrosarcoma initially surgically treated in our hospital between 2007 and 2015. Of these 41 patients, 23 were male and 18 were female, and the average age at initial operation was 26.48 (15-45) years. The median duration of follow-up was 5 (3-10) years.

Results
The number of patients with grade-1 chondrosarcoma, grade-2, grade-3 and grade-4 (undifferentiated chondrosarcoma) are 22, 10, 2 and 7 respectively. Hemipelvectomy was performed in 13 patients to achieve local tumor control and limb-salvage procedure in the other 28 patients. 13 patients (14%) had local recurrence and 11 (10%) had distant metastases. 25 patients (69%) were alive with no evidence of disease, 10 (20%) had died of the disease, six (9%) had died of unrelated causes, and one (2%) was alive with disease at the time of the final follow-up. Inadequate wide surgical margin correlated with local recurrence (p < 0.001). High-grade chondrosarcoma correlated with poor overall survival (p < 0.001). All patients that underwent a limb-salvage procedure could walk in the final follow-up, with a mean functional score of 77% (the system of Musculoskeletal Tumor Society).

Conclusions
Adequate surgical margin of pelvic chondrosarcoma may lead to longer survival time. Tumor grade is highly correlated with overall or disease-free survival.

Keywords Pelvis; chondrosarcoma; survival; hemipelvectomy; limb-salvage; surgical margin.
Surgical options and outcomes for pelvic bone metastasis

Mr. Hong Duan1, Mr. Wenli Zhang1, Mr. Xiang Fang1, Mr. Zeping Yu1, Mr. Senlin Lei1
1West China Hospital, Sichuan University, , China

Background:
Treatment of pelvic bone metastasis is challenging and controversial. This study aimed to report surgical options and outcomes.

Methods:
A retrospective study was performed in 27 patients (15 male and 12 female) with pelvic bone metastasis treated in our hospital between 2004 and 2015. The average age at surgery was 60.5 (16-84) years. Surgery were planned based on location of the lesion, metastasis of other organs and general conditions of the patients. Group A (n=9) with isolated weight-unbearing metastasis (region I or III), good general conditions and no vital organ metastasis underwent en bloc resection and bone cement implantation. Group B (n=5) with multiple metastasis and poor general conditions underwent I125/bone cement implantation following curettage. Group C (n=13) with isolated weight-bearing metastasis (region II) underwent hemipelvectomy with reconstruction. Radiological, VAS, MSTS and SF-36 were analyzed.

Results:
The median follow-up was 25 months. The mean survival for Group A, B and C was 37, 9 and 30 months, respectively. The mean pre-, postoperative and 6-month postoperative VAS for Group A was 8.4, 5.4 and 4.2. For Group B, 8.7, 5.2 and 5.0. For Group C, 9.1, 5.0 and 4.5. The mean postoperative and 6-month postoperative MSTS for Group A was 22.2 and 21.5. For Group B, 16.7 and 18. For Group C, 20.05 and 23.3. The mean pre-, postoperative and 6-month postoperative SF-36 for Group A was 35.1, 75.5 and 68.0. For Group B, 20, 60.5 and 50. For Group C, 25.45, 86.2 and 88.0. Significant differences were noted for VAS and SF-36 respectively, between pre- and postoperatively.

Conclusions:
Surgical options based on location of metastasis, presence of vital organ metastasis and general conditions of the patients could yield good functional outcome and better quality of life.
Effects of mechanical loading on the degradability and mechanical properties of the nanocalcium-deficient hydroxyapatite–multi(amino acid) copolymer composite membrane tube for guided bone regeneration

Mr. Hong Duan

West China Hospital, Sichuan University, , China

Introduction and Purposes:
This study focuses on a novel membrane tube for GBR, which was prepared by a nanocalcium-deficient hydroxyapatite–multi(amino acid) copolymer (n-CDHA-MAC) composite.

Methods:
The biomechanical strength and degradability of this membrane tube under mechanical loading after immersion in phosphate-buffered solution were investigated to evaluate the effects of mechanical loading on the membrane tube. The membrane-tube group with no mechanical loading and femora bone were used as controls.

Results:
The compressive strength and bending strength of n-CDHA-MAC membrane tubes were 66.4 ± 10.2 MPa and 840.7 ± 12.1 MPa, which were lower than those of the goats’ femoral bones (69.0 ± 5.5 MPa and 900.2 ± 17.3 MPa), but there were no significant (P <0.05) differences. In the in vitro degradability experiment, all membrane tubes were degradable and showed a surface-erosion degradation model. The PH of solution fluctuated from 7.2 to 7.5. The weight and mechanical strength of loaded tubes decreased more quickly than nonloaded ones, with significant differences (P <0.05). However, the strength of the loaded group after degradation achieved 20.4 ± 1.2 MPa, which was greater than the maximum mechanical strength of 4.338 MPa based on goat femoral middle stationary state by three-dimensional finite-element analysis.

Conclusions:
n-CDHA-MAC membrane tubes have good biomechanical strength during degradation under mechanical loading. Therefore, this membrane tube is an ideal GBR membrane for critical size defects of long bones in goats for animal experiments.
Analyzing the behavior of a porous nano-hydroxyapatite/polyamide 66 (n-HA/PA66) composite for healing of bone defects.

Mr. Hong Duan
West China Hospital, Sichuan University, China

Introduction:
The aim of this study was to analyze the behavior of the porous nano-hydroxyapatite/polyamide 66 (n-HA/PA66) composite grafted for bone defect repair.

Materials and Methods:
Biological safety of the porous n-HA/PA66 composite, a cytotoxicity test, sensitivity test, pyrogen test, and a hemolysis test were carried out. Macroscopic observations and radiological, histological, and scanning electron microscope analysis based on the rabbit models of tibia defects with grafted porous n-HA/PA66 composite were conducted. And a retrospective review was performed for 21 patients treated with porous n-HA/PA66 composite grafts following bone tumor resection.

Results:
The biological safety experiments revealed that porous n-HA/PA66 composite had no cytotoxicity, no sensitization effect, no pyrogenic reaction, and that its hemolysis rate was 0.59% (less than 5%). In the animal experiments, density of new bone formation was similar to the surrounding host bone at 12 weeks. After 26 weeks, the artificial bone rebuilt to lamellar bone completely. In the clinical study, no wounds issues or fractures. At a mean follow-up of 5.3 years, the mean Musculoskeletal Tumor Society's (MSTS) 93 score was 29.3 points (range: 28-30 points) and mean radiopaque density ratio was 0.77±0.10. The radiologic analysis showed that porous n-HA/PA66 composite had been completely incorporated with the host bone about 1.5 years later.

Conclusion:
In conclusion, this study indicated that the porous n-HA/PA66 composite had biological safety, and good biocompatibility, osteoinduction, and osseointegration. Thus, the porous n-HA/PA66 composite is an ideal artificial bone substitute and worthy of promotion in the field.

KEYWORDS:
artificial bone materials; biomaterial; bone defects healing; bone grafting; porous n-HA/PA66 composite (n-HAPA66)
Total ulna replacement with a 3D printed custom-made prosthesis after en bloc tumor resection

Mr. Hong Duan¹, Mr. Wenli Zhang¹
¹West China Hospital, Sichuan University, China

Purpose:
Primary malignancy with extensive involvement of the ulna is a treatment challenge. The aim of this study was to describe a novel limb-salvage technique after en bloc ulna tumor resection, and the early clinical/functional outcome of a patient.

Methods:
A 17-year-old male with osteosarcoma involving 4/5 of the left ulna was admitted in our center. Due to his favorable response to neoadjuvant chemotherapy, one-stage total ulna replacement with 3D-printed custom-made prosthesis was prepared. The whole procedure took 4 h, and intra-operative blood loss was 300 ml. Postoperative pathology revealed conventional osteosarcoma with extensive degeneration and necrosis (>90%), and the margin was clear.

Results:
At 24 months after surgery, the patient was disease free. The function of limbs was almost completely restored. And there was no evidence of recurrence, dislocation or instability in the X-ray.

Conclusions:
With favorable chemotherapy and 3D printing technique, limbs might be saved even in some extreme conditions.

Keywords:
limb salvage, 3D printing, osteosarcoma, total ulna replacement, function
The effects of surgical treatment with chondroblastoma in children and adolescents in open epiphyseal plate of long bones

Mr. Yun Lang 2, Mr. Hong Duan 1, Mr. Wenli Zhang 1, Mr. Zeping Yu 1, Mr. Xiang Fang 1

1 West China Hospital, Sichuan University, China, 2 People's Hospital of Deyang City, Deyang, Sichuan, China

Background:
Chondroblastoma commonly originates in the epiphyseal plate of long bones. An aggressive curettage is recommended. However, it might jeopardize an open epiphyseal plate and incur limb shortening and deformity for the young patients. This study aims to explore influences on limb growth and development for aggressive curettage.

Methods:
We retrospectively reviewed 18 cases of long bone chondroblastoma with open epiphyseal growth plate during March 2004 to October 2010 in our center. 7 females and 11 males with mean age of 11.6 ± 2.0 years old were included. All patients were treated with meticulous intralesional curettage and inactivity with alcohol followed by bone grafts. All cases were followed up 8.2 ± 1.7 years (5–11.5 years).

Results:
All had no local recurrence and distance metastasis. The length of the affected limb was short, 18.47 ± 7.22 mm (1.5–30 mm). There was no obvious relativity with tumor activity (P = 0.061). Meanwhile, there were obvious relativity with the greatest dimension of the lesion (TGD) (P = 0.003), the vertical dimension between edge of lesion and epiphyseal line (TVD) (P = 0.010), and area ratio of lesion to local epiphysis (lesion/growth plate) (P = 0.015). The MSTS93 (Revised Musculoskeletal Tumor Society Rating Scale 93) and SF-36 (Medical Outcomes Study 36-Item Short-Form Health Survey) had been significantly improved (P < 0.01).

Conclusion:
Managing of chondroblastoma located in open epiphyseal plate of a long bone with meticulous curettage, inactivity, and bone grafts can control tumor progression and recurrence effectively. Meanwhile, early detection and prompt surgical treatment intervention, which reduced significantly the tumor to influence limb growth and development, get encouraging limb function.

Keywords:
Chondroblastoma, Epiphysis, Open epiphyseal plate, Limb-length, Children and adolescents
Total femoral prosthesis replacement following resection of femoral malignant tumors

Mr. Hong Duan¹, Mr. Wenli Zhang¹, Mr. Xiang Fang¹, Mr. Senlin Lei¹
¹West China Hospital, Sichuan University, Chengdu, China

Background:
The essential factor for the good functional outcome after total femoral prosthesis replacement (TFR) was the preservation of muscles around the femur. Patients with extensive muscles invasion usually means a wide surgical resection and less preservation of muscles. Rectus femoris is important to the stability of the prosthesis. We studied the interrelation between the tumor invasion the rectus femoris and the functional outcome after TFR.

Methods:
Between 2010 and 2017, 14 patients with a mean age of 44.8 years were treated for femur tumor with TFR. We categorized the cases into 2 groups: group A (with rectus femoris invasion) and group B (without rectus femoris invasion). Outcome was evaluated by gait analysis, Musculoskeletal Tumor Society Score (MSTS) and Harris hip score (HHS), and complications, by the ISOLS method modified in 2014.

Results:
The average MSTS and HHS score of group A was 17.6±3.1, 55.38±13.30, whereas the average score of group B was 23.0±4.8, 80.17±6.24. There was significant difference between the groups in MSTS (P =0.02, <0.05) and HHS (P =0.001, <0.05). The group without rectus femoris invasion also achieved better limb function (supporting and gait) and active ROM(P<0.05).

Conclusions:
Patients treated with total femur resection and TFR, which without rectus femoris invasion had a better limb function, and greater active hip ROM than those who with.

Keywords:
Femur, Tumor, Total femoral prosthesis replacement, Limb-salvage, rectus femoris invasion
Total talar replacement with a novel 3D printed modular prosthesis for tumors

Mr. Hong Duan¹, Mr. Wenli Zhang¹, Mr. Xiang Fang¹
¹West China Hospital, Sichuan University, Chengdu, China

Purpose:
Widely accepted surgical reconstruction for tumors of the talus is arthrodesis, which may associate with poor limb functions. The aim of this study was to present a novel reconstruction with ankle function preserved after en bloc talus tumor resection.

Method:
A 43-year-old female with mesenchymal sarcoma of the talus was admitted in our center. Total talar replacement with 3D-printed modular total talar prosthesis was prepared for reconstruction. The 3D-printed modular total talar prosthesis was designed exactly as the mirror image of the contralateral talus with complete filling of the sinus tarsi and subtalar joint space. The upper modular component of prosthesis was made of high molecular weight polyethylene (UHMWPE), and the lower component, titanium alloy. Pre-drilled holes in three directions were prepared for screw fixation of the subtalar joint.

Result:
The patient underwent en bloc talus resection through anterior approach, followed by reconstruction with the 3D-printed prosthesis. The whole procedure took 2 h, and intra-operative blood loss was 50 ml.
At the last follow-up our patient was disease free, and she could walk almost normally without any aid or pain. The Musculoskeletal Tumor Society (MSTS) score was 26/30. The American Orthopedic Foot and Ankle Society (AOFAS) score was 91/100. The range of motion for dorsiflexion and plantar flexion was 40 degrees. And no abnormalities were observed in the roentgenograph.

Conclusion:
Total talar replacement with a 3D-printed modular prosthesis may be an effective procedure for patients with tumors of the talus as it could maintain ankle function.

Keywords: bone tumors, sarcoma, reconstructive surgery, high molecular weight polyethylene, limb salvage, en bloc resection
3D-multimodality imaging technique facilitates oncological resection of periacetabular malignancies

Mr. Hong Duan¹, Mr. Zeping Yu¹, Mr. Wenli Zhang¹, Mr. Xiang Fang¹, Mr. Senlin Lei¹
¹West China Hospital, Sichuan University, Chengdu, China

Background
Although various surgical methods have been adopted in pelvic tumor surgeries, the outcomes of periacetabular resection and reconstruction remain unsatisfactory. 3D-multimodality imaging (3DMMI) has been proved to facilitate the oncological resection, but rarely applied in orthopedics. Thus, we adopted the 3DMMI technique to facilitate periacetabular resection and hemipelvic reconstruction.

Methods
A total of 12 consecutive patients underwent periacetabular resection and hemipelvic endoprosthesis reconstruction with the assistance of 3DMMI technique between January 2012 and July 2014. The median follow-up period was 36.2 months (9 to 57). 3D-printed osteotomy guiding plates were individually designed for each patient on the basis of 3DMMI including three-dimensional computed tomography, contrast-enhanced CT angiography, contrast-enhanced magnetic resonance imaging, and neurography. The virtual operation was performed preoperatively on the corresponding model. Clinical, functional, oncological outcomes, and complications were analyzed.

Results
En bloc resection was achieved in 11 patients with wide margins in 10 patients, marginal in one. The mean blood loss was 2291.67 mL (standard deviation ± 868.1 mL) with a mean operating duration of 214.17 minutes (standard deviation ± 40.1 minutes). Musculoskeletal Society functional score was 22.58 (75.3%, range 56.7%–86.7%, standard deviation ± 3.0). The Short Form-36 questionnaire showed a higher score after surgery (p<0.01). One patient developed local recurrence (8.33%). The complication included superficial wound infection in two patients and dislocation of the hip in one patient.

Conclusion
Periacetabular oncological resection and hemipelvic endoprosthesis reconstruction based on 3D-multimodality imaging technique are technically accessible with relatively minor trauma, acceptable early functional and oncological outcomes.

Keywords
Periacetabular tumors, Guided osteotomy, Computer-aided design, Endoprosthetic reconstruction
Enhanced recovery after surgery in combined hemipelvic prosthesis replacement
Clinical practice in the treatment of pelvis tumors

Mrs. Yongmei Chen¹, Mr. Xiang Fang¹, Mr. Li Min¹, Mr. Wenli Zhang¹, Mr. Yi Luo¹, Mr. Chongqi Tu¹, Mr. Hong Duan¹
¹West China Hospital, Sichuan University, China

BACKGROUND:
Patients with pelvic bone tumor suffer from anemia, heavy psychological burden, long operation time of traditional prosthesis, large trauma and bleeding, and strong emergency response to trauma, which affect the recovery of patients. From August 2019 to November 2019, 7 patients with tumors in the acetabulum and surrounding areas of the pelvis and acetabulum were treated with 3D semi pelvic prosthesis by computer-aided design. All the operations were successfully completed. The concept of rapid rehabilitation was used for personalized management, and the postoperative recovery was good.

METHODS:
Choose from August 2019 to November 2019, 7 patients with tumors of pelvis, acetabulum and surrounding area were selected for surgical treatment, including 5 males and 2 females. The age was 15-69 years. There were 3 cases of osteosarcoma, 1 case of chondrosarcoma and 3 cases of metastasis. We will jointly develop positive treatment plans and personalized management, such as positive psychological support. Assessment of nutrition the risk of malnutrition, Strengthen intraoperative management, Postoperative infection prevention and wound care; pain management program; VTE prevention; early rehabilitation training and personalized rehabilitation guidance.

RESULTS
The operation time was 3.5-5.5h and the average blood transfusion was 1528 ± 1702ml. The average length of stay was 13.43 ± 3.60days.

CONCLUSION:
Computer-aided design 3D printing group matched hemi-pelvic prosthesis replacement surgery accurate tumor resection scope and surrounding anatomy, personalized customized group matched joint prosthesis, preoperative simulation surgery to draw up a safe operation plan, so as to shorten the operation time, reduce the amount of bleeding, cooperate with this kind of surgery, pay attention to the preoperative professional nursing evaluation, and implement the corresponding nursing strategies, to achieve rapid recovery of patients Objective.
Development of a general logistic model for disease risk prediction using multiple SNPs

Mr. Cheng Long

West China Hospital, Sichuang University, China

Human diseases are usually linked to multiloci genetic alterations, including single-nucleotide polymorphisms (SNPs). Methods to use these SNPs for disease risk prediction (DRP) are of clinical interest. DRP algorithms explored by commercial companies to date have tended to be complex and led to controversial prediction results. Here, we present a general approach for establishing a logistic model-based DRP algorithm, in which multiple SNP risk factors from different publications are directly used. In particular, the coefficient \( b \) of each SNP is set as the natural logarithm of the reported odds ratio, and the constant coefficient \( b_0 \) is comprehensively determined by the coefficient and frequency of each SNP and the average disease risk in populations. Furthermore, homozygous SNP is considered a dummy variable, and the SNPs are updated (addition, deletion and modification) if necessary. Importantly, we validated this algorithm as a proof of concept: two patients with lung cancer were identified as the maximum risk cases from 57 Chinese individuals. Our logistic model-based DRP algorithm is apparently more intuitive and self-evident than the algorithms explored by commercial companies, and it may facilitate DRP commercialization in the era of personalized medicine.
Diosgenin exerts its tumor suppressive function via inhibition of Cdc20 in osteosarcoma cells

Mr. Cheng Long

1West China Hospital, Sichuang University, ChengDu, China

Osteosarcoma (OS) is one of the aggressive malignancies for young adults. Cdc20 (cell division cycle 20 homologue) has been reported to exhibit an oncogenic role in OS, suggesting that inhibition of Cdc20 could be a novel strategy for the treatment of OS. Since Cdc20 inhibitors have side effects, it is important to discover the new CDC20 inhibitors with non-toxic nature. In the present study, we determine whether natural agent diosgenin is an inhibitor of Cdc20 in OS cells. We performed MTT, FACS, Wound healing assay, Transwell, Western blotting, transfection assays in our study. We found diosgenin inhibited cell growth and induced apoptosis. Moreover, diosgenin exposure led to inhibition of cell migration and invasion. Notably, diosgenin inhibited the expression of Cdc20 in OS cells. Overexpression of Cdc20 abrogated the inhibition of cell growth and invasion induced by diosgenin. Our data reveal that inhibition of Cdc20 by diosgenin could be helpful for the treatment of patients with OS.
Prognostic nomograms to predict overall survival and cancer-specific survival in patients with pelvic chondrosarcoma

Mr. Cheng Long
1
1West China Hospital, Sichuang University, , China

Background:
The pelvis is the most common site of chondrosarcoma (CS), and the prognosis for patients with pelvic CS is worse than that for patients with CS in the extremities. However, clinicians have had few tools for estimating the likelihood of survival in patients with pelvic CS. Our aim was to develop nomograms to predict survival of patients with pelvic CS.

Methods:
Data from the Surveillance, Epidemiology, and End Results (SEER) database of patients with pelvic CS between 2004 and 2016 were retrieved for retrospective analysis. Univariate and multivariate Cox analyses were used to identify independent prognostic factors. On the basis of the results of the multivariate analyses, nomograms were constructed to predict the likelihood of 3- and 5-year overall survival (OS) and cancer-specific survival (CSS) of patients with pelvic CS. The concordance index (C-index) and calibration curves were used to test the models.

Results:
In univariate and multivariate analyses of OS, sex, pathologic grade, tumor size, tumor stage, and surgery were identified as the independent risk factors. In univariate and multivariate analyses of CSS, pathologic grade, tumor size, tumor stage, and surgery were identified as the independent risk factors. These characteristics except surgery were integrated in the nomograms for predicting 3- and 5-year OS and CSS, and the C-indexes were 0.758 and 0.786, respectively.

Conclusion:
The nomograms precisely and individually predict OS and CSS of patients with pelvic CS and could aid in personalized prognostic evaluation and individualized clinical decision-making.
Characteristics and prognosis of pelvic Ewing sarcoma: a SEER population-based study

Mr. Cheng Long¹, Mr. Xin Duan¹
¹West China Hospital, Sichuan University, , China

Background:
The pelvis is one of the primary sites of Ewing sarcoma (ES) and is associated with poorer prognoses than the extremities. Due to the rarity of this disease and limited data available, the prognostic factors of pelvic ES remain controversial. Thus, this study aimed to identify independent prognostic factors, and develop a nomogram for predicting survival rates in patients with pelvic ES.

Methods:
Using data provided by the Surveillance, Epidemiology, and End Results (SEER) database, variables including age, sex, race, tumor size, tumor stage, surgery, and radiotherapy were analyzed using the Kaplan–Meier method and Cox proportional hazards regression. Based on the results of multivariate analyses, a nomogram was built to predict the overall survival (OS) of patients with pelvic ES. The performance of the nomogram was evaluated by the concordance index (C-index).

Results:
A total of 267 cases diagnosed between 2004 and 2016 were included in the study. Univariate and multivariate analyses showed that patients who were younger, white, had a localized tumor stage, or underwent surgery were associated with improved prognoses, while no significant differences were observed in OS based on sex, tumor size, or radiotherapy. A nomogram was developed and the C-index was 0.728, indicating adequate performance for survival prediction.

Conclusions:
Age, race, tumor stage, and surgery were identified as independent prognostic factors for the OS of pelvic ES. The nomogram developed in this study can individually predict 3- and 5-year OS in patients with pelvic ES.
Integrated miRNA-mRNA analysis revealing the potential roles of miRNAs in chordomas

Mr. Cheng Long

Peking University Third Hospital, China

Introduction:
Emerging evidence suggests that microRNAs (miRNAs) are crucially involved in tumorigenesis and that paired expression profiles of miRNAs and mRNAs can be used to identify functional miRNA-target relationships with high precision. However, no studies have applied integrated analysis to miRNA and mRNA profiles in chordomas. The purpose of this study was to provide insights into the pathogenesis of chordomas by using this integrated analysis method.

Methods:
Differentially expressed miRNAs and mRNAs of chordomas (n = 3) and notochord tissues (n = 3) were analyzed by using microarrays with hierarchical clustering analysis. Subsequently, the target genes of the differentially expressed miRNAs were predicted and overlapped with the differentially expressed mRNAs. Then, GO and pathway analyses were performed for the intersecting genes.

Results:
The microarray analysis indicated that 33 miRNAs and 2,791 mRNAs were significantly dysregulated between the two groups. Among the 2,791 mRNAs, 911 overlapped with putative miRNA target genes. A pathway analysis showed that the MAPK pathway was consistently enriched in the chordoma tissue and that miR-149-3p, miR-663a, miR-1908, miR-2861 and miR-3185 likely play important roles in the regulation of MAPK pathways. Furthermore, the Notch signaling pathway and the loss of the calcification or ossification capacity of the notochord may also be involved in chordoma pathogenesis.

Conclusion:
This study provides an integrated dataset of the miRNA and mRNA profiles in chordomas, and the results demonstrate that not only the MAPK pathway and its related miRNAs but also the Notch pathway may be involved in chordoma development. The occurrence of chordoma may be associated with dysfunctional calcification or ossification of the notochord.
Effect of surgical nursing of accelerated rehabilitation on the function and complications of shoulder joint arthroplasty for proximal humeral tumor

Ms. Yan Huang1, Mrs. Yongmei Chen1, Mr. Yi Luo1
1West China Hospital, Sichuan University, China

Objective:
To analyze the effect of surgical nursing of accelerated rehabilitation on the function and complications of shoulder joint arthroplasty for proximal humeral tumor.

Methods:
From January 2018 to October 2019, 82 patients with proximal humeral tumor who were treated in our hospital for shoulder joint replacement were selected. There were 60 males and 22 females. Males: females = 2.7:1. They were randomly divided into control group and treatment group. The control group was given routine nursing. The treatment group received early nutrition powder feeding, standardized painkillers, Mood assessment and intervention, and personalized exercise rehabilitation program after operation.

Result:
The score of life quality of the control groups was lower than that of the treatment group. The evaluation indexes of the postoperative limb efficacy of the two groups were: limb function, muscle strength, hand feeling, shoulder joint activity and treatment acceptance. The normal score was 30, the excellent score was 24-30, the good score was 19-23, the good score was 12-18, and the excellent rate of the treatment group was 71% (59 / 82). The excellent rate of the control group was 28% (23 / 82). The postoperative complications (loosening of prosthesis, fracture around prosthesis, bleeding, infection) of the treatment group were lower than that of the control group, and the satisfaction of nursing service was higher, the difference was statistically significant (P < 0.05).

Conclusion:
Surgical nursing of accelerated rehabilitation has a significant effect on the function and complications of shoulder joint arthroplasty for proximal humeral tumor, which can effectively reduce the complications, improve the overall physical and mental state of patients, and help patients achieve the improvement of rehabilitation efficiency.
Using means of transport and walking aids after treatment for primary malignant bone tumors in the lower extremity - A minimum follow-up of 20 years

Mr. Christoph Hofer1, Ms. Carmen Trost1, Mr. Joannis Panotopoulos1, Mr. Philipp Theodor Funovics1, Mr. Reinhard Windhager1, Mr. Gerhard Martin Hobusch1

1Medical University of Vienna Department Orthopedics and Trauma-Surgery, Vienna, Austria

Introduction:
During the process of rehabilitation after amputation of the lower extremity due to sarcoma, patients rely on others to do their daily life’s commutes. Compared to patients after limb salvage surgery, amputees with a sufficient fitting prosthetic limb do not seem to show significant disadvantages in the ability to ambulate in the short-term.

Methods:
42 patients after ablative surgery (AS) (14 transfemoral, 4 knee disarticulations, 3 transtibial, 21 rotationplasty surgeries) and 40 patients after limb salvage surgery (LSS) were interviewed about the ability to drive a car, the use of public transport and about the utilization of walking aids. A minimum follow-up of 20 years after surgical procedure was required.

Results:
34 patients (81%) after AS reported most often driving a car by their own, 3 (7.1%) didn’t drive a car and 4 (9.5%) reported most often being a co-driver. 32 patients (80%) after LSS reported most often driving a car by their own, 3 (7.5%) didn’t drive a car and 4 (10%) reported most often being a co-driver.

29 patients (69.1%) in the AS group and 27 patients (67.5%) in the LSS group used to commute by public transport. 18 patients (42.9%) in the AS group (within 1 patient didn’t use a prosthetic limb) used – at least seldomly – crutches or a cane indoors, whereas 6 (15%) in the LSS group (p=0.011).

A similar significant difference could be found regarding the usage of crutches or a cane outdoors (p=0.01).

1 patient (2.4%) in the AS group used a wheelchair.

Other vehicles being used were bicycles (7), electro-scooters (2) and a motorbike.

Conclusion:
No difference was found between AS and LSS regarding the usage of cars and public transport in the long-term. Both in- and outdoors, patients after AS are more dependent on walking aids.
Does chemotherapy treatment affect families/work/school and social relations for patients with bone tumours? An observational study.

Mr. Eugenio Bruku, Mattia Morri, Mrs. Viviana Valentina Verdoliva
Istituto Ortopedico Rizzoli, Italy

INTRODUCTION:
The chemotherapy treatment affects the health conditions of patients with bone tumours. Several side effects are described. For patients with bone tumour, these aspects are further amplified by the motor deficit that resection and reconstruction surgeries cause. There is a lack of data about the family and social aspects. The aim of this work is to describe families/work/school and social relations for patients with bone tumours during the chemotherapy treatment.

METHODS:
The items investigated family support, social, work or school relationships, the need for psychological support from professionals and the changes in daily life. The items were evaluated by the Likert scale, with a score ranging from 1 (critical issue) to 7 (absence of problems).

RESULTS:
42 patients were enrolled. The average score on the scale reported from 0 to 100 is equal to 62.8 with DS 27.4. Questions related to the need for psychological support and impact on daily life were the most critical aspects with an average score of 2.9 (± 1.8)

CONCLUSION:
In bone cancer patients, daily life is significantly compromised during chemotherapy treatment and there is an important request for psychological support. The family environment and the social relationships are strong points for the patient.
The physiotherapy assessment and treatment for the child with tumour: Consensus Conference.

Mr. Enrico Venturini¹, Marria Morri²
²Istituto Ortopedico Rizzoli, Italy

Background:
With the increase of the survival rates for the child with bone tumour, it is growed the attention for the side effects associated with the cancer itself and its treatment. No rehabilitation guideline or specific care pathways in the literature are defined for these patients. The goal of the present study is to define the role of the physiotherapist in the assessment and treatment of motor impairments in children/adolescents affected by bone tumors.

Methods/design:
The Italian Association of Pediatric Hematology and Oncology (AIEOP) has established a path of Consensus Conference on motor assessment and rehabilitation treatment for children/adolescents affected by musculoskeletal tumors. A technical-scientific committee established a list of 9 questions and a panel of expert (PoE) answering these questions led to related recommendations and statements. These ones were analysed and voted by a multidisciplinary jury made up of experts from various fields of oncology and rehabilitative medicine.

Results:
The summaries prepared by the PoE resulted in fifteen recommendations, of these recommendations, one have a moderate level of evidence, two low/moderate level, six low level and four very low level. After discussion and vote, a strong agreement was reached for all the recommendations.

Conclusions:
Substantial agreement exists among experts regarding many strong recommendations for the improvement of practice concerning rehabilitation interventions in musculoskeletal oncology patients. These recommendations will represent an occasion to improve care models and resources use.
Rotationplasty in cancer patients: what is the rehab strategy?

Mr. Marco Cotti¹, Mattia Morri¹
¹Istituto Ortopedico Rizzoli, Italy

Introduction:
When is not possible a salvage surgery, rotationplasty is a valid alternative in case of massive osteosarcoma localized in middle and distal femur. Rotationplasty technique consists of removing the tumor from the femur while preserving neurovascular bundle, the distal portion of the tibia and the foot. Tibia and foot are then turned of 180° and stabilized to the proximal femur by titanium platea and screws. In literature this surgical technique is related to good results in functional outcomes and quality of life. Rehabilitation plays a fundamental role to reach the higher functional recovery but there is a lacks of descriptions of rehabilitation treatment. The aim of the present abstract is to show rehabilitative strategy for rotationplasty patient and to report case study based on clinical practice.

Method:
A literary review was carried out about the rehabilitation program after rotationplasty. “Rehabilitation”, “Rotationplasty” and “Bone Cancer” was used for the research on PuBMed. Eleven studies were found in the last 10 years and the results were compared to clinical practices and specific case study.

Conclusion:
Rotationplasty is a valid option to reach high level in quality of life and functional outcomes. Rehabilitative program should provide: early approach to enable the patient to walk as soon as possible, early training for the prosthesis and specific training for the ankle functioning as knee joint.
AYA’s with recurrent bone and soft tissue sarcoma’s, three patients with a characteristic clinical course.

Mrs. Nicolette Leijerzapf¹, Robert Van der Wal¹, Michiel Van der Sande³, PDS Dijkstra³
¹Leiden University Medical Center, Leiden, Netherlands

Background
About 2700 AYA’s (adolescents and young adults between 18-35 years) are diagnosed with cancer each year in the Netherlands. The incidence of cancer among AYA’s in the Netherlands is increasing and is 5 times higher than the incidence of cancer among children aged between 0-17 years.
The median 5-year survival rate for cancer patients is 80% but for some cancers that occur in adolescents and young adults, it is considerably worse, for example for bone and soft tissue tumors. These tumors are rare and includes several types. Some bone and soft tissue cancers including osteosarcoma, Ewing sarcoma and Rhabdomyosarcoma are seen most often in children and young adults.
A presentation of three patients with an osteosarcoma, Ewing sarcoma and Rhabdomyosarcoma with a characteristic clinical course.
Bone heating at tumor endoprosthesis Implantation: a cadaver study

Mr. Christian Pauritsch¹, Ms. Maria Anna Smolle¹, Ms. Jasmina Igrec¹, Ms Ursula Reiter¹, Mr. Jörg Friesenbichler³, Mr. Wolfgang Grechenig¹, Mr. Michael Fuchsjäger¹, Mr. Andreas Leithner¹, Mr. Marko Bergovec¹

¹Medical University Of Graz, Graz, Austria

Background: During the endoprosthesis implantation process, friction between bone and implantation tools increases bone temperature which could have negative consequences: a threshold of 50°C should not be exceeded. Such temperatures lead to thermal osteonecrosis which affects both biological and mechanical properties of bone.

Objectives: The aim of this study is to measure bone heating during the process of implantation of a distal femur cemented tumor endoprosthesis.

Study Design & Methods: Four flouroptic temperature probes were used to measure temperature at different bone localisations during the surgical procedure at cadaver. Simulation of the endoprosthesis implantation matched the real tumor endoprosthesis implantation scenario. For the analysis we looked at the reached temperature during the various part of operations: baseline temperature of the cadaver, bone osteotomy with, bone canal reaming, implantation of endoprosthesis, and cementing. An Implantacast MUTARS distal femur tumor endoprosthesis was used.

Results: The baseline cadaver temperature in the anatomy lab was 22.6°C. At osteotomy a measured temperature of reached 79.6°C. Even higher, the temperature reached up to 106.8°C at reaming. During cementation the temperature was no more than 26.8°C, a 4.2° increase over base value.

Conclusions: Techniques used for the implantation of tumor endoprostheses excessively increase bone temperature due to friction. The temperature during osteotomy or reaming reaches levels where thermal bone necrosis occurs. The cementing process did not increase bone temperature significantly, most likely due to the relatively thin layer of bone cement between endoprosthesis and bone tissue. The temperatures could be even higher in vivo setting, since human bone baseline temperature is higher than the baseline temperature in this study. All attempts should be made, like external irrigation, to keep the bone temperature below the critical value of 50°C, trying to avoid thermal osteonecrosis.
Can a modular tapered fluted titanium femoral stem be used in reconstruction following proximal femur tumor resection?

Mr. Marko Bergovec, Mr. Kresimir Crnogaca, Mr. Mirko Dozan, Mr. Miroslav Smerdelj

1 Department of orthopaedic surgery, Zagreb University School of Medicine, Zagreb, Croatia, 2 Medical University Of Graz, Graz, Austria

Introduction: The biomechanical situation after the proximal femur resection is similar to the unsupportive proximal femur at hip endoprosthesis revision cases. Modular tapered fluted titanium stems are available for use in femoral revision cases.

Methods: We prospectively analyzed 43 patients / 44 hips who underwent en bloc proximal femur resection for tumor and a reconstruction with a modular tapered fluted titanium stems in a 16-years period (1998 to 2013). All patients were followed until death or until the latest clinical check-up, at the latest November 2016. We used revision femoral stem MP Reconstruction Stem (Waldemar Link) in 14 hips, and Revision stem (Lima) in 30 hips. Functional results were measured with Harris Hip Score, Merle d’Aubigne Score and Musculoskeletal Tumor Rating Scale. Twenty-five patients were operated due to primary tumor, and 18 patients / 19 hips due to metastases. Pathologic fracture was an initial presentation in three patients with primary bone tumors and five patients with carcinoma metastasis.

Results: An intraoperative injury of the femoral artery occurred in one patient. One patient has permanent postoperative peroneal palsy. Eight patients had a postoperative hip dislocation (18%). Three underage patients needed acetabular revisions because of growing triradiate cartilage. Deep periprosthetic infection occurred in five patients (11%). Revision due to femoral stem failure was required for 3 patients. Harris Hip Score improved from the mean 25,9 (4,7 to 61,7) preoperatively to 75,4 (26,2 to 95,5) postoperatively (p<0,05). Musculoskeletal Tumor Rating Scale improved from 16,3% (0% to 46,7%) to 68,1% (13,3% to 93,3%) (p<0,05). Merle d’Aubigne Score improved from preoperatively the mean of 4 (0 to 11) to postoperatively 14 (7 to 17).

Conclusion: Because of the good results, comparable with a standard tumor endoprosthesis, and due to economical advantages, this system will be used further on at out Department.
Tumors at the elbow - clinical and oncological results after resection and endoprosthesis replacement: preliminary results of a 101 patients from a multicentric study

Stefano Bastoni, Mr. Marko Bergovec, Nikolay Bolshakov, Domenico Andrea Campanacci, Rodolfo Capanna, Primo Andrea Daolio, Antonio D’Arienzo, Jörg Friesenbichler, Grzegorz Guzik, Jendrik Hardes, Arthur Kievit, Andreas Leithner, Blaz Mavcic, Francesco Muratori, Lauris Repsa, Gerard R. Schaap, Arne Streitbürger, Oleg Vyrva

1Department of Orthopaedics and Trauma, Medical University of Graz, Graz, Austria, 2Department of Surgical Oncology, Orthopaedic Institute “G. Pini”, Milan, Italy, 3Department of Orthopaedic and Trauma Surgery, University of Pisa, Pisa, Italy, 4Department of Orthopaedic Oncology and Reconstructive Surgery, Azienda Ospedaliero Universitaria Careggi, University of Florence, Florence, Italy, 5Department of Orthopaedic Oncology, Specialist Hospital in Brzozów, Podkarpackie Oncology Centre, Poland, 6Department of Orthopaedic Oncology and Reconstructive Surgery, Azienda Ospedaliero Universitaria Careggi, University of Florence, Florence, Italy, 7Department of Orthopaedic Oncology, Specialist Hospital in Brzozów, Podkarpackie Oncology Centre, Poland, 8Sytenko Institute of Spine and Joint Pathology, Kharkiv, Ukraine, 9West German Cancer Center, University Hospital Essen, Essen, Germany, 10Department of Orthopaedic Surgery, University Medical Centre Ljubljana, Ljubljana, Slovenia, 11Hospital of traumatology and orthopaedics, Riga, Latvia, 12Department of oncology and pediatric surgery, D.Rogachev National Medical Research Center of Pediatric Hematology, Oncology and Immunology, Moscow, Russian Federation, 13Amsterdam UMC, Netherlands

Background: Bone and soft tissue tumors involving the elbow are rare. The aim of this study is to analyze the clinical and oncological results after a distal humerus resection for tumors as well as performance of elbow tumor endoprosthesis.

Methods: A multicentric retrospective study. Oncologic outcome (local recurrence, metastases, survival) have been documented. We used Musculoskeletal Tumor Rating Scale (MSTS), Toronto Extremity Salvage Score (TESS), and Mayo Elbow Performance Score (MEPS) to analyze clinical and endoprosthetic performance. Results: In this preliminary results we included 101 patient from 11 European orthopaedic tumor centers. The indications for the operation were metastasis (n=50 patients), soft tissue sarcoma (n=14), osteosarcoma (n=11), chondrosarcoma (n=9), Ewing sarcoma (n=6) and giant cell tumor of bone (6) and other (n=5). An average tumor size was 91mm in largest diameter. Reconstruction was performed with Implantcast MUTARS (n=43), Stryker or HMRS (n=25), Biomet (n=10), and custom made or other type of endoprosthesis (n=23). Early aseptic loosening was found in 2, and late loosening in 8 patients. Only 2 early and 2 late infections have been documented. An average MSTS score was 24 (range: 14 to 30), TESS was 76% (42%-97%), and MEPS was 72 (45-95). Elbow range of motion was 20°-100° or better in 75% of patients. Survival of patients with metastasis, with an average follow-up of 21 months was 52%. Survival of sarcoma patients was 78% at an average of 69 months follow-up. Conclusions: Survival of metastasis patients seems comparable to the patients with bone metastasis on other locations, but survival of sarcoma patients seems better than lower-extremity sarcomas. One quarter of patients do not reach satisfactory elbow function, but scores showed that good to very good clinical performance of elbow tumor endoprosthesis is achieved in most of patients.
Introduction:
The Czech Republic is a country in the middle of Europe with about ten million inhabitants. The aim of this analysis was to collect information on epidemiology, treatment and outcomes of sarcoma patients. The Czech National Cancer Registry (CNCR) has been in operation since 1977, when it was instituted as a national database covering 100% of cancer diagnoses and the entire Czech population. Out of 188 hospitals in total (2013) is the fully specialized oncology care provided in 15 Complex Oncology Care Centres (COC).

Patients and methods:
The Institute of Biostatistics and Analyses of the Masaryk University in Brno analyzed data from the CNCR of all sarcoma patients between 2005-2016. The primary end-point was the overall survival (OS) and the contribution of treatment centralization.

Results:
The average incidence in the last 5-year period (2012-2016) was 596 new sarcoma diagnoses per year. In 2015, 612 sarcomas were diagnosed, 541 soft tissue and 71 bone sarcomas. The incidence has been increasing for the last 2 decades. In the last 15 years, the prognosis hasn’t changed (except of gastrointestinal stromal sarcoma). Syear OS in STS was 61,4% during 2005-2010 and 60,2% during 2010-2015, in bone sarcoma 47,3 % and 54,5 % respectively. The treatment results depend on early and correct therapy in experiences centres. During 2012-2016, 147 first-contact hospitals and 223 other health centres have participated in the diagnostics and primary treatment. Only 70% of patients were sooner or later referred to COCC.

Conclusion:
According to data of CNCR patients have been surgically treated in 124 various hospitals! 1/3 of them has never reached specialized treatment in CCOC. The centralization of treatment is the only way to improve the prognosis of sarcoma patients.

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Protein c-Myb in osteosarcoma – experimental research and retrospective study

Mrs. Dagmar Adamkova Krakorova1, Mr. Petr Benes2,3, Mrs. K Rihová2, Mrs. L Vymětalová2,3, Mrs. M Šrámek2,3, Mrs. F Trcka2,3, Mrs. I Kubelková4, Mrs. Iva Staniczková Zambo5, Mrs. Danica Zapletalová2, Mrs. Peter Múdry6, Mrs. M Hermanova5, Mrs. L Knopfová2,3

1Masaryk Memorial Cancer Institute, Brno, Czech Republic, 2Laboratory of Cell Differentiation, Faculty of Science, Masaryk University, Brno, Czech Republic, 3International Clinical Research Center, St. Anne’s University Hospital Brno, Czech Republic, 4Department of Pathology, University Hospital Brno, Brno, Czech Republic, 51st Department of Pathological Anatomy, Faculty of Medicine, Masaryk University, Brno and St. Anne’s University Hospital, Brno, Czech Republic, 6Department of Pediatric Oncology, University Hospital and Faculty of Medicine, Masaryk University, Brno, Czech Republic

Introduction:
c-Myb is an oncogene often overexpressed in leukemias, breast and colon cancer. Aberrant activation of transcription factor c-Myb and its target genes disturbs the homeostasis in favor of cell proliferation and survival, thus contributing to malignant transformation. Recent studies described its role in bone development as well as its expression in osteosarcoma (OSA) cell lines. The relevance of c-Myb in control of osteosarcoma development, progression and therapeutic resistance is unknown.

Methods:
Osteosarcoma cancer cell lines with knocked-out c-Myb expression were prepared. Their chemosensitivity to methotrexate, cisplatin and doxorubicin was analysed by flow-cytometry. Lung metastasis formation was evaluated in mouse xenografts. Immunohistochemistry protocol in archival osteosarcoma tissue samples was optimized and retrospective study in OSA patients initiated.

Results:
c-Myb expression in osteosarcoma cancer cell lines was confirmed at RNA and protein level. Downregulation of c-Myb made osteosarcoma cell lines more sensitive to therapy but this effect was cell line dependent. c-Myb knock-out impaired the ability of SAOS LMS osteosarcoma cells to form lung metastases in immunodeficient mice. Data from 96 OSA patients diagnosed and treated in Masaryk Memorial Cancer Institute and Department of Pediatric Oncology, University Hospital Brno in the period 2007 – 2020 were collected. Immunohistochemistry revealed significant heterogeneity in c-Myb expression in OSA tissue, the overall expression, however, was lower than previously detected in breast and colon cancer samples. High c-Myb expression was associated with poor overall survival in this cohort.

Conclusion:
Experimental results revealed the importance of c-Myb in regulation of osteosarcoma cancer cell line chemosensitivity and metastatic activity. Clinical retrospective study revealed a heterogeneity in c-Myb staining in OSA patients archival tissue samples. Lastly, c-Myb expression predicted 3-year overall survival in this cohort.

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Preoperative Sarcopenia is Associated with Local Tumor Recurrence but not Wound Complications Following Sacral Tumor Resection

Daniel J. Blezek², Elyse J. Brinkmann¹, Mr. Matthew Houdek¹, Joshua D. Johnson³, Syed Mohammed Karim¹, Peter Rose³, Doris E. Wenger²

¹Department of Orthopedic Surgery, Rochester, United States, ²Department of Radiology, Mayo Clinic, Rochester, United States

Introduction:
Sacral tumor resection is known for a high rate of complications. Sarcopenia has been found to be associated with wound complications; however there is a paucity of data examining the impact of sarcopenia on the outcome of sacral tumor resection.

Method:
Forty-eight patients (31 primary sarcoma, 17 locally recurrent carcinomas) undergoing sacrectomy were reviewed. Central sarcopenia was assessed by measuring the psoas:lumbar vertebra index (PLVI), with the 50th percentile (0.97) used to determine which patients were high (>0.97) versus low (<0.97).

Results:
Twenty-four (50%) patients had a high PLVI and 24 (50%) had a low PLVI (sarcopenic). There was no difference (p>0.05) in the demographics of patients with or without sarcopenia. There was no difference in the incidence of postoperative wound complications (OR 1.0, p=1.0) or deep infection (OR 0.83, p=1.0). Sarcopenia was not associated with death due to disease (HR 2.0, p=0.20) or metastatic disease (HR 2.3, p=0.17), but was associated with local recurrence (HR 6.0, p=0.01).

Conclusion:
Central sarcopenia was not predictive of wound complications or infection following sacral tumor resection. Sarcopenia was, however, an independent risk factor for local tumor recurrence following sacrectomy, and should be considered when counseling patients on the outcome of sacrectomy.
The use of 3D printing in the treatment of osteolytic bone lesions – a workflow

B. Jadav¹, MJ. Jagiello¹, LJ. Johnson¹, J. Prijs¹, M. Rego¹, Mr. Wolfram Weschenfelder¹,²
¹Flinders Medical Centre, Flinders University, Adelaide, Australia, ²University Hospital Jena, Friedrich Schiller University Jena, Jena, Germany

Introduction:
Complex anatomical regions make for difficult planning and execution of Orthopaedic Oncology surgeries. Full appreciation of lesion extent and geometry is often difficult to determine, in particular in pelvis, sacrum & proximal tibia. 3D printing is being used increasingly in Orthopaedic Trauma for understanding fracture patterns & enabling more thorough pre-operative planning. The South Australian Bone & Soft Tissue Tumour Unit has recently adopted 3D printing technology for pre-operatively planning complex tumour operations, creating true-to-scale models for surgeon and patient education and to track changes in lesions undergoing systemic medical treatment.

Methods:
Illustrated is the workflow for 2 representative tumour cases. Case 1 displays a large pelvic aneurysmal bone cyst in a paediatric patient. Case 2 displays a patient with a large giant cell tumour of bone of the proximal tibia. The workflow comprises: 1) extraction of thin-slice CT images from Hospital PACS; 2) conversion of 2D CT to 3D model using open-access software ‘3DSlicer’; 3) isolate region of interest; 4) transform 3D virtual model to a printable model; 5) print the model.

Results:
The workflow of the 2 cases presented display a step-by-step guide for effective clinical use of 3D printing in a simple, reproducible and easily deployable method that can be integrated in hospitals around the world, using free open-access software and a single 3D printer. The models produced are of a quality to allow accuracy in surgical planning and in patient and surgeon education.

Conclusion:
3D printing is a technical adjunct that brings preoperative imaging one step closer to the true intraoperative 3D shape morphology of bone tumours. This provides (even for experienced surgeons) an enhanced understanding of the size, geography and extent of a tumour lesion in the pre-operative planning phase of patient care, further refining the principle of ‘personalised medicine’ in Orthopaedic Oncology care.
Melorheostosis – A potential diagnostic pitfall mimicking malignant lesion

Ms. Ann-Katrin Kaufman-Bühler¹, Mr. Elmar Janek¹, Ms. Iva Brcic², Mr. Jörg Friesenbichler³, Ms. Susanne Scheipl³, Mr. Michael Fuchsjaeger¹, Mr. Andreas Leithner³, Ms. Jasminka Igrec¹

¹Medical University of Graz, Department of Radiology, Division of General Radiology, Graz, Austria, ²Medical University of Graz, Institute of Pathology, Graz, Austria, ³Medical University of Graz, Department of Orthopaedics and Trauma, Graz, Austria

Introduction:
Melorheostosis is a rare benign bone dysplasia that causes periosteal and endosteal solid bone formation with various cutaneous and connective tissue abnormalities. In its classic form, melorheostosis occurs primarily in the peripheral skeleton, involving several bones of the same sklerotome with typical linear hyperostosis along the inner and outer cortical surfaces. Due to this characteristic appearance, the polyostotic form of melorheostosis can be distinguished from other lesions. However, further morphological subtypes have been described, including the osteoma-like, myositis-like and osteopathia striata-like forms. In particular, if these lesions are limited to one bone, i.e. monostotic, differentiation from other malignant and benign neoplasms can be challenging. The treatment includes symptom-oriented pain management and restoration of a full range of motion. Recurrence after operative excision is seen.

Methods:
We performed a literature search of human studies in the English language using PubMed electronic search using the words “melorheostosis” and “MRI” or “CT” or “conventional radiography”.

Results:
The search revealed 56 matching publications with a total of 382 patients including 207 female and 175 male, age range 2 - 68 years (mean age 31.5 y). Lesion distribution was mainly monomelic (70.8%). A monostotic from was described in 12.0% of the cases. Most frequently, the changes affected the lower (47.5%) and the upper (29.9%) extremity. The spine, ribs and skull were rarely involved. The classic dripping candle wax morphology was identified in about half of the lesions (52%).

Conclusion:
Melorheostosis is a classic "don't touch" lesion. Radiographs suffice for establishing the diagnosis of melorheostosis; there is no need for a histopathological confirmation. CT and MRI are problem-solving tools when considering the common differential diagnosis like myositis ossificans, osteochondroma, osteoid osteoma, and parosteal osteosarcoma.
Rapid pain relief and functional improvement after local radiofrequency ablation and cementing combined with internal fixation for long bone metastases. A prospective study

Mrs. Vania Oliveira, Mr. Francisco Leite, Ms. Ana Ribau, Mr. Pedro Cardoso, Mr. António Araújo
Centro Hospitalar Universitário do Porto, Porto, Portugal

Introduction:
Metastatic patients are living longer. Bone metastases are associated to pathological fractures, severe pain, and functional impairment. There is evidence of pain relief and functional improvement after radiofrequency ablation (RFA) and/or cementing. These procedures present a synergistic effect. Intramedullary nailing allows immediate weight bearing and complements stabilization, pain and functional improvements. In this study, a combined palliative local treatment for multiple bone metastases aims to relief pain and improve function.

Methods:
Prospectively were analysed 30 patients and a total of 32 long bone metastases treated with local curettage, RFA, cement filling, and internal fixation. It was evaluated pain (Visual Analogue Scale), function (Karnofsky Performance Score), treatment complications, and survival. Local tumour progression was evaluated on radiographs and CT scan.

Results
Mean follow-up was 17.5 months (range 1-63). All patients experienced immediate pain relief 15 days after treatment. Mean VAS improved from 8.63 (SD 0.75, range 7-10) to 3.72 (SD 1.92, range 0-7). The mean VAS reduced even more at 6 weeks to 2.5 (SD 1.77, range 0-6) and at final follow up stabilized at 2.19 (SD 1.77, range 0-6). The postoperative improvement is statistically significant for all time visits (p<0.0001). The preoperative mean functional KPS was 57.7 (SD 14.55, range 30-80) compared to 74 (SD 16.32, range 40-100) postoperatively (p<0.0001). There was no evidence of local disease progression. There were no reported complications. Mean survival was 23.0 months (SD 4.35, 95% CI range 14.5-31.6).

Conclusion:
The combined treatment presented rapid pain relief and significant functional improvement impacting on quality of life. This study shows an effective local tumour control. RFA, cementing, and internal fixation should be incorporated in multidisciplinary discussion since the beginning in order to be used early in the treatment algorithm. Patients with short to medium-term survival significantly benefit from this treatment.
Long-term results of proximal femoral tumor endoprosthesis replacement after primary and metastatic tumors resection.

Mr. Anatoly Sokolovsky¹, Mr. Vladimir Sokolovsky, Mr. Aslan Valiev
¹N.N. Blokhin Russian Cancer Research Center, Moscow, Russian Federation

Introduction:
Endoprosthetics of the hip joint allows provide early activation of the patient, in the first days after the surgery, to begin functional and psycho-social rehabilitation in the hospital, achieve good cosmetic and functional results, continue conservative treatment, on time.

Methods:
The study included 172 patients with primary bone sarcomas, metastatic lesions, benign bone tumors, who from March 1996 to December 2019 performed 194 primary and revision operations. In the study group of patients, 47.1% were diagnosed with a primary malignant tumor, 37.8% had metastatic lesion. The mean follow-up period was 80.87 months. The leading complication at the time of the endoprosthetics was late aseptic instability (Type IIB — 37.5%).

Results:
Aseptic instability is the leading complication in the postoperative period 6.2%. Changes in the technology of primary and revision hip arthroplasty, a qualitative change in the implanted materials, made it possible to reduce the number of aseptic loosening of the endoprosthesis in the interval from 2008 to 2018 (11 years) by more than 2 times to 4.5%, compared to the previous 11 years interval from 1996 to 2007, where the frequency of aseptic instability reached 9.8%. Primary and revision endoprosthetics survival after 5 years was 91.9%, after 10 years was 81.3%, after 15 years was 76.5%, after 20 years was 68% of patients. The average functional result on the MSTS scale after 6 months after primary and revision endoprosthetics was 72.6%, after 12 months 84.2%.

Conclusion:
The introduction of innovative technological solutions in the design, materials of the endoprosthesis, will become a means of ensuring a further progressive decrease in the frequency of complications and increase the life of the implant.
Prediction models for survival, local recurrence and metastases of Leiomyosarcomas of trunk wall and extremities: A multicentre study

Mr. Mohamed Elgohary1, Dr. Jay Dee Ferguson2, Dr. Bryan Chew3, Mr. Han Hong Chong1, Dr. Thomas McCulloch4, Mr. Kenneth Rankin2, Prof. Robert Ashford3

1Health Education England. Newcastle University, United Kingdom, 2Newcastle University, United Kingdom, 3University Hospitals of Leicester, United Kingdom, 4Nottingham University Hospitals, United Kingdom

Leiomyosarcomas (LMS) are aggressive neoplasms with poorly understood pathogenesis. The accurate prediction of their behavior has proven difficult, and there are no universally accepted prognostic factors. We aimed to identify the risk factors for early recurrence, metastases, and poor survival and build a prediction model.

Methods:
We included 121 patients who had LMS involving trunk wall and extremities. Overall survival, local recurrence, and metastasis were the outcome measures. We have used the Kaplan Mier plot and multivariate analysis for prognostication. Nomograms were built using STATA 16.

Results:
The mean survival was 38.2 months (SD 44.4). 17.4% (15/86) patients had local recurrence, 47% (7/15) of these local recurrences were within 12 months of diagnosis. 58% (66/107) of patients developed metastases, 3.7% (4/107) had metastasis at presentation. 62.1% of metastasis occurred in less than 36 months.

Our analysis shows that younger age (p 0.03), deep location (p 0.01), and mitoses > 10/HPF (p 0.001) are independent prognostic factors predicting a higher risk of metastasis. Eventhough the univariate analysis suggested that age (p 0.0001), size (p 0.041), deep location (p 0.049), mitosis (p 0.0001), grade (p 0.0001), necrosis (p 0.023), presence of IHC CD 34 (p 0.004), and absence of estrogen/progesterone receptor (p 0.005) predicted poor survival, the multivariate analysis of these factors did not attain statistical significance.

The univariate analysis suggested that younger age (p 0.005), site of occurrence (p 0.027), deep location (p 0.002), mitoses (p 0.002), and IHC AE1/3 (p 0.05) predicted increased local recurrence, these factors were not independent predictors on multivariate analysis.

Conclusion:
The young age of occurrence, deep location and mitoses > 10/HPF are prognostic factors for higher risk of metastasis. Several factors were associated with local recurrence and poor survival, but, none of them were independently predictive. The multivariate predictive models have displayed a good predictive accuracy.
Chondroblastoma: is intralesional curettage with the use of adjuvants a sufficient way of therapy?

Tymoteusz Budny³, Ms. Marieke De Vaal¹, Niklas Deventer², Mr. Niklas Deventer¹, Georg Gosheger¹, Timo Lübben¹
¹Department of Orthopedics and Tumororthopedics, University Hospital Muenster, Münster, Germany, ²Department for General Pediatrics, University Hospital Muenster, Muenster, Germany

Background:
Chondroblastoma is a rare benign cartilaginous bone tumor. It is characterized by aggressive growth and possible recurrence after surgical treatment. It includes intralesional curettage with or without the use of adjuvants. Local recurrence rates vary between less than 10% up to more than 30%.

Methods:
In this retrospective study we analysed 38 cases of chondroblastoma with a mean follow-up of 27.9 months who underwent a surgical treatment. Epidemiological data, radiographic and histological examinations, different surgical techniques, complications and local recurrence were evaluated to comment on the question if curettage with or without adjuvants is a sufficient way of therapy.

Results:
The study includes 25 male (65.8%) and 13 female (34.2%) patients with a mean age of 17.2 years. The most common location was the proximal humerus (34.2%), followed by the proximal tibia (26.3%) and the distal femur (15.8%). Joint involvement occurred in 28 patients (73.7%). In all cases intralesional curettage was performed; in 25 cases (65.8%) the resulting cavity was filled with bone substitute, in 7.9% (3 cases) with bone cement and in 10.5% (4 cases) with autogenous bone graft. Adjuvant hydrogen peroxide was used in 64.9% of the cases. The overall recurrence rate was 39.5% (15 cases). The subgroup analysis showed a recurrence rate of 100% (4/4 cases) after curettage and defect reconstruction with autogenous bone. In the case of intralesional curettage and filling of the cavity with bone substitute but without use of adjuvant the recurrence rate was 50% (4/8 cases). A low recurrence rate of 11.8% (2 cases) was observed in the case of intralesional curettage, using hydrogen peroxide as adjuvant (17 cases) and bone substitute for defect reconstruction.

Conclusions:
Therapeutically an aggressive intralesional curettage with the use of hydrogen peroxide as adjuvant and filling up the defect with bone substitute leads to low recurrence rates.
Osteofibrous dysplasia-like Adamantinoma of the tibia progressing into Adamantinoma after 36 years. Considerations regarding the management between careful observation and early aggressive therapy

Tobias C. Bühler, Mr. G. Ulrich Exner, Natasha Forster, Michael O. Kurrer, Pascal A. Schai

1Orthopädie Zentrum Zürich, Zurich, Switzerland, 2LUKS Wolhusen, Wolhusen, Switzerland, 3KS Baden, Baden, Switzerland, 4SWISSPARC, Switzerland, 5Pathologikum, Zurich, Switzerland

Introduction:
Osteofibrous dysplasia (OFD) is a rare benign fibro-osseous lesion predominantly affecting the tibia (Campanacci). OFD-like Adamantinoma (OFD-AD) differs from OFD by the inclusion of clusters of epithelial cells spread throughout the lesion, whilst Adamantinoma (AD) is a malignant biphasic tumor with nests or sheets of epithelial cells surrounded by spindle cells with an osteofibrous component (WHO). There is controversy whether one can progress to another. In a single-institution study (Scholfield) no patient with OFD or OFD-AD (10 cases f/u 36 to 316, average 97 months) progressed to AD. In a large multicenter study (Schutgens) OFD-AD showed aggressive behavior without metastatic potential; only one of the 117 OFD-AD patients developed classic AD over 39 years, following treatment was df at 5 years. AD in this study showed full malignant potential with local recurrence, metastases (17%) and fatal outcome (13%). Only one other case with transition from OFD-AD to AD between the age of 12 to 23 years was reported (Hatori). Our case is presented to draw the attention for the need of principally ‘open-end’ f/u for patients with the OFD-AD.

Case Report:
*1975. 1984 diagnosed as OFD with elements of AD. The wedge of corrective osteotomy 1995 showed OFD. Imaging (MRI, X-Ray) remained unchanged until MRI 2020 showed new FDG-avid osteolytic lesions within the preexisting changes. Curetted material contained typical AD.
An extralesional resection of the involved diaphyseal tibial segment was performed with autologous replantation after pasteurization to support the transposed pedicled ipsilateral fibula.

Conclusion:
Besides the pathologic ‘diagnostic etiquette’ it is needed to understand the biology in the spectrum of OFD to OFD-AD to AD. This case is of special interest because of the long-term f/u of an OFD-AD over 30 years and late transition into AD. The correct management between careful observation and resection appears mandatory but difficult.
Advanced Imaging versus Clinical Signs and Symptoms for Detecting Local Recurrence of Soft Tissue Sarcoma

Ms. Cara Cipriano, Mr. Patrick England, Mr. Zachery Hong, Mr. Lee Rhea, Ms. Angela Hirbe, Mr. Douglas McDonald

1Washington University In St Louis, St. Louis, United States

Introduction:
Early detection of soft tissue sarcoma (STS) recurrences may decrease the morbidity of reoperation and improve outcomes. The benefit of surveillance imaging compared to clinical follow-up in detecting local recurrences remains controversial. Our objective was to determine 1) how many local recurrences were detected by surveillance imaging compared to clinical follow-up, 2) if local recurrences detected by surveillance imaging were smaller than those detected by clinical signs and symptoms, and 3) whether detection method was affected by potential confounding factors such as tumor, patient, or operative characteristics.

Methods:
We retrospectively reviewed the electronic medical records from all patients at a single sarcoma center who underwent excision of a STS between August 1999 and December 2018. Patients routinely underwent local magnetic resonance imaging (MRI) according to current sarcoma surveillance guidelines. The number of local recurrences first identified by MRI versus clinical detection were compared, as was the median size of local recurrence detected by each modality. Logistic regression was performed to evaluate variables (tumor dimension, location, or depth; patient age or BMI; flap closure; or radiation status; alone or in combination) that might impact the sensitivity of physical examination.

Results:
Sixty-one of 366 patients (16.7%) developed a local recurrence. A higher proportion of locally recurrent tumors were first detected by clinical follow-up than surveillance imaging (40/61 [66%] versus 21/61 [34%]). There was no difference in the size of tumor detected by clinical follow-up compared to surveillance imaging (median 3.9cm [IQR 2.5-7.8] versus 4.5 cm [IQR 2.7-6.2]; [p = 0.98]). Tumor, patient, or operative characteristics were not associated with method of local recurrence detection.

Conclusion:
MRI may lead to earlier detection of LR than clinical follow-up alone. We were unable to identify risk factors for sarcoma patients that are more or less likely to benefit from advanced imaging.
Does Extrapulmonary Imaging Have a Role in Systemic Surveillance of Soft-Tissue Sarcoma?

Ms. Cara Cipriano1, Mr. Zachery Hong1, Mr. Patrick England1, Mr. Lee Rhea1, Ms. Angela Hirbe1, Mr. Douglas McDonald1

1Washington University In St Louis, St Louis, United States

Introduction
Chest surveillance is universally practiced following treatment of soft tissue sarcoma (STS); however, current guidelines on imaging of the abdomen and pelvis are variable and not supported by evidence. Therefore, we asked: (1) What proportion of patients initially developed extrapulmonary compared to pulmonary metastases or both? (2) Was time from surgery to initial metastasis different for pulmonary versus extrapulmonary disease? (3) Can patient and tumor characteristics predict which patients are at increased risk for developing extrapulmonary metastases?

Methods
Our retrospective analysis included 382 patients who underwent excision of a non-metastatic STS at our sarcoma center from August 1999 - December 2018. We calculated the proportion of patients with initial extrapulmonary versus pulmonary metastases and compared metastases-free survival between these groups using a log rank test. Logistic regression was used to assess the correlation between clinically relevant variables (patient age, body mass index [BMI] and gender; tumor histology, grade, depth, location and size) with initial extrapulmonary metastases.

Results
Thirty-three percent of patients developed metastases. Of those, 72% percent first developed pulmonary metastases, 22% first developed extrapulmonary metastases, and 6% had both simultaneously. Initial extrapulmonary metastases occurred later than initial pulmonary metastases (log rank p = 0.049). Median time to development of metastases was 11 months (IQR, 5 to 19) for isolated pulmonary and 22 months (IQR, 6 to 45) for isolated extrapulmonary disease. Patient age, BMI and gender, or tumor grade, depth, location, histologic type and size were not found to be associated with development of extrapulmonary metastases.

Conclusions
A substantial minority of patients initially developed extrapulmonary metastases, which occurred over a later and broader time than initial pulmonary metastases. Routine abdominopelvic imaging may detect earlier disease in these cases; however, we were unable to identify predictors of initial extrapulmonary metastases that could be used to target surveillance.
Influence of tumour-infiltrating immune cells on local control rate, distant metastasis, and survival in patients with soft tissue sarcoma

Mrs. Joanna Szkandera¹, Maria Anna Smolle, Laurin Herbstroher, Mark Goda, Iva Brcic, Marko Bergovec, Susanne Scheipl, Barbara Prietl, Amin El-Heliebi, Martin Pichler, Armin Gerger, Florian Posch, Martina Tomberger, Pablo Lopez-Garcia, Julia Feichtinger, Claudia Baumgartner, Andreas Leithner, Bernadette Liegl-Atzwanger
¹Medical University of Graz, Austria

Introduction:
Soft tissue sarcomas (STS) are considered non-immunogenic, although distinct entities respond to anti-tumour agents targeting the tumour microenvironment. This study’s aims were to investigate (1) relationships between tumour-infiltrating immune cells and patient/tumour-related factors, and (2) their prognostic value for local recurrence (LR), distant metastasis (DM), and overall survival (OS).

Materials and Methods:
One-hundred-eighty-eight STS-patients (87 females [46.3%]; median age: 62.5 years) were retrospectively analysed. Tissue microarrays (in total 1266 cores) were stained with multiplex immunohistochemistry and analysed with multispectral imaging. Seven cell types were differentiated depending on the marker profile (CD3+ T-cells, CD3+ CD4+ helper T-cells, CD3+ CD8+ cytotoxic T-cells, CD3+ CD4+ CD45RO+ helper memory T-cells, CD3+ CD8+ CD45RO+ cytotoxic memory T-cells, CD20+ B-cells, CD68+ macrophages). Correlations between phenotype abundance and variables were assessed with Wilcoxon rank-sum and Kruskal-Wallis tests. Uni- and multivariate Fine&Gray and Cox-regression models were constructed to assess prognostic impact of variables on outcome events. Model calibration was assessed with C-index. Gene expression specific for macrophages, T- and B-cells from 256 patients of the TCGA-SARC database were used to validate IHC findings.

Results:
B-cell-percentage was lower in patients older than 62.5 years (p=0.013), whilst macrophage-percentage was higher (p=0.002). This association was also observed on the genetic level. High B-cell (p=0.035) and macrophage levels (p=0.003) were associated with increased LR-risk in the univariate analysis. In the multivariate setting, high macrophage levels (p=0.014) were significantly associated with increased LR-risk, irrespective of margin status, age, gender or B-cells. Other immune cells were neither associated with increased LR-, DM-risk, or OS.

Conclusion:
High macrophage levels were a poor prognostic factor for LR, irrespective of margin status, B-cell levels and patient age. Thus, anti-tumour agents targeting macrophages may be applied more frequently in tumours with enhanced macrophage infiltration.
Bone & Soft Tissue Cancer in Ancient Egypt. The largest series.

Mr. Albert Isidro Llorens¹, Mr. Miguel Botella², Ms. Agustina Rodriguez-Machado¹, Ms. Bibiana Agusti³, Mr. Jesus Herrerin⁴
¹Hospital Universitari Sagrat Cor, Barcelona, Spain, ²Universidad de Granada, Granada, Spain, ³Universitat de Girona, Girona, Spain, ⁴Universidad Autonoma de Madrid, Madrid, Spain

The antiquity of Cancer has always been one of the most interesting field of research in the Evolutionary Medicine. Why the skeletons diagnosed of malignant disease are so scarce in Ancient Times?. Absence of pollutants, the lacks of fire domestication (no heavy metals), the diet (low fat and sugars) and, mainly, the shorter life span have been inferred to explain this absence.

Ancient Egypt is, with no doubt, a work field in which this item could be better assessed. The presence of a civilization that covers more than 4000 years in the same geographical area is a very useful tool to infer the evolution of malignant disease.

In 1924, Smith & Dawson, diagnosed an osteosarcoma in a distal femur from 5th dynasty; almost 40 years after this, this lesion was re-diagnosed as a benign bone tumor. This point has been a constant in the lack of accuracy in the diagnosis of cancer in ancient remains.

The majority of the cases of cancer in old times are case report along with the revision of literature or, in some cases, short series.

After an accurate differential diagnosis that includes field x-ray examination we present the worldwide largest series of malignant disease in individual belongs to 5 different Spanish Missions from Egypt. The series includes 14 cases: 2 cases from Middle Egypt (1 from Oxyrhynchus, 1 from Sharuna); 12 cases from Upper Egypt (9 from West Thebes and 3 from Qubbet el-Hawa). It is noteworthy that 7 correspond to metastasis, 1 to nasopharyngeal carcinoma, 1 Ewing sarcoma, 2 multiple myeloma, 1 acute leukemia and 1 soft tissue sarcoma.
Effect of Neoadjuvant and Adjuvant Radiotherapy on Local Recurrence, Distant Metastasis, and Overall Survival in Extremity Soft Tissue Sarcoma.

**Ms. Maria Anna Smolle**, Ms. Judith Woelfel, Ibtissam Acem, Prof. Michiel Van de Sande, Prof. Lee Jeys, Prof. Han Bonekamp, Prof. Rob Pollock, Prof. Johnny Keller, PD Dr. Per-Ulf Tunn, Prof. Rick Haas, Prof. Rober J Van Ginkel, Prof. Cornelius Verhoeof, PD Dr. Florian Posch, Prof. Bernadette Liegl-Atzwanger, Dr. Dalia Moustafa-Hubmer, Prof. Philipp J Jost, Prof. Andreas Leitner, PD Dr. Joanna Szkandera

1Medical University of Graz, Graz, Austria, 2Leiden University Medical Centre, Leiden, Netherlands, 3The Royal Orthopaedic Hospital, NHS Foundation Trust, Birmingham, United Kingdom, 4Radboud University Medical Center, Nijmegen, Netherlands, 5Royal National Orthopaedic Hospital, Stanmore, United Kingdom, 6Aarhus University Hospital, Aarhus, Denmark, 7HELIOS Klinikum Berlin-Buch, Berlin, Germany, 8The Netherlands Cancer Institute, Amsterdam, Netherlands, 9University Medical Center Groningen (UMCG), Groningen, Netherlands, 10Erasmus MC Cancer Institute, Rotterdam, Netherlands

**Introduction:**
Radiotherapy (RTX) administered as neoadjuvant (NRTX) or adjuvant treatment (ARTX) is considered equivalent with regards to reducing local recurrence (LR) risk in extremity soft tissue sarcoma (eSTS), whilst differing toxicity profiles may be decisive for timing of RTX. Based on the assumption that LR is associated with development of distant metastasis (DM), and subsequent reduced overall survival (OS), this study aimed at analysing the independent effect of both NRTX and ARTX in a multicentre cohort of eSTS patients.

**Methods:**
1152 eSTS patients were retrospectively included from 10 tertiary sarcoma centres (mean age: 59.9±17.3 years; 43.8% females; median follow-up: 45.3 months). Two analyses were performed, one for patients with NRTX or no RTX (n=295), and one for patients with ARTX or no RTX (n=1092), Propensity score and inverse probability of treatment weight (IPTW) was used to compensate for factors differing between treatment groups at baseline for Fine&Gray (LR, DM-risk) and Cox-regression models (OS).

**Results:**
IPTW-weighting adjusted for differences at baseline depending on administration of NRTX (size, depth, age, chemotherapy), and ARTX (age, depth) in comparison to no RTX. The multivariate IPTW-weighted model for LR revealed a significant positive impact of both NRTX (SHR: 0.296; p=0.002, irrespective of histology, size) and ARTX (SHR: 0.560; p=0.001, irrespective of size, histology, margins, age, grading). No significant difference for DM was found for NRTX or ARTX (p>0.05). Multivariate IPTW-weighted model for OS revealed a protective effect of NRTX (HR: 0.418; p=0.008, irrespective of age, histology, grading, size) and ARTX (HR: 0.733; p=0.013, irrespective of grading, size, margins, histology, age).

**Conclusion:**
According to the present study, positive effects of NRTX and ARTX beyond the reduction in LR-risk may prompt more deliberate administration in eSTS patients.
Outcomes of Soft Tissue Sarcomas in Nonagenarians

Dr. Laura Hartley¹, Mr. Motaz AlAqeel², Mr. Vineet Kurisunkal², Mr. Scott Evans²
¹Sandwell And West Birmingham Hospitals NHS Trust, Birmingham, United Kingdom, ²The Royal Orthopaedic Hospital NHS Foundation Trust, Birmingham, United Kingdom

Aims:
Current literature suggests that survival outcomes and local recurrence rates of primary soft tissue sarcoma diagnosed in the very elderly age range (over 90 years) are comparable to those diagnosed under the age of 75. Our aim is to quantify these outcomes with a view to rationalising management and follow-up for our very elderly patients.

Patients and Methods:
Retrospective access to a prospectively maintained oncology database yielded a cohort of 48 patients across 15 years with a median follow-up of 12 months and average age at diagnosis of 92 years. 42 patients were managed surgically with either limb salvage or amputation.

Results:
A lower overall recurrence rate (LRR) was seen with primary amputations compared to limb salvage (p>0.05). LRR was comparable between R0, R1 and R2 resection in the limb salvage group. Amputation was also associated with longer survival times (p<0.05). Overall median survival time was limited to 20 months.

Conclusion:
Early and aggressive treatment with appropriate oncology surgery confers the lowest LRR and a survival advantage versus conservative treatment in this cohort of patients. With limited survival, follow-up can be rationalised on a patient-by-patient basis utilizing alternative means such as GP, local oncology and/or patient-led follow-up.
Tumor Bed complications in patients with Soft Tissue Sarcomas of the extremities and the superficial trunk treated with Surgery and Perioperative High Dose Rate Brachytherapy (PHDRB): clinical and dosimetric analysis

M. Gimeno², Mr. Jorge Gómez Álvarez¹, JM. Lamo-Espinosa¹, R. Martinez-Monge², M. San-Julian¹
¹Department of Orthopedic Surgery, Pamplona, Spain, ²Department of Orthopedic Oncology, Pamplona, Spain

Introduction:
Wound healing complications (WHC), osteoradionecrosis (ORN), and nerve damage (ND) are the most common adverse late effects in adult patients with soft tissue sarcomas treated with surgery and adjuvant brachytherapy alone or combined with external beam radiotherapy (EBRT).

Methods:
169 patients enrolled in two parallel prospective studies were included in this analysis. Previously unirradiated cases (Group 1; n=139) were treated with surgical resection, 16-24Gy of PHDRB and 45Gy of EBRT. Adjuvant chemotherapy was given to selected patients with high-grade tumors. Previously irradiated cases (Group 2; n=30) were treated with surgical resection and 32-40Gy of PHDRB without further EBRT. Patient factors, tumor factors, surgical factors, PHDRB factors and EBRT factors were analyzed using Cox univariate and multivariate analysis.

Results:
In previously unirradiated cases, WHC, ORN and ND occurred in 38.8%, 5.0% and 19.4%. Multivariate analysis indicated that WHC increased with CTV size (p=0.02) and CTV2cm³ DVH-based dose (p=0.02). ORN increased at Bone2cm³ EQD2 ≥ 67Gy (p=0.01) and ND was more frequent in tumors greater than 10cm (p=0.02) and in patients with TV100 DVH-based dose ≥ 84Gy (p<0.01). In previously irradiated cases, WHC, ORN and ND occurred in 63.3%, 3.3% and 23.3%. Multivariate analysis showed that WHC was more frequent in patients with Skin2cm³ Lifetime EQD2 ≥ 84Gy (p=0.01) and ND was more frequent after CTVD90 Physical Doses ≥ 40Gy (p<0.01).

Conclusion:
In previously unirradiated patients, WHC can be minimized by using a more conservative CTV definition, meticulous implant technique and exhaustive planning to minimize hyperdose CTV2cm³ areas. ORN can be greatly reduced by using Bone2cm³ EQD2 of less than 67 Gy. In previously irradiated patients, Lifetime EQD2 Skin2cc doses should not exceed 84 Gy. ND occurs more frequently after resection of large tumors and high doses to irradiated tissues.
Reconstruction of resected calcaneus due to osteosarcoma with a free osteocutaneous fibular flap: Case report

Andrej Laposa2, Klemen Lovsin2, David Martincic1, Mr. Blaz Mavcic1, Aljaz Mercun1, Mojca Unk3
1University Medical Centre Ljubljana, Department of Orthopaedic Surgery, Ljubljana, Slovenia, 2University Medical Centre Ljubljana, Department of Plastic Surgery and Burns, Ljubljana, Slovenia, 3Institute of Oncology, Ljubljana, Slovenia

Introduction:
Osteosarcoma of calcaneus is a very rare entity – less than 2% of osteosarcoma arise at this location. Due to its rarity in occurrence, there are not many surgical techniques which would include limb-salvage methods described in the literature. The aim of this study is to report a rare case of free osteocutaneous fibular flap reconstruction after resection of primary osteosarcoma of calcaneus.

Methods:
A case report and surgical technique of treatment of a 52-patient with an osteosarcoma of left calcaneus is presented with preoperative imaging and staging of the lesion.

Results:
Surgical procedure consists of two parts. First wide resection (RO) with clear margin of calcaneus osteosarcoma was performed (total calcanectomy) with detachment of Achilles tendon and sparing of vital neurocirculatory bundle. The second stage consisted of harvesting of free osteocutaneous fibular graft from ipsilateral leg and forming it in the shape of letter U. Then recipient site of two holes in the inferior body of talus were drilled and osteosynthesis was performed. Reinsertion of Achilles tendon was than made with suture anchors and microsurgical anastomoses of fibular graft to tibialis posterior artery for its nutrition.

Conclusion:
This is a new and not yet described surgical technique for a reconstruction after total calcanectomy. Calcaneus is a weight-bearing bone with distinct shape and important function of hindfoot therefore it is vital for locomotion and weight-bearing so reconstruction should be considered whenever possible.
Lack of Radiosensitivity Predicts Poor Oncologic Outcome in Extremity Myxoid Liposarcoma

Mr. Matthew Houdek\textsuperscript{1}, Mrs. Katherine Mallett\textsuperscript{1}, Ms. Safia Ahmed\textsuperscript{1}, Mr. John-Rudolph Smith\textsuperscript{1}, Mrs. Ivy Petersen\textsuperscript{1}, Mr. Peter Rose\textsuperscript{1}
\textsuperscript{1}Mayo Clinic, Rochester, United States

Background:
Myxoid liposarcoma (ML) is a common variant of soft-tissue sarcoma known to be radiosensitive, with improved oncologic outcomes compared to other sarcomas. Although these tumors are known to “shrink” following radiotherapy, there is a paucity of data examining the degree of radiosensitivity in terms of oncologic outcome. The purpose of the current series was to evaluate pre- and post-radiotherapy tumor volume to determine if size reduction impacts oncologic outcome.

Methods:
We reviewed 65 patients with ML undergoing surgical resection combined with preoperative radiotherapy, with pre- and post-radiotherapy MRI. This included 36 (55%) males, with a mean age of 48±14 years. All tumors were deep to the fascia, with 14 (22%) patients having tumors with a round-cell component.

Results:
Following radiotherapy the mean volume reduction was 50±30%. Compared to patients with >25% volume reduction, patients with reduction ≤25% had worse 10-year disease specific survival (84% vs. 29%, p<0.01), which translated into an increased risk of death due to disease (HR 4.54, p<0.01) and metastatic disease (HR 3.47, p<0.01).

Conclusion:
Lack of radiosensitivity in terms of volume reduction is a risk factor for metastatic disease and subsequent death due to disease in patients with extremity ML treated with combined preoperative radiotherapy and surgery.
Presence of a Soft-Tissue Mass is Associated with Worse Outcome for Patients with Scapular Chondrosarcoma

Ms. Elizabeth Wellings\textsuperscript{1}, Mr. Chad Parkes\textsuperscript{1}, Mr. Adam Tagliero\textsuperscript{1}, Mr. Peter Rose\textsuperscript{1}, \textbf{Mr. Matthew Houdek\textsuperscript{1}}\textsuperscript{1}Mayo Clinic, Rochester, United States

Background:
Chondrosarcomas are common primary bone tumor in adults, often affecting the flat bones. The scapula is a common location for these tumors, however there is a relative lack of outcome studies, with previous series having conflicting results.

Methods:
Thirty-nine patients (26 males:13 females) with a mean age of 46±17 undergoing surgical resection of a scapular chondrosarcomas were reviewed (Table 1). Most patients had Grade 1 (n=24) tumors, with 26 (67\%) having an associated soft-tissue mass. The mean follow-up was 8 years. Reconstruction of the scapula was based on the resection (Table 2).

Results:
The 10-year disease specific survival was 77\%. High grade tumors (HR 18.15, p<0.01) were associated with death due to disease (Table 3). The 10-year local recurrence- and metastatic free survival were 77\% and 74\%. Positive surgical margins (HR 8.85, p<0.01) was associated with local recurrence and local recurrence was associated with metastatic disease (HR3.37, p=0.04). All disease recurrences and death due to disease occurred in patients with a soft-tissue mass (p<0.05). Following surgery (Table 4) the mean MSTS93 rating was 77±19\% and the mean shoulder elevation was 81±66\°. When examining the patient function based on the type of resection patients who underwent had a partial scapulectomy which preserved the glenoid had improved outcome in terms of mean MSTS93 (p<0.01) and mean forward elevation of the shoulder (p<0.01).

Conclusion:
Presence of a soft-tissue mass was associated with a worse oncologic outcome in patients with scapular chondrosarcomas. Positive margins were associated with local recurrence, which was associated with metastatic disease; as such wide local excision with negative margins should be goal for all patients, regardless of tumor Grade.
Free Functional Latissimus Dorsi Reconstruction of the Quadriceps and Hamstrings Following Oncologic Resection of Soft-Tissue Sarcomas of the Thigh

Mr. Matthew Houdek, Ms. Elizabeth Wellings, Mrs. Katherine Mallett, Mrs. Rachel Honig, Mr. Peter Rose, Mr. Steven Moran

Mayo Clinic, Rochester, United States

Background:
Limb salvage surgery combined with radiotherapy has become the primary treatment for soft-tissue sarcomas of the extremity. Free functional latissimus flaps (FFLF) are an option to restore function in the setting of volumetric muscle loss. The purpose of the current study was to examine the use of FFLF in patients undergoing resection of a thigh sarcoma.

Methods:
Twelve patients with a sarcoma involving the hamstring (n=6), quadriceps (n=5) or combined (n=1) defects which included multiple muscle groups were reviewed (Table 1). This included 9 males and 3 females with a mean age and BMI of 56 years and 31.3 kg/m².

During the oncologic extirpation, care is taken to identify the perforating nerve branches entering either the quadriceps or hamstring muscle bellies at the proximal level of resection. The FFLF is harvested in the standard fashion, and care is taken to preserve the thoracodorsal nerve. The latissimus is exposed and before releasing the muscle the natural resting tension is marked at 5-cm intervals. Once the microvascular procedures are completed, the resting tension is then adjusted to allow for the markings on the FFLF to measure 5 cm.

Results:
The mean defect volume and operative time was 3,689 cm³ and 587 minutes. Postoperatively, the mean knee range of motion, MSTS93 score and muscle strength was 89±24⁰, 90±15%, and 4±1; with 75% of patients ambulating without gait aids. Seven (58%) patients sustained a complication, namely delayed wound healing (n=2).

Conclusion:
This study shows the utility of FFLF to provide coverage and restoration of knee range of motion following resection of a soft-tissue sarcoma of the thigh. Although these procedures are technically demanding, they allow for most patients to ambulate without gait aids and to return to all activities of daily living who would otherwise have substantial impairment in function of the extremity.
Treatment options for aneurysmal bone cyst of the foot: a series of 10 cases

Tymoteusz Budny\textsuperscript{1}, Ms. Marieke De Vaal\textsuperscript{1}, Mr. Niklas Deventer\textsuperscript{2}, Georg Gosheger\textsuperscript{1}, Timo Lübben\textsuperscript{1}
\textsuperscript{1}Department of Orthopedics and Tumororthopedics, University Hospital Muenster, Muenster, Germany, \textsuperscript{2}Department for General Pediatrics, University Hospital Muenster, Muenster, Germany

Introduction:
Aneurysmal bone cyst (ABC) is a benign, locally aggressive tumor that occurs in childhood and early adulthood. It usually affects the metaphysis of long bones but can also occur in rare cases in the foot. This is the first comparative case series of ABCs of the foot which describes the pathology and two relevant treatment options.

Methods:
This single-center study is a retrospective review of ten patients with primary ABCs of the foot which underwent an intralesional curettage or a polidocanol instillation in our institution. Epidemiological data, radiographic and histological examinations, different surgical techniques, number of instillations, complications and local recurrence were evaluated.

Results:
The study includes 10 patients with the diagnosis of a primary ABC of the foot. Five patients were male (50%), the mean age was 16.7 years and the mean follow-up time 33.4 months. After intralesional curettage a local recurrence was observed in 3/5 cases (60%). The instillation of polidocanol showed a significant reduction of the initial cyst volume (p=0.0267). In the instillation subgroup primary complete healing was achieved in three cases (60%); a persistent disease with necessity of further treatment was detected in 2/5 cases (40%) resulting in a conversion to intralesional curettage. No recurrence was seen in the instillation group after final treatment.

Conclusion:
The therapy of an ABC of the foot is often challenging due to local recurrence. Therapeutically sequential percutaneous instillation of polidocanol is a promising treatment option compared to intralesional curettage. The less invasive character of the instillation justifies it as primary attempt of therapy.
Early response monitoring of neoadjuvant chemotherapy using FDG PET can predict the clinical outcome of extremity osteosarcoma

Byung Hyun Byun², Wan Hyeong Cho¹, Dae-Geun Jeon¹, Mr. Chang-bae Kong², Won Seok Song¹
¹Department of Orthopedic Surgery, Korea Institute of Radiological and Medical Sciences, Seoul, South Korea, ²Division of Nuclear Medicine, Korea Institute of Radiological and Medical Sciences, Seoul, South Korea

Introduction:
To propose a personalized therapeutic approach in osteosarcoma treatment, we assessed whether sequential [18F]FDG PET/CT (PET/CT) could predict the outcome of patients with osteosarcoma of the extremities after one cycle and two cycles of neoadjuvant chemotherapy.

Methods:
A total of 73 patients with AJCC stage II extremity osteosarcoma treated with 2 cycles of neoadjuvant chemotherapy, surgery, and adjuvant chemotherapy were retrospectively analyzed in this study. All patients underwent PET/CT before (PET0), after 1 cycle (PET1), and after the completion of neoadjuvant chemotherapy (PET2), respectively. Maximum standardized uptake value (SUVmax) (corrected for body weight) and the % changes of SUVmax were calculated, and histological responses were evaluated after surgery. Receiver-operating characteristic (ROC) curve analyses and the Cox proportional hazards models were used to analyze whether imaging and clinicopathologic parameters could predict event-free survival (EFS).

Results:
A total of 36 patients (49.3%) exhibited a poor histologic response and 17 patients (23.3%) showed events (metastasis in 15 and local recurrence in 2). SUVmax on PET2 (SUV2), the percentage change of SUVmax between PET0 and PET1 (Δ%SUV01), and between PET0 and PET2 (Δ%SUV02) most accurately predicted events using the ROC curve analysis. SUV2 (relative risk, 8.86; 95% CI, 2.25–34.93), Δ%SUV01 (relative risk, 5.97; 95% CI, 1.47–24.25), and Δ%SUV02 (relative risk, 6.00; 95% CI, 1.16–30.91) were independent predicting factors for EFS with multivariate analysis. Patients with SUV2 over 5.9 or Δ%SUV01 over –39.8% or Δ%SUV02 over –54.1% showed worse EFS rates than others (p < 0.05).

Conclusions:
PET evaluation after 1 cycle of presurgical chemotherapy can predict the clinical outcome of extremity osteosarcoma. [18F]FDG PET, which shows a potential role in the early evaluation of the modification of timing of local control, can be a useful modality for early response monitoring of neoadjuvant chemotherapy.
Usefulness of increased 18F-FDG uptake for detecting local recurrence in patients with extremity osteosarcoma treated with surgical resection and endoprosthetic replacement

Byung Hyun Byun, Wan Hyeong Cho¹, Dae-Geun Jeon¹, Mr. Chang-bae Kong¹, Won Seok Song¹

¹Department of Orthopedic Surgery, Korea Institute of Radiological and Medical Sciences, Seoul, South Korea, ²Division of Nuclear Medicine, Korea Institute of Radiological and Medical Sciences, Seoul, South Korea

Introduction:
To investigate the changes of increased F-18 fluorodeoxyglucose (18F-FDG) uptake around the prosthesis and its ability to differentiate local recurrence from postsurgical change after endoprosthetic replacement in extremity osteosarcoma.

Methods:
A total of 355 positron emission tomography (PET)/computed tomography (CT) scans in 109 extremity osteosarcoma patients were retrospectively analyzed. All patients were followed up with 18F-FDG PET/CT for more than 3 years after tumor resection. For semiquantitative assessment, we drew a volume of interest around the entire prosthesis of the extremity and measured the maximum standardized uptake value (SUVmax). Independent samples t test was used to compare SUVmax at each follow-up time. SUVmax at 3 months (SUV1) and SUVmax at the time of local recurrence in patients with recurrence or at the last follow-up in others (SUV2) were compared using the Mann–Whitney test. Diagnostic performances of PET parameters were assessed using ROC curve analyses.

Results:
Nine patients (8 %) showed a local recurrence. Mean SUVmax at 3, 12, 24, and 36 months was 3.1±1.5, 3.8±1.9, 3.6±1.9, and 3.7±1.5 respectively. In ROC curve analysis, the combination of SUV2 >4.6 and ΔSUV >75.0 was a more useful parameter for predicting local recurrence than SUV2 or ΔSUV alone. The sensitivity, specificity, and accuracy for identifying local recurrence were 89, 76, 77 % for SUV2; 78, 81, 81 % for ΔSUV; and 78, 94, 93 % for the combined criterion respectively.

Conclusion:
The combination of SUV2 and ΔSUV was more useful than the SUV2 or ΔSUV used alone for the prediction of local recurrence.
Custom-made endoprosthetic replacement of the distal ulna after resection of giant cell tumor of bone: a case-report

Ms. Nina Engel¹, Mr. Timo Lübben¹, Mr. Georg Gosheger¹, Mr. Niklas Deventer¹
¹University Hospital Muenster, Münster, Germany

Introduction:
Giant cell tumor of bone (GCTB) is characterized by aggressive growth, possible recurrence after surgical treatment and, in seldom cases, metastasis. Surgical management is the primary treatment and includes intralesional curettage with adjuvants or, in seldom cases, wide resection. In case of resection of the distal ulna an endoprosthetic replacement is a feasible treatment option. Data on patients with GCTBs close to the carpal joint and treatment with custom-made ulna endoprostheses are scarce.

Methods:
A 25-year-old female with a GCTB of the distal ulna was treated with denosumab preoperatively for 9 months. Due to an extensive local destruction of the distal ulna with possible joint affection, the patient preferred a wide resection and endoprosthetic replacement instead of an intralesional curettage with higher risk of local recurrence. A custom made distal ulnar prosthesis with a 5x50mm stem was manufactured based on a CT-scan of the contralateral forearm. Wide resection and implantation of the prosthesis were conducted without complications. The patient was treated with a short arm cast for 6 weeks. The patient was seen for short-time follow-up three months after surgery.

Results:
At 3-months follow-up there was no sign of local recurrence. The patient was satisfied with the postoperative results but reported some loss of force compared to the preoperative function. Results in functional scores and range of motion after surgery were very promising (TESS: 73,33%, MSTS: 80 %, DASH: 36,7). The postoperative X-ray showed a good osseous integration without any fracture, dislocation or implant failure.

Conclusion:
In patients with locally aggressive GCTBs close to the carpal joint, with local recurrence after former surgery and contraindications for denosumab, the implantation of a custom-made prosthesis seems to be an adequate treatment option. Satisfying results without signs of local recurrence can be reached in short-time follow-up.

Mr. Matthew R. Claxton¹, Mrs. Kimberly Tsoi², Mrs. Katherine Mallett¹, Mr. Peter Rose¹, Mr. Anthony Griffin², Mr. Jay S. Wunder², Mr Peter C. Ferguson², Mr. Matthew Houdek¹.
¹Mayo Clinic, Rochester, United States, ²Division of Orthopaedic Surgery, Department of Surgery, University Musculoskeletal Oncology Unit, Mount Sinai Hospital, University of Toronto, Toronto, Canada

Introduction:
Dermatofibrosarcoma protuberans (DFSP) is a rare soft tissue sarcoma. It is a locally aggressive tumor, with a very low rate of metastatic disease. Previous series have shown a potential superiority of Moh’s micrographic surgery (MMS) compared to wide local excision (WLE), however those series were flawed in their study design. As such the purpose of the current series was to compare the outcome of patients undergoing WLE to MMS.

Patients and Methods:
We reviewed 233 (113 female, 120 male, mean age of 41±15) patients undergoing MMS (n=80, 34%) or WLE (n=153, 66%) at two tertiary sarcoma centers. 178 (76%) patients had a history of a previously inadvertently excision. Mean tumor size was 4±2 cm. Mean follow-up was 6 (range 2-28 years).
In the WLE group, margins were negative in 144 (94%) and microscopically positive in 9 (6%). In MMS, 1 patient had a residual microscopically positive margin which required WLE. The MMS group required 2±1 layers to reach a negative margin.

Results:
There was no difference (p>0.05) in the baseline characteristics between patients undergoing WLE versus MMS. Following excision there was 1 local recurrence occurring at 4-years occurring in the MMS group, while there were 2 cases of distant recurrence in WLE group at 2- and 3-years postoperative. The 5-year local recurrence free survival was 100% in the WLE versus 98% in the MMS group (p=0.16). Complications occurred in 25 (11%) patients, with no difference (p=0.37) between patients treated with a WLE (n=14, 9%) and MMS (n=11, 14%). In MMS 7 (9%) patients required an additional surgical procedure for wound closure or coverage.

Summary:
Contrary to previous series, there was no difference in oncologic outcome comparing MMS or WLE. The goal of treatment for DFSP is to achieve a negative margin and with this local recurrence is very low.
Socioeconomic and Preoperative Risk Factors Associated with Limb Salvage versus Amputation for Adult Extremity Bone Sarcomas in Patients with Insurance Coverage

Mr. Matthew Houdek, Mr. Michael Stuart, Ms. Elizabeth Wellings, Mr. Peter Rose, Mr. Steven Moran

1Mayo Clinic, Rochester, United States

Introduction:
Limb salvage (LS) has become the preferred treatment for adult patients with bone sarcoma of the extremities. The decision to perform LS versus an amputation is often dictated by tumor characteristics, however socioeconomic and patient factors have been found to be associated with this decision. Previous series have shown that patients from lower socioeconomic status, particularly those with either no insurance or Medicaid coverage, have worse survival and more likely to undergo amputation. Currently there is a paucity of data examining if these socioeconomic factors persist in patient with medical insurance at the time of diagnosis.

Methods:
Data from Optum Labs Data Warehouse (OLDW), a national administrative claims database, was analyzed to identify patients with extremity bone sarcomas from 2006 to 2017. The OLDW contains the enrollment records for commercial and Medicare Advantage (MA) enrollees and contains their longitudinal health information. 1,390 (743 males, 647 female) patients, 252 (18%) under amputation while 1,138 (82%) underwent LS.

Results:
Household income <$75,000 per year (OR 1.38, p=0.03), those treated in a public hospital (OR 1.41, p=0.04) and at a hospital with <200 beds (OR 1.90, p=0.006) were more likely to be treated with an amputation. Household income >$125,000 per year was associated with limb salvage surgery (OR 0.62, p=0.04). Patients with a lower extremity sarcoma (OR 4.72, p<0.001) were more likely to be treated with an amputation. Patients with an upper extremity tumor (OR 0.21, p<0.001), and less than or equal to 1 Elixhauser risk factor (OR 0.41, p=0.01) were more likely to be treated with a limb salvage.

Conclusion:
In a patient population with preexisting medical insurance, socioeconomic factors such as lower income and being treated at smaller and public hospitals were associated with an amputation for the treatment of an extremity bone sarcoma.
Prophylactic Antibiotic Regimens In Tumor Surgery (PARITY): An International, Multi-Center Randomized Controlled Trial Comparing Alternative Antibiotic Regimens in Patients Undergoing Tumor Resection and Endoprosthetic Reconstruction of the Lower Extremity

Ms. Michelle Ghert, PARITY Investigators

1McMaster University, Hamilton, Canada

Background:
The risk for surgical site infection (SSI) remains high following endoprosthetic reconstruction for tumors of the femur or tibia. The most effective peri-operative antibiotic regimen in preventing post-operative SSIs remains unknown, and the current state of practice varies widely, particularly with respect to antibiotic duration. The Prophylactic Antibiotic Regimens in Tumor Surgery (PARITY) trial aimed to determine whether a long duration (5 days) of post-operative prophylactic antibiotics decreases the risk of SSI when compared to a short duration (1 day).

Methods:
The PARITY trial was an international, triple-blinded randomized controlled trial with centralized outcome adjudication. From January 2013 to October 2019, 605 patients across 48 clinical sites in 12 countries were randomized to receive either a long or a short duration of post-operative prophylactic antibiotics following oncologic endoprosthetic reconstruction of the lower extremity. Participants were followed post-operatively at regular intervals for one year. A Cox proportional hazards model was utilized to assess whether a long duration regimen decreases the risk of the primary outcome of SSI.

Results:
**PARITY data is embargoed until October 2021 when results will be announced at the MSTS Annual Meeting***

Participants were a mean XX years old and XX% male. Overall, XX SSIs were identified over the one year follow-up period (XX%, 95% CI:YY–YY). A long duration regimen conferred the following risk/protection against developing a SSI: HR:XX, 95% CI:YY–YY, p=X. In comparison to a short duration, a long duration regimen impacted secondary outcomes as follows: antibiotic-related complications (HR:XX, 95% CI:YY–YY, p=X); unplanned re-operations (HR:XX, 95% CI:YY–YY, p=X); and mortality (HR:XX, 95% CI:YY–YY, p=X).

Conclusion:
The PARITY trial was the first international collaborative effort in prospective randomized research in orthopaedic oncology. The results of the trial are poised to significantly impact peri-operative clinical practice for lower extremity bone tumor patients.
THE SURVEILLANCE AFTER EXTREMITY TUMOR SURGERY (SAFETY) TRIAL: International Enrolment and Expansion

SAFETY Investigators
1McMaster University, Hamilton, Canada

Introduction:
Following surgical resection of a high grade extremity soft-tissue sarcoma (STS), 40-50% of all patients will develop a local or distant recurrence. Therefore, intensive post-operative surveillance is routine practice. However, the adverse effects of intensive surveillance must be considered, particularly in light of the fact that the majority of patients that develop distant metastases cannot be cured.

Methods:
The Surveillance After Extremity Tumor Surgery (SAFETY) trial an international multi-center randomized controlled trial (RCT) aimed to identify the optimal post-operative surveillance strategy in the STS population. Patients are randomized into one of 4 surveillance groups for the first 2 years of follow-up: (1) CXR every 3 months, (2) CT every 3 months, (3) CXR every 6 months, or (4) CT every 6 months. The primary outcome is overall survival at 5 years, and secondary outcomes include quality of life and healthcare costs.

Results:
At the time of abstract submission, STS patients have been randomized across 14 open clinical sites in five countries. An additional 12 clinical sites are in the active start-up phase. Patient interest in the trial has matched or exceeded expectations and multi-site collaborative experience has led to important protocol refinements.

Conclusions:
STS patient surveillance has been identified by consensus as a top research priority in the field. The SAFETY investigators have successfully demonstrated the ability to coordinate international RCTs through the PARITY trial and continue to do so in the SAFETY trial. Further expansion of the SAFETY collaborative network will be important for the recruitment of the SAFETY target sample size, and EMSOS members are encouraged to visit the study website at www.SAFETYrct.com to register as an investigator.
Leiomyosarcoma of Bone: a multicenter study of 35 cases investigating the optimal treatment options.

Ms. Maya Niethard1,2, Ms. Carolin Knebel3, Mr. Andreas Leithner4, Mr. Per-Ulf Tunn1, Mr. Dimosthenis Andreou5,6
1Clinic for Tumor Orthopedics, Sarcoma Center, Helios Klinikum Berlin-Buch, Berlin, Germany, 2Center for Orthopedics, Trauma Surgery and Rehabilitation Medicine Clinic and Outpatient Clinic for Orthopedics and Orthopedic Surgery, Medical University of Greifswald, Germany, 3Department of Orthopaedics and Sports Orthopaedics, Technical University of Munich, Klinikum rechts der Isar, Germany, 4Department of Orthopedics and Trauma, Medical University of Graz, Austria, 5Division of Orthopedic Oncology and Sarcoma Surgery Helios Klinikum Bad Saarow, Bad Saarow, Germany, 6Department of General Orthopedics and Tumor Orthopedics, Medical University of Muenster, Germany

Primary leiomyosarcoma of bone (LMSoB) makes up only <0.7% of primary malignant bone tumors and is extremely rare. It shows similar histopathological properties as soft tissue leiomyosarcoma (STLMS). Current treatment approaches include besides the surgical wide resection the use of perioperative chemotherapy, in analogy to the treatment of osteosarcoma or highly malignant STLMS. Data on the effectiveness of these therapeutic protocols in LMSoB is rare. The goal of our multicenter study was to determine the value of these (neo-)adjuvant therapeutic approaches.

We retrospectively analysed data of 35 patients with LMSoB from 4 referral centers in Germany and Austria between 1993 and 2018. Survival curves were calculated with the Kaplan–Meier-method and compared with the log-rank-test. Median follow-up was 49 months. Event-free survival (EFS) after 2/5 years was 60%/45%. Disease-specific survival (DSS) after 2/5 years was 91%/87%. 64% developed distant metastases after a median of 20 months (IQR 12-63 months). At last follow-up 31% of the patients were alive with their disease, 40% with no evidence of disease and 20% died from their disease. 84% underwent surgical treatment. 94% had an R0 resection. Surgical complication rate was 6.5%. 53% of patients with a high-grade tumor received perioperative chemotherapy. Survival improved significantly for patients with surgery (DSS: p=0.011) and for high-grade tumors located on the extremities (DSS: p=0.003, EFS: p<0.001). Operated patients with a tumor < 8cm had better DSS (p=0.036). Perioperative chemotherapy for high-grade tumors was not associated with an improvement in DSS (p=0.719) or EFS (p=0.858).

Surgery remains the most important treatment option for LMSoB. Potential for distant metastasis is high. Patients with tumor size <8cm and extremity localization had a better prognosis. The use of perioperative chemotherapy had no effect on EFS or DSS so that their use outside of randomized therapy optimization studies does not appear to be justified.
Surgical management of 244 TGCT patients in a single institution: a 20-year cohort study

**Mr. Geert Spierenburg**, Mrs. Lizz Van der Heijden, Mrs. Monique Mastboom, Mr. Robert Van der Wal, Mr. Hans Gelderblom, Mr. Michiel Van de Sande

1Leiden University Medical Center, Leiden, Netherlands

Introduction:
Tenosynovial Giant Cell Tumour (TGCT) is a rare, aggressive synovial neoplasm. Surgery is the mainstay of treatment, but tumour control can be difficult. We present the largest cohort of TGCT patients surgically treated in one specialised sarcoma centre.

Methods:
Consecutive patients with TGCT in large joints surgically treated between 2000 to 2020 were included.

Results:
244 patients were eligible; mean age was 38.4 years (SD±14.1), 143 (58.6%) were female. Diffuse-type TGCT (Dt-TGCT) was the most common subtype (n=146; 59.8%) and predominantly the knee was affected (n=182; 74.6%). Fifty-eight (23.8%) patients were referred to our centre with relapsing tumour. Surgery was mainly performed by open synovectomy in both subtypes (n=229; 93.9%); complete arthroscopic excision was only performed for Localised-type TGCT (L-TGCT) (n=4).

Median follow-up for Dt-TGCT and L-TGCT were 35.5 and 14.0 months, respectively. Residual Dt-TGCT was present in 49.5% one year postoperative, resulting in higher relapse rates than having no residual tumour (32.7 vs 6.1%; p=0.004). During follow-up, Dt-TGCT and L-TGCT relapsed in 40.7% and 9.1%, and clinically deterioration in 34.5% and 14.4%, respectively. TGCT clinically deteriorated without radiological tumour progression in 24/64 (37.5%) patients. Relapsing tumours did not induce clinical deterioration in 15/47 (31.3%) Dt-TGCT patients.

Forty (16.4%) patients received subsequent therapy after surgery (Dt-TGCT; n=37).

Conclusion:
TGCT is primarily treated by open synovectomy, but complete resection remains challenging. Relapse rates are relatively high, especially for patients with residual Dt-TGCT postoperatively. Also, clinically deterioration after surgery is common. However, radiological and clinical deterioration are not always mutually related.
Total hip arthroplasty in Hereditary Multiple Exostosis patients: Literature review and evaluation of 10 cases.

Mr. Federico Ostetto

Istituto Ortopedico Rizzoli, Bologna, Italy

Background:
Acquired hip deformities in patients affected by hereditary multiple exostosis may incur in early hip osteoarthritis and functional limitation requiring primary total hip arthroplasty. Characteristic coxo-femoral joint dysmorphisms in HME may pose a challenge for the orthopedic surgeon. Here we report our experience in a series of patients with HME treated in our Hospital with THA.

Methods:
With a mean follow-up of 5 years, 10 primary total hip arthroplasties were reviewed; proximal femur deformities, acetabular dysplasia and joint osteoarthritis has been assessed through x-rays and CT-scan evaluation. In all cases hemispheric press-fit cups were used; four stem had metaphyseal engagement, five had proximal diaphyseal engagement and one, with anatomical geometry, had metaphyseal fixation. Two cases require stem cementation, three modular neck and one lateralized. The clinical data, complications and clinical outcomes, were recorded and analyzed.

Result:
The mean HHS increased from 34 pre-operative to 86 post-operative; pre-operative mean neck shaft angle was 150°, head neck ratio 0.6, offset 31mm; Wiberg angle 28°, Sharp angle 38°, one patient had subluxation grade 4 according to Crowe, eight hips showed osteoarthritis (Tonnis grade ≥ 2 ); five femurs were classified as Dorr type C, two as type B and three as type A. Peri-operative complications have not been observed.

Conclusion:
Primary total hip arthroplasty in HME significantly improved clinical and functional outcomes. Press-fit cup fixation together with metaphyseal and proximal diaphyseal stem engagement on reliable bone quality femur, represents a valid option in HME patients with normal acetabular morphology, wide broaden neck and valgus NSA.
Introduction: 
Chondrosarcomas represent a heterogeneous group of primary bone cancers characterized by hyaline cartilaginous neoplastic tissue and are predominantly resistant to radiation and chemotherapy. To improve the efficiency of treatment, we have tested a combination therapy with the proteasome inhibitor bortezomib.

Methods: 
Using a 3D spheroid model, 0-20 Gy of ionizing radiation (IR) was applied to chondrosarcoma cells and healthy human chondrocytes. After a combined treatment of IR and bortezomib, cell cycle, apoptotic induction, the survivin pathway, autophagy, and DNA damage were evaluated.

Results: 
Both cell types revealed a slight decrease in viability after increasing doses IR, whereby the chondrosarcoma cells showed a significant dose-dependent increase in the expression of the DNA damage marker γH2AX. A combination treatment with bortezomib reduced the viability significantly after 48 h. High dose IR caused a G2/M phase arrest, which was accompanied by a decrease in the number of G1 and S phase cells. An additional bortezomib treatment changed this outcome.

The expression of the pro-apoptotic genes Bcl-2-associated X protein (Bax) and Bak was significantly increased by bortezomib treatment and combination therapy with IR. Furthermore, the combination therapy resulted in a synergistic reduction of survivin and its corresponding downstream pathway including heat shock protein 90 (HSP90), X-linked inhibitor of apoptosis protein (XIAP), smad 2 and smad 3. Since the downregulation of survivin induces apoptosis of cancer cells and suppresses tumor growth, it is an interesting target for therapy. Comparative analyses of the phosphorylation of H2AX on serine 139 (γH2AX) 60 min and 24 h after IR revealed efficient DNA repair in human chondrosarcoma cells.

Conclusion: 
We conclude that additional bortezomib treatment can improve the radiation sensitivity of chondrosarcoma cells only temporarily. However, the inhibition of the survivin pathways revealed a new interesting aspect in the tumor biology of chondrosarcoma 3D spheroid cultures.
The long term outcomes of limb salvage surgery, single institute experience, review of 210 cases.

Mr. Ahmad Shehadeh¹
¹King Hussein Cancer Center, Amman, Jordan

Introduction:
Limb salvage surgery is the adopted approach for managing bone sarcomas and aggressive bone tumors. In different literature, the outcome has varied based on the surgical approach and expertise of the surgical team. In this paper, we will discuss the outcome of limb salvage surgery in a single center where all cases were operated upon by the same surgeon.

Methods:
Two hundred forty four patients with malignant bone tumors were referred to KHCC, Thirty-four of the patients were found ineligible for limb salvage surgery and received primary amputation. The remaining 210 patients received limb salvage surgery. In 193 patients (92.4%), endoprostheses (Modular type, Joint sparing and expandable) were used for reconstruction of the skeletal defects. After a mean follow up period of 6 years (1-14.5 years) the following variables were reviewed; limb salvage rate for all patients, oncological outcome (negative margin and local control), surgery related complications, prosthesis and limb survival, and functional outcome.

Results:
Limb salvage was performed in 210 patients out of a total of 244 (86%). Negative resection margins were achieved in 204 patients (97%). Local control was achieved in 178 patients (85%), local recurrence in 32 patients, and 14 of them developed systemic metastasis. One hundred fifty-six patients (74%) did not develop any complications and received only the primary surgery. see the attached file for prosthesis and limb survival. There was no significant difference between the 3 main subtypes of implants regarding medium and long term survival (p = 0.5). The mean functional score using the modified musculoskeletal tumor society score (MSTS) was 90% for all anatomical locations.

Conclusion:
This study shows the rewarding outcome of limb salvage surgery in terms of oncological, functional and complication free course, for the same cohort of patients over a long term follow up period.
Curettage versus resection surgery in grade 1 chondrosarcomas

Mr. Hugo Miguel Miranda1, Mr. Manuel Magalhães1, Mr. Pedro Cardoso1
1 Centro Hospitalar Universitário do Porto, Porto, Portugal

Introduction:
Chondrosarcoma (ChS) remains a surgically challenging neoplasm. In recent years, the recommended surgical treatment of grade 1 (G1) ChS is curettage as opposed to classical surgical resection. The aim of our work is to assess the difference in survival outcomes in G1 ChS submitted to curettage and surgical resection.

Methods:
We retrospectively identified 34 chondrosarcomas submitted to curettage or surgical resection. Mean age was 50.5±19.0 years and 17 (50%) were female. At the end of follow-up eleven (32.4%) died, eleven (32.4%) had had local relapse and eight (23.5%) had metastasized. Mean overall survival (OS) was 66.3±61.9 months, mean local relapse-free survival (LRFS) was 62.0±60.5 months and metastasis-free survival (MFS) was 63.0±63.2 months.

Results:
Nineteen ChS were G1: nine (47.4%) were submitted to curettage and the remaining were surgically resected. Out of those, only one (5.3%) has died (in the curettage subgroup), five (26.3%) had relapsed (3 after curettage and 2 in the resection subgroup) and three (15.8%) had metastasized (all in the curettage subgroup) during follow-up. By using Cox regression model, we observed that surgery was not statistically different between G1 Chs regarding OS (p=0.966), LRFS (p=0.604) or MFS (p=0.964). However, hazard ratios (HR) were always numerically favourable of surgical resection: HR=0,000 for OS; HR=0,623 for LRFS; HR=0,000 for MFS.

Conclusion:
These findings indicate that surgical resection of grade 1 ChS offer better prognosis comparing with curettage. However they must be interpreted with care: this study has a low sample number, which may have biased the results. Also, surgical resection may offer more morbidity in cancer patients when compared with bone curettage, and this fact alone must be taken into account when choosing the surgical approach.
Microbiologic Profile and Risk Factors for Infection after Oncologic Sacral Resections

Syed Mohammed Karim¹, Peter Rose¹, Matthew Houdek¹
¹Mayo Clinic, Rochester, United States

Introduction:
Infection is a common adverse event after sacrectomy. We investigated the microbiologic profile and risk factors for deep infection after oncologic sacral resections and whether deep infections increase the rate of hardware failure.

Methods:
Retrospective review of adults who underwent partial or complete sacrectomy without external hemipelvectomy from 2000-2017. Deep infections involved either wound debridement or percutaneous abscess drainage. Independent variables were evaluated as risk factors for infection; significance at p < 0.05.

Results:
The cohort comprised 155 patients. Median follow-up was 42 months. There were 17 complete sacrectomies, 29 hemisacrectomies through the SI joint, and 109 partial sacrectomies. Pathology included 93 sarcomas (60%) and 54 carcinomas (35%). Anterior-posterior approach was used in 110 patients (71%). Radiotherapy was administered to 74 patients (48%) and chemotherapy to 63 patients (41%). Instrumentation was used in 40 patients (26%) and failed in 28 (70%). At last follow-up, 65 patients (42%) were alive.

Deep infection occurred in 50 patients (32%) at a median 27 days after surgery with 76 organisms isolated (51 gram +, 16 gram -, 9 yeasts). MSSA was the most common organism (20). Infections were gram + only in 20 patients; polymicrobial in 13 patients; gram - only in 9 patients; and yeast only in 3 patients.

Table 1 shows higher BMI and colorectal cancer trended towards being independent risk factors for infection, but no variable reached statistical significance. Deep infection did increase the risk of hardware failure (RR=2.4; p=0.02).

Conclusion:
Deep infections are common after sacrectomy (32%). While gram + infections predominate, gram - organisms comprised 21% of isolates. These data can guide perioperative antimicrobial selection. No specific risk factors for deep infection were identified, but among patients needing instrumentation, deep infection increases the risk of hardware failure.
Activation of efficient DNA repair mechanisms after photon and proton irradiation of human chondrosarcoma cells

Mrs. Birgit Lohberger¹, Mr. Dietmar Glänzer³, Mrs. Nicole Eck¹, Mrs. Sylvia Kerschbaum-Gruber²,³, Mr. Tobias Madl⁴, Mr. Karl Kashofer⁵, Mrs. Andreas Leithner¹, Mr. Dietmar Georg²,³

¹Department of Orthopedics and Trauma, Medical University of Graz, Graz, Austria, ²Department of Radiation Oncology, Medical University of Vienna, Vienna, Austria, ³MedAustron Ion Therapy Center, Wiener Neustadt, Austria, ⁴Gottfried Schatz Research Center for Cell Signaling, Metabolism and Aging Molecular Biology and Biochemistry, Medical University of Graz, Graz, Austria, ⁵Institute of Pathology, Medical University of Graz, Graz, Austria

Introduction:
Although particle therapy with protons has proven to be beneficial in the treatment of chondrosarcoma compared to photon-based radiation therapy, the cellular and molecular mechanisms have not yet been sufficiently investigated.

Methods:
Cell viability, proliferation behavior, and colony forming ability were analyzed after photon and proton irradiation (IR). Cell cycle were analyzed using flow cytometry and corresponding regulator genes and key players of the DNA repair mechanisms were measured using next generation sequencing, protein expression, immunohistochemistry and immunofluorescence staining. Changes in metabolic phenotypes were determined with nuclear magnetic resonance spectroscopy.

Results:
Radiation with both, photons as well as protons, resulted in reduced cell survival and a G2/M phase arrest of the cell cycle. Especially 1 h after IR, a significantly higher level of phosphorylated γH2AX foci was observed. This was accompanied with a reprogramming in cellular metabolism. Interestingly, within 24 h the majority of clearly visible DNA damages were repaired and the metabolic phenotype restored. Involved DNA repair mechanisms are, besides the homology directed repair (HDR) and the non-homologous end-joining (NHEJ), especially the mismatch mediated repair (MMR) pathway with the key players EXO1, MSH3, and PCNA. Protons, as compared to 160 kV x-rays, resulted in more pronounced effects.

Conclusion:
Chondrosarcoma cells have a highly efficient DNA repair program which regenerates the majority of DNA damages within 24 h. These molecular mechanisms represent an important basis for an improved therapy.
Walking Balance and Compensatory Gait Mechanisms in Surgically treated Patients for Pelvic Musculoskeletal Tumours – A Presentation of Preliminary Findings

Mrs. Sherron Furtado, Mr. Matt Thornton, Ms. Roisin Delaney, Ms. Abigail McCarthy, Ms. Deborah Eastwood, Mr. William Aston, Mr. Craig Gerrand

JRU/Sarcoma Unit/Therapies Royal National Orthopaedic Hospital Nhs Trust, Greater London, United Kingdom

Introduction:
People undergoing surgery for pelvic tumours present with impaired balance and gait capacity, which reduces daily functioning. Established sarcoma scales cannot quantify such impairments, but a real-time motion capture system can. Our objective was therefore to describe balance and gait using GRAIL (Gait Real-time Analysis Interactive Lab) comprising a treadmill and VICON marker-based assessment after pelvic tumour surgery.

Methods:
Patients surgically treated for pelvic tumours after 3-9 months were referred. Patients underwent gait assessments using the GRAIL system with the Royal National Orthopaedic Hospital NHS Trust (RNOH) marker set. Balance and gait for patients were characterised and compared to healthy controls.

Results:
8 patients (6 males, 2 females) of mean age 48±10 years were enrolled. Patients underwent resection (5), reconstruction with endoprosthesis (2) and cone (1) for a chondrosarcoma (3), osteosarcoma (1), pleomorphic bone sarcoma (1), benign tumour (2) and metastatic renal cancer (1). During walking, patients compensated with altered kinematics including pelvic tilt, hip rotation, thorax rotation, ankle movement (Fig.1). Other outcomes were also affected in patients compared to healthy people. For instance, Centre of Mass (COM) forward velocity indicative of dynamic balance 0.0001± 0.0009 vs 0.0014±0.0056 m/s; left single-support time (time-based gait outcome) 0.4787±0.1028 vs 1.2756±0.0221 seconds and left ankle power during push off (kinetic outcome) 0.8119± 0.9501 vs 2.9996 ± 0.5866 psc (Fig.2)

Conclusion:
These preliminary results highlight altered postural control and gait after pelvic tumour surgery. There is a need to target impairments and intervene with innovative targeted rehabilitation including virtual reality and rehabilitation robotics at multiple clinic follow-ups to optimise patient outcomes.
Outcome of Total Hip Arthroplasty in the Setting of Multiple Hereditary Enchondromatosis

Cory G. Couch¹, Mark J. Heidenreich¹, Mr. Matthew Houdek¹, Joshua R. Labott¹, David G. Lewallen¹, Peter Rose¹
¹Department of Orthopedic Surgery, Mayo Clinic, Rochester, United States

Background:
Multiple Hereditary Exostosis (MHE) is a rare autosomal dominant disorder characterized by multiple osteochondromas which leads to deformity of the metaphyseal region of bone. Often patients develop degenerative changed in the joint which require arthroplasty, however the deformity of the proximal femur adds complexity. Due to the rarity of this disease, there is a paucity literature concerning total hip arthroplasty (THA) for treatment of osteoarthritis secondary to MHE. The aim of this study is to report long-term outcomes of THA in the setting of osteochondroma secondary to MHE.

Methods:
14 (10 male, 4 female) patients with a mean age of 47.8 years (range, 38-74) who underwent THA for the treatment of osteoarthritis in the presence of osteochondroma secondary to MHE with a minimum follow-up of 1 year (mean 11.0 years). Eight (57%) received cemented femoral components and 6 (43%) received uncemented femurs.

Results:
Functional outcomes as measured by Harris Hip Score (HHS) demonstrated a mean improvement from 48 preoperatively to 82 at final follow-up (p=0.0001). MSTS scores improved from a mean of 40% pre-op to 70% at final follow-up (p=0.001). Two patients (14%) reported a leg length discrepancy at final follow-up requiring heel lifts; 1 operative leg short, 1 operative leg long. One patient (7%) developed a superficial wound dehiscence requiring irrigation debridement and primary closure while no patients developed a PJL. At final follow-up 12 (86%) THA were retained; 1 uncemented THA required revision of ceramic femoral head and liner after a fall at 7-years post-op and 1 cemented THA required poly exchange and acetabular bone graft at 18-years post-op with subsequent femoral component replacement at 20 years post-op for hardware fracture.

Conclusions:
Total hip arthroplasty in the setting of MHE is a safe procedure with improved patient satisfaction and low revision rate.
Outcomes of Intramedullary Nail Fixation for Metastatic Disease: Impending and Pathologic Fractures

Mr. Aaron Owen1, Mr. Mason Udovich1, Mr. Vivek Somasudaram1, Mr. Brandon Yuan1, Mr. Peter Rose1, Mr. Matthew Houdek1

1Mayo Clinic, Rochester, United States

Introduction:
Improvements in oncologic care has led to improved survival of patients with metastatic skeletal disease. The femur is a common site of musculoskeletal metastasis requiring stabilization to improve pain and mobilize patients; however, there are few reports on the outcomes of intramedullary nail (IMN) fixation for impending and pathologic fractures. This study aims to characterize the functional outcomes, complications, as well as survivorship of patients treated with IMN for femoral metastatic disease.

Method:
We reviewed 183 IMNs placed for impending (n=145) or pathologic (n=38) metastatic fractures from 2010 to 2018. Baseline characteristics between groups were similar with mean age of 65 years, 45% female, and mean body mass index of 28 kg/m². Complications including blood transfusions, venous thromboembolisms (VTEs), readmissions, and reoperations were studied. Kaplan-Meier survival analysis was used to determine survival of impending and pathologic fracture cohorts.

Results:
Patients with impending lesions were more likely to be ambulatory at final follow-up (Pathologic: 82%, Impending: 99%, p<0.0001) and reported greater MSTS at final follow-up (Pathologic: 11.7±7, Impending: 17.1±5, p<0.0001). Likewise, pathologic fractures were associated with greater discharge to non-home locations (Pathologic: 74%, Impending: 17%, p<0.0001). Patients with pathologic fractures were more likely to require a postoperative transfusion (Pathologic: 63%, Impending: 21%, p<0.0001). However, there was no difference in the incidence of VTEs (p=0.67), 90-day readmissions (p=0.94), or reoperations (p=0.97) between cohorts. Patients treated for impending fractures had improved disease-specific survival 90-days (80% [95% confidence interval (CI)=73-85%] vs. 49% [95%CI=34-64%]) and 1 year (47% [95%CI=39-55%] vs. 21% [95%CI=11-36%]) (p<0.0001).

Conclusion:
IMN fixation is a durable treatment for metastatic lesions to the femur. Identification and treatment of these lesions is critical as patients treated for impending lesions in our series had greater functional outcomes, fewer complications and improved survivorship at 90-days and 1 year compared to patients treated for pathologic fractures.
Safety and preliminary efficacy of vimseltinib in tenosynovial giant cell tumor (TGCT)

Mr. Michiel Van de Sande¹, Mr. Hans Gelderblom², Mr. Albiruni Abdul Razak³, Ms. Amparo Sánchez-Gastaldo⁴, Mr. Piotr Rutkowski⁵, Ms. Breelyn A. Wilky⁶, Mr. Andrew J. Wagner⁷, Ms. Mary Michenzie⁸, Mr. Marc Vallee⁸, Ms. Maitreyi Sharma⁸, Mr. Matthew Sherman⁸, Mr. Rodrigo Ruiz-Soto⁸, Mr. William D. Tap⁹

¹Department of Orthopedics, Leiden University Medical Center, Leiden, Netherlands, ²Medical Oncology, Leiden University Medical Center, Leiden, Netherlands, ³Toronto Sarcoma Program, Princess Margaret Cancer Center, Toronto, Canada, ⁴Phase I Unit, Medical Oncology, Hospital Universitario Virgen del Rocio, Seville, Spain, ⁵Maria Skłodowska-Curie National Research Institute of Oncology, Warsaw, Poland, ⁶Medicine, University of Colorado Cancer Center, Aurora, United States, ⁷Medical Oncology, Dana-Farber Cancer Institute, Boston, United States, ⁸Deciphera Pharmaceuticals, LLC, Waltham, United States, ⁹Medical Oncology, Memorial Sloan Kettering Cancer Center, New York, United States

Introduction:
Diffuse TGCT is a rare, locally aggressive neoplasm, where overexpression of colony-stimulating factor 1 (CSF1) drives recruitment of macrophages leading to local inflammation and joint destruction. Vimseltinib (DCC-3014) is an oral, highly selective, switch-control kinase inhibitor of CSF1 receptor (CSF1R). We report the safety and efficacy of vimseltinib in patients (pts) with TGCT in the phase 1 arm of the phase 1/2 study (NCT03069469).

Methods:
In phase 1 (dose-escalation) and phase 2 (expansion) study, pts with unresectable TGCT were treated with vimseltinib. Primary objectives of phase 1 were to determine safety, tolerability, and recommended phase 2 dose (RP2D). Antitumor activity assessed using RECIST version 1.1.

Results:
As of Feb 26, 2021, 32 TGCT pts enrolled in phase 1; 24 pts remain on study. Median age was 51 years (range, 23–73), median treatment duration was 6.8 months (range, 1–19), and most common disease site was knee in 20 (63%) pts. Treatment-emergent adverse events (AEs) of grade 3-4 in >5% were increases in blood creatine phosphokinase, aspartate aminotransferase (AST), lipase, amylase, and hypertension. Enzyme elevations consistent with CSF1R inhibitor mechanism of action. Treatment-related grade 3 serious AEs in 2 pts: metabolic encephalopathy and vaginal hemorrhage. Dose-limiting toxicity of asymptomatic grade 3 AST increase in 2 pts (1 each, cohort 5 and 8), both had grade 1 AST increase at baseline. Objective responses observed in 13 (1 complete, 12 partial responses; 45%) of 29 efficacy evaluable pts across all phase 1 dose cohorts (Table). Enrollment ongoing in phase 2; all 16 TGCT pts enrolled to date remain on study.

Conclusions:
Vimseltinib was well tolerated with encouraging and durable antitumor activity across all phase 1 TGCT dose cohorts. Safety profile of vimseltinib remains manageable with longer-term follow-up. Phase 2 safety and preliminary efficacy data at RP2D (30 mg twice weekly) will be presented.
Allograft Prosthetic Composite Reconstruction Using a Reverse Total Shoulder Arthroplasty for Failed Oncologic Proximal Humerus Reconstruction

Jonathan D. Barlow¹, Bassem T. Elhassan³, Mr. Matthew Houdek¹, Peter Rose¹, Joaquin Sanchez-Sotelo², Eric R. Wagner²
¹Department of Orthopedic Surgery, Mayo Clinic, Rochester, United Kingdom, ²Department of Orthopedic Surgery, Emory University, Atlanta, United States, ³Harvard University, Boston, United States

Introduction:
The proximal humerus is a common location for primary and non-primary tumours. Limb salvage is the preferred means to manage tumours in this location and following oncologic resection, oftentimes reconstruction is performed with an endoprosthesis or an allograft. Failure of these reconstructions may occur, but historically revision of failed oncologic proximal humerus reconstructions has been performed rarely due the lack of reliable reconstructive options. Recent advances in surgical techniques utilizing a reverse shoulder arthroplasty with an allograft prosthetic composite (APC) may provide a means to salvage these failed procedures.

Methods:
Eleven (6 male, 5 female) patients (mean age 51±17 years) underwent revision of a failed oncologic reconstruction of the proximal humerus utilizing a reverse APC. The most common indication for revision was subluxation (n=7) and the most common previous implant was a modular endoprosthesis (n=5). The mean length of the proximal humeral allograft was 14±7 cm.

Results:
Revision with a reverse APC resulted in improvements in shoulder elevation (39° vs. 73°, p=0.012), external rotation (13° vs. 25°, p=0.031), American Shoulder and Elbow Surgeons score (39 vs. 61, p=0.001) and Musculoskeletal Tumor Society Scores (51% vs 61%, p=0.001) between the pre- and postoperative setting. There were 2 re-revision procedure performed for an allograft fracture 2 years postoperative and for allograft resorption and loosening 7-yars postoperative. There were no cases of dislocation.

Conclusions:
Revision of a failed oncologic proximal humerus reconstruction with a reverse APC is a safe and effective means to restore patient function. Due to the complexity of the cases we advocate for these procedures to be performed by subspecialty upper extremity surgeons trained in complex revision shoulder arthroplasty.
Increased risk of venous thromboembolism with aspirin versus low molecular weight heparin for chemoprophylaxis in patients undergoing surgery for metastatic bone disease

Syed Mohammed Karim\textsuperscript{1,2}, Kevin Raskin\textsuperscript{2}, Joseph Schwab\textsuperscript{2}, Erik Newman\textsuperscript{2}, Santiago Lozano-Calderon\textsuperscript{2}
\textsuperscript{1}Mayo Clinic, Rochester, United States, \textsuperscript{2}Massachusetts General Hospital, Boston, United States

Introduction:
Venous thromboembolism (VTE) is a common adverse event after orthopaedic surgery, and patients with cancer are at higher risk given the hypercoagulable state conferred by malignancy. While there is considerable literature on VTE prophylaxis in elective joint arthroplasty, data comparing VTE prophylaxis regimens in patients undergoing surgery for metastatic bone disease are lacking.

Methods:
Prospective, randomized trial comparing two VTE prophylaxis regimens in adult patients after surgery for pelvic or lower extremity bone metastases: oral aspirin 325 mg daily (ASA) versus subcutaneous enoxaparin 40 mg daily (LMWH). Planned enrollment was 239 patients per treatment arm. Investigation for VTE was based on treating clinicians’ suspicion rather than a pre-defined surveillance protocol. Timing and duration of follow-up were not prescriptive and were at the surgeons’ discretion. The primary outcome was incidence of VTE: deep venous thrombosis (DVT) and/or pulmonary embolism (PE).

Results:
23 patients were randomized: 14 patients to aspirin; 8 patients to LMWH; 1 patient was excluded due to fat embolism during surgery. 19 patients were treated with internal stabilization for femur metastases, and 3 underwent total hip arthroplasty. No significant differences existed between treatment groups in terms of adjuvant chemotherapy or radiotherapy. In the aspirin group, the primary outcome occurred in 5 patients (35.7%): 3 lower extremity DVTs, 1 upper extremity DVT, and 1 PE. In the LMWH group, the primary outcome did not occur. The trial was stopped early due to the difference in the rate of VTE between treatment groups.

Conclusion:
The rate of VTE after orthopaedic surgery for pelvic and/or lower extremity bone metastases is higher when aspirin is used for prophylaxis versus LMWH. These results suggest that aspirin-based regimens that are commonly used for VTE prophylaxis in non-oncologic orthopaedic surgery should not necessarily be applied to patients undergoing surgery for metastatic bone disease.
Navigation and 3D Printing in Traumatology and Orthopedics: Comparative cadaveric study of the accuracy obtained by various registration methods

Mr. Daniel Salgado

Casr/redsalud/bupa, Santiago, Chile

Introduction:
Surgical navigation has markedly improved the accuracy and quality of orthopedic surgery. Every surgical navigation system requires to have reference points (anatomical landmarks) of sufficient number and quality to make the registration process possible, essential for the use of the equipment. This requirement generates delays in the procedure and, in some cases, limits its application.

Objectives:
to compare the navigation accuracy obtained by different registration methods in cadaveric femurs.

Methods:
3 radiopaque markers (Screws) were placed in 3 cadaveric femurs. Subsequently, high-resolution tomography of the pieces was performed, processing the images using software for engineering design on anatomy (Materialize NV), which allowed generating three-dimensional models of the pieces. On these models, registration guides were designed tailored to each anatomical piece, which were then manufactured by 3D printing. This information was later entered into the intra-surgical navigation system (Stryker). Two navigations were made on each cadaveric piece: a) Recording through anatomical landmarks; b) Registering by using custom registration guides. Then the navigation accuracy was measured in each case and for each piece, taking as a true value the position of the markers (screws), and comparing with the position indicated by the navigator.

Results:
at the same registration time, the use of registration guides tailored to the patient and printed in 3D improves navigation accuracy by around 500%.

Conclusion:
The tailored registration technique for intra-surgical navigation allows high accuracy over anatomic landmarks, also providing technical simplicity since they do not require the expansion of the surgical approach.
Resection and reconstruction navigated with custom implant

Mr. Daniel Salgado
Caser/redsalud/bupa, Santiago, Chile

Introduction:
Virtual planning and navigated surgery constitute a useful tool in oncological resection, preserving anatomy and function, especially in the pelvis.

Objectives:
To present the planning, resection and reconstruction navigated with implant to measure of a chondrosarcoma of the pelvis.

Methods:
Male, 62 years old, no antecedents, history of 6 months of evolution of left hip pain. A study with radiography, CT, MRI and CO was performed, which showed a tumor mass in zone two of 8x6 cm in diameter with a posterior soft tissue mass. Dissemination study does not show pulmonary lesions. Bone puncture biopsy shows low-grade G1 chondrosarcoma. Surgical planning, navigated hemipelvectomy with oncological margins, custom implant and preservation of the left hip. Image processing using software for engineering design on anatomy (Materialize NV), which allowed the generation of three-dimensional models of both the pelvis and the tumor. On these models, custom registration and cutting guides were designed, which were then manufactured by 3D printing. This information was later entered into the intra-surgical navigation system (Stryker). In addition, a tailor-made implant in trabecular titanium was made based on the planned resection.

Results:
Navigated hemipelvectomy with zone 2 tumor resection reconstructing with custom implant and left hip prosthesis. Biopsy of the anatomical piece confirms the diagnosis and without tumor involvement in the margins. Good evolution, without complications, wandering with poles and without dislocation of the left hip. But, after a month the patient dies due to a pulmonary thromboembolism.

Conclusion:
Custom implant reconstruction requires precise, carefully planned browser-assisted osteotomies where registration is the critical step. Resection and reconstruction with a tailored implant of malignant tumors in the pelvis is possible with the intra-surgical assistance of the navigator. but it is not without complications.
Tumor resection with cut guide to measure Recurrent distal femur chondrosarcoma.

Mr. Daniel Salgado
Capredsalud/bupa, Santiago, Chile

Introduction:
Virtual planning and custom cutting guides constitute a useful tool in oncological resection allowing precision and accuracy.

Objectives:
To present the planning, tumor resection with cut-to-measure guide and reconstruction with osteoarticular allograft of a distal femur chondrosarcoma.

Methods:
Female, 59 years old, with no significant morbid history, with a history of grade 1 chondrosarcoma of the medial distal femur operated by Curettage and filling with cement in 2013. In controls she evolved with knee pain (2015). A study with radiography, CT, MRI and CO was performed, showing suspicion of recurrence. A dissemination study was performed that did not show pulmonary lesions. Bone puncture biopsy reveals a recurrent low-grade G1 chondrosarcoma. Surgical planning, resection with custom cut guide with tumor-free margins and preservation of the knee with allograft. Allografts from the bone bank were digitally analyzed. Image processing using software for engineering design on anatomy (Materialize NV), which allowed the generation of three-dimensional models of both the patient’s femur and the allograft. Custom cut guides were designed on these models, which were then manufactured by 3D printing.

Results:
Tumor resection of the medial femoral condyle with a custom cut guide with a 15 mm margin, reconstructing with an osteoarticular allograft. Biopsy of the anatomical specimen confirms the diagnosis and does not show tumor involvement in the bone margins. The patient presented a good evolution, without complications in five years of follow up.

Conclusions:
Resection with custom cut guides and allograft reconstruction is an alternative due to the high cost of surgical navigation. The intra-surgical assistance of custom cut guides has allowed to obtain a precise tumor resection, with tumor-free margins, allowing the limb to be preserved.
Navigation and Surgical Guides to Measure the Patient 3D Printed for Unicortical Resection of Metaphyseal Tumors of Distal Femur. Cadaveric Validation Study

Mr. Daniel Salgado
CASR/REDSALUD/BUPA, Santiago, CHILE, Chile

Introduction:
Surgical navigation has notably improved the accuracy and quality of orthopedic cancer surgery. Allowing to obtain tumor resections with better tumor-free margins, achieving anatomical reconstruction and preservation of the extremities.

Objectives:
To determine, in three cadaveric models, the accuracy achieved in metaphyseal osteotomies of the distal femur through the use of custom cutting and registration surgical guides manufactured by 3D printing.

Methods:
High-resolution tomography of the 3 pieces were performed, processing the images using software for engineering design on anatomy (Materialize NV), which allowed generating three-dimensional models. On these models, the cuts were planned in the metaphyseal region, simulating the resection of a tumor located in this area. This information was later entered into the intra-surgical navigation system (Stryker). Subsequently, the registration and positioning of the corresponding cutting guide was carried out on each cadaveric piece, which was assisted by navigation. The next step was to make the cuts. Subsequently, new high-resolution tomography and the processing of these images were carried out in order to determine the accuracy achieved through digital comparison of the planned cutting planes versus those actually achieved in the pieces.

Results:
The average accuracy of the analyzed cutting planes gives an accuracy of 1 mm; with a standard dispersion of 0.5 mm.

Conclusion:
The resection technique with tailored cutting and registration guides assisted by intra-surgical navigation allows high accuracy, broadening the spectrum of cases in which it is possible to perform conservative resection surgery of the joint and with an adequate oncological margin.
Surgical treatment scenario for osteoblastoma of the pelvis: Long-term follow-up results

Mr. Michele Fiore, Mr. Andrea Sambri, Ms. Carlotta Calamelli, Mr. Riccardo Zucchin, Mr. Claudio Giannini, Mr. Marco Distefano, Mr. Davide Maria Donati, Mr. Andreas Leithner, Mr. Domenico Andrea Campanacci, Mr. Massimiliano De Paolis

1Alma mater Studiorum - Università di Bologna, Bologna, Italy, 2IRCCS Azienda Ospedaliera Universitaria di Bologna, Bologna, Italy, 3Azienda Ospedaliera Universitaria Careggi, Firenze, Italy, 4IRCCS Istituto Ortopedico Rizzoli, Bologna, Italy, 5Department of Orthopaedics and Trauma, Medical University of Graz, Graz, Austria

Introduction:
The aim of this study was to evaluate the results of different treatments for pelvic Osteoblastoma (OB), which can often pose site-related challenges.

Methods:
We retrospectively evaluated 34 patients affected by primary pelvic OB from 3 oncologic referral centers. Patients with a minimum follow-up of 24 months were included. Local recurrence (LR) rate and complications were recorded.

Results:
The primary treatment was radio-frequency ablation (RFA) in 4 patients (11.8%), curettage (ILC) in 21 (61.7%) and resection (EBR) in 9 (26.5%). Mean follow-up was 8.9 years (SD ± 6.6). Local recurrence free survival (LRFS) rate after primary surgery was 79.4% at 3 and 5 years. In details, LRFS rate at 3 and 5 years was 50.0% in RFA, 81.0% in ILC and 88.9% in EBR. Post-operative complications occurred in 6/34 patients (17.7%), in particular after EBR.

Conclusions:
RFA is the least invasive technique to treat OB but with high LR rate. Thus, it should be reserved to very small lesions. ILC is a suitable treatment for stage II OB. For stage III OB, EBR is the treatment of choice, despite an increased risk of complications. For selected stage III OB (relatively small, periacetabular area) ILC might be considered.
Impact of Insurance Status on Chondrosarcoma Diagnostic Stage: Implications for Detection and Outcomes

Ms. Puja Yatham¹, Ms. Valeria Fagundo¹, Ms. Jacklyn Garcia¹, Dr. Juan Gabriel Ruiz-Peláez¹, Dr. Ana Cecilia Belzarena¹
¹Miami Cancer Institute, Herbert Wertheim College of Medicine, Florida International University, Miami, United States

Introduction:
Chondrosarcomas account for approximately 20% of primary bone tumors. An advanced stage at diagnosis is associated with poor prognosis. The purpose of this study is to evaluate the association between insurance status and the stage of chondrosarcoma at the time of diagnosis in the United States.

Methods:
A retrospective observational study was conducted using the SEER database. Patients with Chondrosarcoma of the limbs and pelvis after the year 2007 were included. A total of 2351 patients were analyzed; 164 patients were excluded due to incomplete information. Variables of interest included insurance status, age, gender, race, ethnicity, marital status, residence, primary site and stage at diagnosis. Possible associations between the different variables were assessed using the chi-square test. All tests were deemed significant at the 0.05 level.

Results:
A total of 2187 patients were included for statistical analysis. The majority were male (58%), ages 31-50 (32%), white (85%), non-Hispanic (85%), married (60%), living in a metropolitan area (90%), and insured (83%). Localized disease was the initial stage in 1213 (55%) patients, 974 (45%) had an advanced stage. The majority of the patients (1883, 86%) had a non-pelvic tumor. Variables with a significant association with a later stage at diagnosis included being older than 65 (p<0.001), male gender (p<0.001) and pelvic location (p<0.001). The unadjusted relative risk (RR) of late stage at diagnoses for the uninsured was 1.25. After adjusting for other variables, the odds of being diagnosed at a later stage is increased by 77% (p=0.01) in uninsured patients.

Conclusion:
Being uninsured increased the chances of a late-stage diagnosis of Chondrosarcoma. Immediate efforts are required to remediate healthcare access disparities in cancer care. This knowledge will hopefully contribute to improve overall detection and outcomes by emphasizing awareness and promoting interventions in patients who are at risk for a late diagnosis.
Female Presenting trends in Oncology Orthopedics – An Analysis of the past 5 years

Ms. Ana Cecilia Belzarena¹, Sarah N. Joseph¹, Roselle C. Okubo¹
¹Miami Cancer Institute, Miami, United States

Introduction:
Even though the number of females in medicine increased in the past years, still remains low in orthopedic surgery (10-15%) and in oncology orthopedics (6-7.6%). Previous studies, in other areas, shown that even when the female numbers increase, female colleagues continued to be underrepresented in leadership positions as well as presenting in conferences. The purpose of this study is to assess if women were proportionally represented as presenting authors, senior authors and guest speaker roles in Oncology Orthopedics conferences.

Methods:
Final programs of the MSTS and ISOLS conferences from 2015-2019 were assessed for percentage of females presenting, senior authors, moderators and guest speakers. Observed proportions of women in leadership positions were also assessed. Rates of representation of women across each year based on the presence or absence of a woman in research leadership positions were compared.

Results:
Over 350 papers were assessed. The percentage of female presenting varied over the years, 2017 having the least female presenters (13.4%). The same occurred with first authors, with 6 of the 47 papers being presented by a woman in 2017. The percentage of female moderators has remained stable over time, with a maximum of 33.3% in 2016 versus 9.4% in 2015. Senior authorship continued the trend with a minimum in 2017 with 6.4% of the manuscripts. In none of the conferences president or chair roles were females. For the percentage of female oncology orthopedists, the numbers do not show an underrepresentation in most categories except conference chair and conference president.

Conclusions:
Gender disparity exists the academic practice locations in many areas of medicine, which is magnified at the research production level. Even though females are underrepresented in orthopedic surgery and even more in oncology orthopedics compared to the male counterparts, they attain higher percentage of representation in conference leadership positions.
Rapidly Acquired Valgus Deformity After Resection of Osteochondroma: A Report of Two Cases

Alexandra H. Aitchison¹, David Alcoloumbre¹, Ms. Ana Cecilia Belzarena², John S. Blanco¹
¹Division of Pediatric Orthopedic Surgery, Hospital for Special Surgery, New York, United States, ²Oncology Orthopedics Department, Miami Cancer Institute, Miami, United States

Introduction:
Multiple hereditary exostosis (MHE) is a rare disease characterized by several benign osteochondromas. Patients often develop leg length discrepancies and limb alignment deformities. A previous report describes 3 patients who experienced rapidly progressive tibial valgus within 2 years after excision of medial proximal tibial osteochondromas.

Methods:
We aim to add and expand upon the literature by reporting on two patients with MHE who developed a rapidly progressing valgus deformity after resection of distal femur osteochondromas.

Results:
Case 1
A 7-year-old female with normal limb-alignment and painful medial distal femur and proximal tibia osteochondromas underwent uneventful resection. On two-month radiographs she had increased valgus of her left distal femur which further progressed. Patient underwent hemi-epiphysiodesis of the left distal femur and proximal tibia with eight plates. The eight-plates were in place for 11.7 months. At latest follow-up 5-months post hardware removal, radiographs revealed good alignment.

Case 2
A 9-year-old female with MHE presents with left knee valgus and a large distal right femoral osteochondroma. The patient undergoes concomitant excision of the osteochondroma and a hemi-epiphysiodesis on the left side. She had increased valgus of her right distal femur at her 2-month visit which continued to increase. The patient underwent hemi-epiphysiodesis of the right distal femur and proximal tibia with eight plates. She has improved valgus deformity 4-months after the procedure. The eight-plate was in place for 6.7 months. On her latest follow-up 4-months post screw removal, the patient had full range of motion and good alignment.

Conclusion:
Excision of osteochondromas near the physis of a skeletally immature patient can cause overgrowth resulting in a rapidly progressing unilateral coronal deformity. Surgeons should be aware of this potential complication and closely follow growing patients with serial alignment radiographs and counsel the family regarding the potential of acquired limb deformity and subsequent surgeries.
Bone Overgrowth and Limb Deformity After Osteochondroma Resection

David Alcoloumbre, Ms. Ana Cecilia Belzarena, John S. Blanco

1Oncology Orthopedics Department, Miami Cancer Institute, Miami, United States, 2Division of Pediatric Orthopedic Surgery, Hospital for Special Surgery, New York, United States

Introduction:
Patients with multiple osteochondromas can present with limb alignment deformity around the knee as part of the disease’s natural course. One prior study reported on genu valgum occurring subsequent to proximal tibia osteochondroma resection in three multiple hereditary exostoses (MHE) patients. We therefore asked: (1) How frequent are limb deformities after an osteochondroma resection? (2) Are there any risk factors associated with this phenomenon?

Methods:
This was a single-center, observational, retrospective study. Fifty-nine patients with solitary or multiple osteochondromas and open physes who underwent resection between 01/2016 and 07/2018 were included. Patients were followed for a minimum of 12 months or until deformity presented.

Results:
Our sample included 59 patients with 64 osteochondromas; 37 were males, mean age was 13.3 years (range 7-17, SD 2.7). Thirty-four osteochondromas were on the femur, 24 on the tibia, 3 on the humerus, and 3 on the fibula. Forty-two patients had a solitary osteochondroma and for the remaining 17 the osteochondroma was part of a syndrome, 16 of those patients the diagnose was (MHE) and one had Trevor’s disease. The mean follow up was 23.8 months (range 10-41, SD 10.5). Eleven patients presented with an alignment deformity prior to resection. Two other patients, who initially had normally aligned limbs developed a genu valgum deformity after the osteochondroma resection. Younger age of the patient was significantly associated with postresection development of limb deformity (p=0.007).

Conclusion:
Excision of osteochondromas near the physis of a skeletally immature patient can cause overgrowth resulting in a rapidly progressing unilateral coronal deformity. This phenomenon has a prevalence of 0.03% and younger age of the patients was found to be a risk factor. Surgeons should be aware of this potential complication and closely follow younger patients and counsel the family regarding the potential limb deformity and subsequent surgeries.

Ms. Maria Anna Smolle¹, Ms. Angelika Kogler¹, Mr. Jörg Friesenbichler¹, Ms. Susanne Scheipl¹, Mr. Marko Bergovec², Mr. Christoph Castellani², Mr. Holger Till², Mrs. Freyja-Maria Smolle-Juettner³, Mr. Andreas Leithner¹

¹Department of Orthopaedics and Trauma, Medical University Of Graz, Austria, ²Department of Paediatric and Adolescent Surgery, Medical University Of Graz, Austria, ³Division of Thoracic and Hyperbaric Surgery, Department of Surgery, Medical University Of Graz, Austria

Introduction:
Prognosis of bone sarcoma (BS) patients with metastases is rather poor, due to limited efficacy of systemic treatment options. Thus, locally active therapeutic strategies, as radiotherapy and metastasectomy, may be considered. This study aimed at analysing the effect of metastasectomy in patients with BS regarding post-metastasis survival (PMS).

Methods:
Altogether, 46 patients with BS (mean age: 30.9 ± 20.7 at time of metastasis; 50.0% males; 33 osteosarcomas), treated at a single institution for primary localised disease who secondarily developed lung metastases, were retrospectively included. Median follow-up was 37.0 (IQR: 25.0-89.0) months. In order to independently assess the impact of metastasectomy on patients’ PMS, a propensity score for the likelihood of a patient to undergo metastasectomy was calculated, on which an inverse-probability-of-treatment-weight (IPTW) was based on. Uni- and multivariate Cox-regression models were performed after weighting the data for the IPTW.

Results:
Eleven patients had bilateral pulmonary lesions at metastasis diagnosis (23.9%), and 19 at least two nodules (41.3%). Metastasectomy was performed in 37 patients (80.4%), with patients having singular metastasis (p=0.001), only one lung affected (p=0.013), low LDH (p<0.001), and low CRP levels (p=0.014) being more likely to undergo metastasectomy. In the naïve univariate Cox-regression analysis, metastasectomy was associated with a significantly better PMS (HR: 0.136; 95%CI: 0.047-0.393; P<0.001). After weighting the data for the IPTW (including bilateral involvement, CRP- and LDH-levels), the protective effect of metastasectomy towards PMS prevailed (HR: 0.138; 95%CI: 0.054-0.353; p<0.001). Furthermore, metastasectomy was independently associated with improved PMS in the IPTW-weighted multivariate model (HR: 0.146; 95%CI 0.055-0.386; p<0.001), irrespective of age (HR: 1.038; p=0.001), and gender (female HR: 2.770; p=0.025).

Conclusion:
According to the present study, metastasectomy seems to improve PMS in BS patients with lung metastases, irrespective of variables that are decisive for metastasectomy, wherefore it may be considered as a valid treatment option.
The importance of awaiting biopsy results in solitary pathological proximal femoral fractures. Do we need to biopsy solitary pathological fractures?

Ms. Floortje G.M. Verspoor¹,², Mr. Gerjon Hannink³, Mr. Michael Parry¹,⁴, Mr. Lee Jeys¹,⁴, Mr. Jonathan Stevenson¹,⁴

¹Royal Orthopaedic Hospital, Birmingham, United Kingdom, ²Amsterdam UMC, University of Amsterdam, Amsterdam, Netherlands, ³Radboud University Medical Center, Nijmegen, Netherlands, ⁴Aston University, Birmingham, United Kingdom

Introduction:
The optimal surgical treatment for patients presenting with (impending) pathological fractures of the proximal femur is predicated by prognosis. Guidelines recommend pre-operative biopsy in solitary bone metastases to exclude rare sarcomas. No evidence confirms a benefit. This study aims to describe the diagnostic accuracy, morbidity and sarcoma incidence of biopsy results in these patients.

Methods:
All patients (n=153), presenting with a pathological or impending fracture of the proximal femur referred to a single orthopaedic oncology centre between 2000-2019 were retrospectively evaluated. Patients after inadvertent surgery (n=25) were excluded. Descriptive statistics were used to evaluate the accuracy and morbidity of a diagnostic biopsy. In patients with solitary tumours, Kaplan–Meier survival analysis was used to calculate overall survival.

Results:
Of 112 (out of 128) patients who underwent biopsy, nine (8%) biopsy results were unreliable either due to being inconclusive (n=5) or because the diagnosis changed after resection (n=4). In patients with impending fractures (n=37), 32% fractured following biopsy. Median time from diagnosis to surgery was 30 days (IQR 21-46 days). The positive predictive value (PPV) of a biopsy to differentiate between sarcoma and non-sarcoma in all patients was 1.00 (95% CI 0.88-1.00).

In patients with a solitary tumour and previous malignancy (n=24), biopsy (n=23) identified the diagnosis in 83% (PPV 0.91 (95% CI 0.71-0.99)), of whom five (24%) patients had a new diagnosis.

In patients with solitary metastasis without a history of cancer (n=61) final diagnosis included carcinomas (n=24, 39.3%), sarcomas (n=24, 39.3%) or haematological (n=13, 21.3%). Biopsy (n=58) correctly identified the diagnosis in 66%, with a PPV of 0.80 (95% CI: 0.67-0.90).

Conclusion:
This study confirms the importance of a pre-operative biopsy in solitary pathological (impending) fractures of the proximal femur, due to the risk of sarcoma, both in patients with and without a history of cancer. However, biopsy delays the time to definite surgery, its results can be inconclusive or false, and risks completion of impending fractures.
Treatment of giant cell tumor with intralesional surgery and denosumab

Mr. Anatoli Diedkov\textsuperscript{1}, Mr. Bogdan Maksymenko\textsuperscript{1}, Mr. Sergey Boichuk\textsuperscript{1}, Mr. Victor Kostyuk\textsuperscript{1}

\textsuperscript{1}National Cancer Institute, Kyiv, Ukraine

Introduction:
Treatment of giant cell tumor (GCT) remains a problematic issue due to the significant risk of recurrence in conservative surgery and high complications after radical resections. Targeted therapy had an potential to solve this problem, but recent studies have shown conflicting results.

Materials and Methods:
We compared the treatment results in two group of patients: 1st retrospective group with surgical treatment and 2nd prospective group with combination of surgery with neoadjuvant and adjuvant denosumab. 99 patients with GCT were included in two cohorts: 57 patients of control retrospective group who underwent only curettage, and 42 patients of the main (prospective) group who received 5 neoadjuvant and 5 adjuvant cycles of denosumab. The median follow-up time was 189 months in the control group, and 45 months in the main group.

Results:
Disease progression which identified as a local recurrence was revealed in the control group in 15 patients (25.4%) and in 7 patients (16.7%) from main group (p = 0.25). In the main group, the median time to relapse was 19.8 months (8 - 34 months) from the date of surgery, in the control group - 15.1 months (9 - 28 months), respectively. The statistically significant difference in PFS between patients in the main group and in the control group (p = 0.18) was not revealed. But the 5-year PFS in the main group was higher and reached to 85% (95% CI 74% - 96%) versus 75% (95% CI 64% - 86%) in control group, respectively. There was no evidence of malignant transformation in the main group and one case in retrospective group.

Conclusions:
But adjuvant administration of denosumab can be considered as preventing factor of recurrence after primary tumor excocleation, which may be perspective for further study and optimization of indications for its application in patients with GCT.
Haemorrhagic soft-tissue sarcoma: oncological outcomes and prognostic factors for survival

Ms. Danielle Maes, Mr. Motaz AlAqeel, Mr. Michael Parry, Mr. Lee Jeys, Mr. Jonathan Stevenson

The Royal Orthopaedic Hospital NHS Foundation Trust, Birmingham, United Kingdom

Introduction:
Haemorrhagic soft-tissue sarcomas (HSTS) represent a separate entity of STS with specific histopathological and radiological features, characterised by aggressive local growth and highly metastatic behaviour. We aimed to describe the oncological outcomes and identify prognostic factors.

Methods:
Retrospective review including 64 patients treated with palliation (n=7) due to extensive local and systemic disease or poor performance status, with limb salvage surgery (LSS) (n=9), with neoadjuvant radiotherapy (RT) + LSS (n=12), with LSS + adjuvant RT (n=30) or amputation (n=6). Data collection included histopathological diagnosis, resection margin and oncological outcome. Kaplan-Meier-survival-analysis estimated overall survival (OS), metastasis-free survival (MFS) and local recurrence-free survival (LRFS) and via uni- and multivariate analysis prognostic factors affecting OS, MFS and LRFS were identified.

Results:
Median age was 67 years (IQR 23 years) with median follow-up of 11 months (IQR 28 months). Histopathological diagnosis was high-grade for all. Eight (13%) had pulmonary metastases at presentation and another 40 (63%) developed metastases after a median of 9.3 months (IQR 16.5 months). Median OS was 12 months (IQR 38 months), and estimated OS after two-years was 15.9% and 52.9% for patients with and without metastatic disease at presentation, respectively. Improved OS is associated with negative resection margins (p=0.031), RT (p=0.023) – with better OS for neoadjuvant RT (p=0.034) compared to adjuvant RT – and amputation (p<0.001) versus LSS. MFS was 35.1% after two-years. LR occurred in 18 of 51 (35.3%) patients with surgically treated localised disease of which eight had a positive resection margin and ten had LSS only. LRFS was 63.4% at two-years and significantly affected by a negative margin (p=0.033) and RT (p=0.002).

Conclusion:
High-grade localised HSTS should be treated timely and surgically, either with amputation or LSS with a negative margin. If LSS is attempted, neoadjuvant RT offers superior local control and overall survival.
The amount of bone resected in periacetabular tumor resection impacts on alloprosthetic reconstruction survival and function

Mr. Alessandro Bruschi¹, Mr. Luca Cevolani¹, Mr. Tommaso Frisoni¹, Mrs. Benedetta Spazzoli¹, Mr. Marco Focaccia¹, Dr. Stefano Pasini¹, Mr. Davide Maria Donati²
¹Istituto Ortopedico Rizzoli, Bologna, Italy, ²Università di Bologna, Bologna, Italy

Background:
The survival and function of alloprosthetic composite reconstruction after resection for periacetabular tumors undergo several complications: tumor relapse, infection and mechanical failure. Some case series conclude that extension of periacetabular resection does not affect survival of the reconstruction but others highlight the importance of bone mass sparing resections. To date, the impact of type of resection on mechanical survival and function remains unclear.

Methods:
Retrospectively, we selected 33 patients who had no infection or local tumor relapse. The patients were divided in two groups based on a resection classification developed to better define the amount of bone excised: Group 1 (limited bone excision: 1A resection type) and Group 2 (extended bone excision: all other resections). Survival of the implant and Musculoskeletal Tumor Society Functional score system were applied.

Results:
Patients in Group 1 had 38% failure rate of the implant after a mean failure time of 144 months (+/- 69 months) while patients in Group 2 had 88% failure rate after a mean failure time of 109 months (+/- 84 months) (p=0.021). Average functional score was higher in Group 1 compared with patients in Group 2 at 2, 5 years follow as well as at the last follow up.

Patients older than 40 years old had better survival rate of the reconstruction if compared with patients younger than 40. At 120 months, the application of artificial ligament showed to have non-significant impact on survival of the reconstruction in Group 1, while significantly improving survival of reconstruction in Group 2.

Conclusions:
The amount of periacetabular bone resected impacts on alloprosthetic composite reconstruction survival and function. Limited bone excision resections (1A type) provide better survival and functional scores. Artificial ligament does not influence hip joint stability in limited periacetabular resections, while it decreases mechanical failure rate in reconstructions with wide bone sacrifice.
Development of metastatic orthotopic xenografts from sarcoma patients as models for therapeutic decision making

Ms. Suzanne Fischer\textsuperscript{1,2,3}, Mrs. Elly De Vlieghere\textsuperscript{1,3}, Mr. David Creytens\textsuperscript{2,4}, Mrs. An Hendrix\textsuperscript{1,3}, Mr. Olivier De Wever\textsuperscript{1,2}, Mrs. Lore Lapeire\textsuperscript{2,5}, Mrs. Gwen Sys\textsuperscript{2,6}

\textsuperscript{1}Laboratory of Experimental Cancer Research, Ghent University, Ghent, Belgium, \textsuperscript{2}Cancer Research Institute Ghent, Ghent, Belgium, \textsuperscript{3}Department of Gastro-Intestinal Surgery, Ghent University Hospital, Ghent, Belgium, \textsuperscript{4}Department of Pathology, Ghent University Hospital, Ghent, Belgium, \textsuperscript{5}Department of Medical Oncology, Ghent University Hospital, Ghent, Belgium, \textsuperscript{6}Department of Orthopedic Surgery and Traumatology, Ghent University Hospital, Ghent, Belgium

Introduction:
Despite trials with new compounds, survival rates for metastasized sarcoma patients have stagnated over the past 20 years. Patient-derived xenografts (PDX) are increasingly used to validate preclinical research, however clinical translation is still absent. Popular subcutaneous PDX arguably do not recapitulate the heterogeneity of the tumor nor have the propensity to metastasize. Therefore, they do not accurately represent the patient’s clinical course.

Objective:
Development of metastatic PDX models that can be used to predict patient treatment response.

Methods:
Tumor samples were collected from high-grade soft tissue sarcoma patients, from primary tumor tissue and lung metastasis, during resection. Samples were minced into 2mm\textsuperscript{3} pieces and for every patient implanted in 8 mice: subcutaneously or orthotopically on the lower limb of Swiss Nu/Nu and NSG mice. Animals were followed with MRI. Once the tumor reached a size of >250 mm\textsuperscript{3}, the limb was amputated. When metastasis occurred, the animals were euthanized. Both primary tumor and metastasis tissue were harvested. Tumor histology was evaluated by a specialized pathologist.

Results:
Tumor take rate was 100% for all patients in orthotopic NSG models, and drastically lower in all other models. Although all models had negative resection margins at amputation, 50% of orthotopic NSG mice developed metachronous metastases, and this for all subtypes, concordant with the patient’s clinical course. None of the other models showed metastasis, except for the lung metastasis derived orthotopic Swiss Nu/Nu models (metastasis ratio 50\% for all subtypes). Second generations have been set-up for both primary and metastasis PDX tissue. PDX derived primary and metastatic tissue show concordance in histopathological characteristics on immunohistochemistry analysis.

Conclusion:
Metastatic PDX models were successfully developed by engrafting tumor tissue orthotopically, and accurately represent our patient's clinical course. A PDX clinical trial using both primary and metastatic tissue is designed to assess personalized patient treatment response.
Whoops lesions, still there?

Mrs. María Sanz-Pascual¹, Mr. Israel Pérez-Muñoz¹, Mr. Gonzalo Grande-Gutiérrez¹, Mr. Fausto González-Lizán¹, Ms. María Eugenia Reguero Callejas¹  
¹Ramón Y Cajal University Hospital, Madrid, Spain

Introduction:  
After the resection of soft tissue tumor (STT) without preoperative planning, it is not uncommon to obtain sarcoma. This is due to the surgeon’s overconfidence, who operates without adequate imaging and biopsy tests, and may affect survival and limb-sparing surgery. Our aim is to show consequences of unplanned surgeries in STT.

Material and methods:  
This is a retrospective observational study. We analyze 50 patients with soft tissue sarcoma after an initial intervention for a presumed benign lesion, performed in our sarcoma unit between 2008 to 2020. We reviewed etiology, mid- and long-term follow-up, accuracy of diagnostic studies prior to the first biopsy, surgical margins in first and subsequent surgeries, need for adjuvant therapy, complications, local relapse, and survival.

Results:  
We analyzed 24 men and 23 women between 15 and 89 years old, mean follow-up of 54 months. Three patients decided to continue treatment elsewhere, leaving us 47 patients to study. We diagnosed 30 high-grade sarcomas, 14 low-grade sarcomas, and 3 squamous cell carcinomas with important soft tissue involvement. The initial diagnostic study prior to the biopsy was not adequate in 94% of patients. Surgical margins after unplanned initial resection were affected in 95% of patients, requiring surgical reoperation in 93% of them. Two out of three patients who initially underwent surgery for a benign tumor, required chemo and / or radiotherapy. 37 patients are disease-free, 5 patients have died of disease, and in 2 patients there is active residual disease expecting treatment.

Conclusion:  
Accurate diagnostic studies for local and distant extension together with biopsy are mandatory before surgery. About to finish the first quarter of this century, this situation happens in many patients. The study emphasizes that therapeutic approach to these patients and their prognosis will be impaired if these lesions are not suspected and the diagnostic protocol followed.
Restaging after Neoadjuvant Radiotherapy for Soft Tissue Sarcoma

Mr. Bob Schultze, Mrs. Ibtissam Acem, Mr. Dirk Jan Grünhagen, Mr. Cornelis Verhoef

Department of Surgical Oncology, Erasmus MC Cancer Institute, Rotterdam, Netherlands

Introduction:
Soft tissue sarcomas (STS) are known to mainly disseminate to the lungs. The primary tumours are most commonly treated with neoadjuvant radiotherapy (RT) followed by surgery. However, there is a lack of evidence regarding the value of restaging with chest CT or X-ray after neoadjuvant RT. This study assessed the use and value of restaging with chest CT or X-ray after neoadjuvant RT in the treatment of non-retroperitoneal STS.

Methods:
This is a single-centre retrospective cohort study. Patients ≥18 years, diagnosed at or referred to Erasmus MC between January 2010 and October 2020, with a non-retroperitoneal STS and who were staged with a chest CT or X-ray before the start of neoadjuvant RT, were analysed.

Results:
A total of 152 patients were included. Restaging after neoadjuvant RT was done in 91% of all patients. Median time between staging and restaging was 15.0 weeks (IQR 12.9-16.8). During restaging, metastases were reported in 29 out of the 138 patients who were restaged (21%, 29/138), compared to four patients during staging (p<0.001). A change in treatment strategy, as a result of findings during restaging, was seen in 18% of patients out of the total study population. Out of the patients who had newly found metastasis, 81% had a change of strategy.

Conclusion:
Restaging after neoadjuvant RT should be recommended because of the number of findings that resulted in a change in strategy. The percentage of change in strategy we observed are comparable, or even higher, than other reported percentages in other types of cancer throughout the literature, that suggested that restaging is a valuable additional diagnostic modality. Recommending restaging after neoadjuvant RT would be a good addition to current clinical sarcoma guidelines.
Artificial muscle: are we there yet?

Mr. Alessandro Bruschi\textsuperscript{1,2}, Mr. Davide Maria Donati\textsuperscript{1,2}, Mr. Peter FM Choong\textsuperscript{3}, Mr. Enrico Lucarelli\textsuperscript{1}, Mr. Gordon Wallace\textsuperscript{4}

\textsuperscript{1}Istituto Ortopedico Rizzoli, Bologna, Italy, \textsuperscript{2}Università di Bologna, Bologna, Italy, \textsuperscript{3}University of Melbourne - Department of Surgery, Melbourne, Australia, \textsuperscript{4}Intelligent Polymer Research Institute, ARC Centre of Excellence for Electromaterials Science, Wollongong, Australia

Our inability to replace human muscle in surgical practice is a significant challenge. An artificial muscle controlled by the nervous system is considered a potential solution for this. Here we define this as a neuromuscular prosthesis. Muscle loss and dysfunction related to musculoskeletal oncological impairments, neuromuscular diseases, trauma or spinal cord injuries could be treated through artificial muscle implantation. At present, the use of dielectric elastomer actuators (DEAs) working as capacitors appears a promising option. Acrylic or silicone elastomers with carbon nanotubes functioning as the electrode achieve mechanical performances similar to human muscle in vitro. However, mechanical, electrical and biological issues have prevented clinical application to date. Here we present which materials and mechatronic solutions could tackle current clinical problems associated with implanting an artificial muscle controlled by the nervous system. Progress depends on the improvement of the actuation properties of the elastomer, seamless or wireless integration between the nervous system and the artificial muscle and on reducing the foreign body response. We believe that combining the mechanical, electrical and biological solutions proposed here, an artificial neuromuscular prosthesis may be a reality in surgical practice in the near future.
Is magnetic intramedullary nail suitable for treating lower limb length discrepancy in patients after bone tumor?

Mrs Laura Campanacci, Mr. Luca Cevolani, Mr. Marco Focaccia, Mr. Marco Manfrini, Mr. Stefano Pasini, Mr. Alessandro Bruschi, Mr. Annalisa Baiardi, Mrs. Benedetta Spazzoli, Mr Davide Maria Donati

1Istituto Ortopedico Rizzoli, Bologna, Italy

To determine the efficacy of PRECICE 2® nail in treatment of lower limb length discrepancy in patients with a history of bone tumor.

Seventeen patients were treated with intramedullary magnetic nails. All patients have been surgically treated for a bone tumor in their growing period, with a biological reconstruction. All patients attended the outpatient’s clinic to assess the correct lengthening. The outcomes measured were the Distraction Index, and the Consolidation Index.

The main patients age at the time of surgery was 19 years (range, 11-32). There were 9 males and 8 females. Average follow-up time was 29 months (range, 12 to 59). PRECICE 2 nail was performed on 14 femurs (6 retrograde in and 8 anterograde) and 3 tibias. The average preoperative limb length discrepancy (LLD) was 50 ± 20 mm. All patients achieved regenerate consolidation at the end of follow up. Sixteen out of 17 (94%) of the patients reached the targeted length. The average consolidation time was 141 days (range, 50 – 360) with a mean CI of 31 ± 12 days/cm. The ASAMI bone score showed 14 (82%) excellent results, 1 (6%) good and 2 (12%) poor results. The ASAMI functional score showed 13 (84.6%) excellent results, 3 (11.5%) good, and 1 (3.8%) fair result. Patients treated with chemotherapy for bone cancer did not show any increase in time of distraction as well as in time of consolidation. A total of 3 (17%) problems, 1 obstacle (5.5%), and 1 complication (5.5%) were encountered in our case series.

Conclusion:
PRECICE 2 nail allows effective and accurate lengthening preserving the range of motion in patients treated for bone tumor. Although intramedullary nail lengthening is not free of complication, the risk of complication is lower than with other devices.
Is percutaneous injection of bone marrow concentrate, demineralized bone matrix and PRF an alternative to Curettage and bone grafting for treating aneurysmal bone cyst?

Mr. Luca Cevolani¹, Mr. Laura Campanacci¹, Mr. Stefano Pasini¹, Mr. Alessandro Bruschi¹, Ms. Benedetta Spazzoli¹, Mr. Annalisa Baiardi¹, Mr. Marco Focaccia¹, Mr. Davide Maria Donati¹

¹Istituto Ortopedico Rizzoli, Bologna, Italy

Objectives to determine the efficacy and safety of a single injection with autologous bone marrow concentrate (BMC) combined with demineralized bone matrix (DBM), and platelet rich fibrin (PRF) compared to curettage and bone grafting for treating aneurysmal bone cysts (ABC).

Materials and Methods:
Two hundred thirty-nine were treated with curettage and bone grafting (Curettage group), and 21 with percutaneous injection of DBM associated with autologous BMC and PRF (DBM + BMC + PRF Group). All patients attended the outpatient clinic to assess ABC healing and clinical results at first 3, 6, 9 and 18 months after surgery and then annually in the absence of symptoms. The mean follow-up was 42 months for the Curettage Group (range 6–180 months) and 28 months for the DBM + BMC + PRF Group (range, 6–85 months).

Results:
Out of the 21 patients who had injection with BMC, DBM, and PRF, 17 (80%) require no additional treatment and they were considered healed. Of the 239 patients treated with Curettage and bone grafting after core needle or open biopsy, 177 (74%) were considered healed after the first treatment. Injection in comparison with curettage presented the same risk for local recurrence. The overall rate of local recurrence for all patients was 25%. Univariate and multivariate analysis showed a significant difference in local recurrence rates in patients younger than 15 years, and for the cyst located in the long bones of the lower limbs than the cyst located in the long bones of the upper limbs.
Operating procedures for electrochemotherapy in bone metastases: Results from a multicenter prospective study on 102 patients

Mrs. Laura Campanacci1, Mr. Luca Cevolani1, Mr. Marco Focaccia1, Mr. Giuseppe Bianchi1, Mr. Costantino Errani1, Dr. Stefano Pasini1, Dr. Alessandro Bruschi1, Dr. Benedetta Spazzoli1, Mr. Tommaso Frisoni1, Dr. Annalisa Baiardi1, Mr. Davide Maria Donati1

1Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction:
Bone metastases are frequent in patients with cancer. Electrochemotherapy (ECT) is a minimally invasive treatment. Preclinical and clinical studies supported the use of ECT in patients with metastatic bone disease (MBD). The purposes of this multicentre study are to confirm the safety and efficacy of ECT, and to identify appropriate operating procedures in different MBD conditions.

Materials and methods:
102 patients were treated in 11 Centres and recorded in the REINBONE registry (a shared database protected by security passwords): clinical and radiological information, ECT session, adverse events, response, quality of life indicators and duration of follow-up were registered.

Results:
105 ECT sessions were performed (one ECT session in 99 patients, two ECT sessions in 3 patients). 24 patients (23.5%) received a programmed intramedullary nail after ECT, during the same surgical procedure. Mean follow-up was 5.9 ± 5.1 months (range 1.5–52). The response to treatment by RECIST criteria was 40.4% objective responses, 50.6% stable disease and 9% progressive disease. According to PERCIST criteria the response was: 31.4% OR; 51.7% SD, 16.9% PD with no significant differences between the 2 criteria. Diagnosis of breast cancer and ECOG values 0–1 were significantly associated to objective response. A significant decrease in pain intensity and significant better quality of life was observed after ECT session at follow-up.

Conclusion:
The results are encouraging on pain and tumour local control. ECT proved to be an effective and safe treatment for MBD and it should be considered as an alternative treatment as well as in combination with radiation therapy.
Surgical treatment of impending fractures significantly improves the survival and quality of life of patients with bone metastases from carcinoma

Mr. Francesco Nicolosi

Introduction:
In our center they were treated well from 2010 to 2021 242 patients
Impending fractures that have involved the femur, humerus, tibia, radius, pelvis.

Methods:
Most of the time intramedullary nails have been used, followed by cemented endoprostheses and to a lesser extent resection prostheses. In the last two years we have used the system in the upper limb Illuminos. Thermoablation with radiofrequencies and subsequent plastic cement has been used in some districts (such as pelvis) where the traditional surgical aggression of the lesion would have been inappropriate. In this type of intervention we made use of the O-ARM navigation system.

Discussion:
The treatment of impending fractures allowed the patient an improvement in painful symptoms accompanied by rapid mobilization. This led to a decrease in hospitalization times, allowing considerable economic savings. from obtaining a pathological fracture, also accompanied by the relative socio / family relief.

Results:
The treatment of impending fractures must necessarily make use of a multidisciplinary team that must include Oncologists, Radiotherapists, Interventional Radiologists, Oncological Orthopedists, in order to be able to evaluate the patient at 360° in order to choose the appropriate diagnostic and interventional procedure.

Conclusion
In the light of what has been expressed and from the data collected in the post-operative course, it is clear that the quality of life and survival of patients, compared with those suffering from pathological carcinoma fractures, is much better, guaranteeing a better approach to care and social conditions economic health.
Pelvic metastases from renal cell carcinoma – Results after surgical treatment

Mr. Guido Scoccianti¹, Mr. Roberto Scanferla¹, Mr. Maurizio Scorianz¹, Ms. Elisabetta Neri¹, Mr. Francesco Muratori¹, Mr. Domenico Andrea Campanacci¹

¹Careggi University Hospital - Orthopaedic Oncology Department, Firenze, Italy

Introduction:
Renal cell carcinoma has a high metastasizing potential to bone. Due to low sensibility to radiotherapy, surgical treatment was often advocated, but few studies specifically addressed results of the most surgically challenging bone sites, like the pelvis.

Methods:
From 2009 to 2019 we surgically treated 21 patients affected by metastatic lesions at the pelvis (17 open and 4 percutaneous procedures). Tumor involved the periacetabular area (zone II) in twelve cases, with surgical procedures including two resections and reconstructions (1 allograft, 1 custom-made prosthesis), eight curettage, cement and arthroplasty, two selective embolizations. The remaining nine patients (zone I) received curettage or resection and cement in seven cases and percutaneous ablation in two.

Results:
One patient was early lost, eleven were alive at latest follow-up (ranging from 16 to 92 months), six had died of the disease (16 to 59), three of concomitant diseases (3 to 22). One local recurrence occurred. A valid gait restoration (no or one crutch) was obtained in 12 patients; 8 patients walked with two crutches; no gait restoration occurred in one. Despite all patients, except two, underwent preoperative embolization, a mean of 4.1 blood transfusions was necessary (0 to 16). One reconstruction after resection failed due to deep infection.

Conclusion:
11 patients could live more than two years from surgery and 6 of them more than four years. Three more patients were alive during their second year at follow-up. These findings confirm that surgery also in difficult locations like the pelvis can be indicated in patients affected by bone metastatic disease from renal cell carcinoma. Only one local recurrence was found after curettage and cement out of seven procedures; this kind of procedure should be preferred, when feasible, rather than resection procedures due to
Defining Depression and Anxiety in Orthopaedic Sarcoma Patients

Mrs. Elizabeth Polfer1, Ms. Yesne Alici2, Mr. John Healey2, Mrs. Meredith Bartelstein1

1Memorial Sloan Kettering Cancer Center, New York, United States

Introduction:
Depression is a common healthcare concern worldwide. It is estimated that the 12-month prevalence of depression in the United States is 8.6% and 3.2% worldwide. Depression results in increased healthcare utilization among cancer patients, as well as increased morbidity and mortality. While prior studies have evaluated depression in carcinoma patients, there is a paucity of literature evaluating sarcoma patients. The purpose of this study was to evaluate the prevalence of anxiety and depression in sarcoma patients treated in the orthopaedic clinic.

Methods:
Sarcoma patients were invited to complete the 9-Item Patient Health Questionnaire (PHQ-9) as well as the Generalized Anxiety Disorder Scale (GAD-7) upon arrival to clinic. Questionnaires were scored per protocol. For both, we referred patients with scores 10-14 to social work and 15 or higher to psychiatry. Patients were categorized by disease state—initial management, locally recurrent disease, metastatic disease, and no evidence of disease (NED).

Results:
To date, 80 patients have completed surveys. Depression was seen in 34 (42.5%) patients—16 (20%) mild, 13 (16.3%) moderate, 4 (5%) moderately severe, 1 (1%) severe. Anxiety was seen in 33 (41%) patients—18 (22.5%) mild, 8 (10%) moderate, 7 (8.8%) severe. Nine patients (11.3%) had thoughts of hurting themselves/thinking they were better off dead within two weeks of the visit. Referrals were most frequent in patients with recurrence, 67% and 50% respectively for depression and anxiety, followed by initial management, metastatic, and NED patients.

Conclusion:
Our study demonstrates that in sarcoma patients, anxiety and depression exist at a higher prevalence that of the standard population, often warranting referral to mental health providers. When treating sarcoma patients, consideration should be given to potential underlying psychiatric diagnosis and screening.
Development of a scoring system combined clinical, radiological, and histopathological examinations for differential diagnosis between lipoma and atypical lipomatous tumor/well-differentiated liposarcoma

Mr. Yohei Asano1, Mr. Norio Yamamoto1, Mr. Katsuhiko Hayashi1, Mr. Akihiko Takeuchi1, Mr. Shinji Miwa1, Mr. Kentaro Igarashi1, Mr. Hirotaka Yonezawa1, Mr. Sei Morinaga1, Mr. Shiro Saito1, Mr. Hiroyuki Tsuchiya1

1Kanazawa University Graduate School of Medical Science, , Japan

Background:
Preoperative differential diagnosis between atypical lipomatous tumor (ALT)/well-differentiated liposarcoma (WDLS) and lipoma is important to determine the appropriate resection margin. However, their radiological and histopathological findings are similar, and sometimes difficult to make a differential diagnosis. This study evaluated the diagnostic accuracy of clinical, radiological, and histopathological examinations for diagnosing ALT/WDLS and aimed to develop a new combined scoring system that enables differential diagnosis from lipoma.

Methods:
Eighty-nine ALT/WDLS and 56 lipomas were included and their clinical characteristics, magnetic resonance imaging (MRI) findings, histological findings by hematoxylin and eosin (HE) staining were investigated and compared between ALT/WDLS and lipoma. Then, multivariate logistic regression analysis was performed on factors that had a significant difference in the diagnosis of ALT/WDLS, and a combined scoring system consisted of predictive factors of ALT/WDLS was developed.

Results:
The univariate and multivariate logistic regression analyses revealed that tumor location (lower extremity), deep site, and size (>11cm), thick septa (>2mm), enhancement of septa or nodular lesions on MRI, and lipoblasts in HE staining were significantly different for the diagnosis of ALT/WDLS. We developed a combined scoring system based on the six predictive factors (0–16 points, the cutoff was 9 points). The mean score of ALT/WDLS was significantly higher than lipoma (11.9 vs. 5.6, p<0.0001). The area under the curve was 0.945, and sensitivity and specificity were 87.6% and 91.1%, respectively by the receiver operating characteristics curve.

Conclusions:
We developed a new combined scoring system based on comprehensive examinations that excluded examination which requires special equipment and reagents such as fluorescence in situ hybridization (FISH), and this may be able to use in many medical institutions. The diagnostic accuracy of ALT/WDLS was high and useful for preoperative diagnosis and surgical plan.
Midterm MRI follow-up of untreated enchondroma and atypical cartilaginous tumours in the long bones.

J.W.J. De Rooy², Ms. Claudia Deckers, E.F. Dierselhuis¹, U. Flucke³, H.W.B. Schreuder¹, I.C.M. Van der Geest¹

¹Department of Orthopedics, Radboud University Medical Center, Nijmegen, Netherlands, ²Department of Radiology, Nuclear Medicine and Anatomy, Radboud University Medical Center, Nijmegen, Netherlands, ³Department of Pathology, Radboud University Medical Center, Nijmegen, Netherlands

Introduction:
Management of atypical cartilaginous tumours (ACT) in the long bones shifts towards active surveillance to avoid unnecessary surgeries. The frequency and duration of active surveillance for these tumours is unclear as there is little knowledge of its biological behaviour. In this retrospective study, we examined the natural course of enchondroma and ACT through active surveillance.

Methods:
128 central cartilaginous tumours, located in the long bones, with a minimum interval of 24 months between baseline and last MRI were included in this study. MRI characteristics (e.g. size, scalloping, fat entrapment) were scored and tumours were classified according to the changes between MRIs.

Results:
Mean follow-up of this study was 50 months, range: 25 – 138 months. 65 cases (51%) showed no change from baseline to last MRI, whereas 46 cases (36%) showed tumour regression and 17 cases (13%) showed progression (i.e. growth) of the tumour. Figure 1 shows an example of tumour regression. Majority of the cases (87%) that developed tumour regression presented with entrapped fat at diagnosis. None of the cases developed signs of higher grade chondrosarcoma.

Conclusion:
Majority of the cartilaginous tumours (87%) remained stable or showed regression on MRI. Only 13% showed progression on MRI, although none of the tumours developed characteristics of high grade chondrosarcoma. Follow-up schemes should be tailored according to the biological behaviour. We propose active surveillance for all asymptomatic enchondroma or ACT in the long bones, irrespective of tumour size.
Despite Education Orthopaedic Surgeons Still Perform Unplanned Resections

Ms. Ana Cecilia Belzarena¹, David Joyce²
¹Orthopaedic Oncology Service, Miami Cancer Institute, Miami, United States, ²Sarcoma Department, Moffitt Cancer Center, United States

Introduction:
Soft tissue sarcomas often present with unspecific symptoms and, unplanned resections can commonly occur. Unplanned excisions tend to happen in a community or nonspecialized cancer center setting where this rare disease is not usually seen. The purpose of this study is to report on the incidence of unplanned excisions of soft tissue sarcomas in the community and to determine if and why orthopaedic surgeons continue to contribute to the unplanned resection burden.

Methods:
A retrospective chart review was conducted on patients who underwent an unplanned soft tissue sarcoma resection between 01/2013 and 07/2017. Demographic information along with tumor characteristics, imaging studies performed prior to resection, initial pathology report, and type of referring center were recorded. A root cause analysis method was then used to identify orthopaedic surgery errors in workup.

Results:
A hundred and seven patients with unplanned sarcoma excisions were included. The overall incidence of unplanned procedures was 23.4%. The mean age at diagnosis was 59 years old (range 12-87). The most frequent diagnoses were: Myxofibrosarcoma (19.6%), Undifferentiated Pleomorphic Sarcoma (UPS) (18.7%), Liposarcoma (LS) (15.9%), and Leiomyosarcoma (10.3%). Orthopaedic surgeons performed 17.8% (N=19) of the unplanned resections of 6 LS, 4 UPS and 3 chordomas. Orthopaedic surgeons obtained an MRI with contrast in 47% of cases while only 18% of other surgical services obtained a contrasted MRI which was statistically significant (p=0.013). The most common incorrect diagnoses were hematoma or vascular malformation, cyst and lipoma.

Conclusions:
Orthopaedic surgeons, despite years of education continue to make the mistake of an unplanned resection. Compared to other surgical services, orthopedists are significantly more likely to order the appropriate imaging study but unfortunately still perform unplanned resections. The incidence of these could be improved by increasing education efforts towards the community physicians and referring the patient earlier to a specialized center.
Incremental Direct Imaging Costs Due to Non-Referring Sarcoma Patients

Ms. Ana Cecilia Belzarena¹, Michael D’Angelo², David Joyce², Douglas Letson²

¹Orthopedic Oncology Service, Miami Cancer Institute, Miami, United States, ²University of South Florida, Moffitt Cancer Center, , United States

Background:
Soft tissue sarcomas are rare malignancies with unspecific symptoms, thus numerous patients are initially seen at low-volume centers and may undergo inappropriate and unnecessary imaging studies. The purpose of this study is to perform a cost analysis of the direct expenses generated due to unnecessary radiology exams patients undertake before reaching specialized care.

Methods:
A retrospective chart review was conducted on patients with soft tissue sarcoma between 01/2013 and 12/2017 and who did not have any contraindication to obtain a contrasted MRI. Direct costs consisted of the costs for the exam itself and the additional cost of a radiologist interpreting the exam. Unnecessary exams were defined as any exam that was not a radiography or a contrasted Magnetic Resonance Imaging (MRI) study of the area of concern. Results were expressed in American dollars (USD) and as a percentage of the cost of a contrasted MRI, considered the gold standard for such diagnoses.

Results:
This study included 129 patients, the most frequent diagnosis was Undifferentiated Pleomorphic Sarcoma (20.2%), followed by Liposarcoma (18.6%). At least one unnecessary imaging exam was done in 43.4% of the patients with a total of 65 inappropriate imaging studies. This represented a total surcharge of $23,931.9 and a 50.8% increment over the cost of a contrasted MRI. The most frequent inappropriate exams were Computed Tomography scans (38.5%) and Ultrasounds (36.9%). Despite MRI without contrast being the third most frequent exam performed (24.6%) it represented 49.7% of the total incremental costs. The average increment per patient was $427.36 (Range $110.06-1,109.65).

Conclusion:
The incremental costs to the healthcare system derived from inappropriate radiology exams could be easily avoided by early referral of sarcoma patients to specialized cancer facilities with a high volume of patients.
Evaluation of C-reactive protein levels for prognosis assessment in bone and soft tissue tumors - a 13 years retrospective single center study

Ms. Sarah Consalvo, Mr. Florian G.M. Hinterwimmer, Mr. Ulrich Lenze, Mr. Rüdiger Von Eisenhart-Rothe, Ms. Carolin Knebel

Klinikum Rechts der Isar, Munich, Germany

Eleveted CRP levels are common in patients with malignant bone and soft tissue tumors. However, it is unclear if a preoperative elevated serum CRP level may have a prognostic value. The aim of the study was to retrospectively identify in which entities in this single center study an elevated CRP level is associated with a poor survival.

We analyzed the outcome of all patients with histologically confirmed malignant bone and soft tissue tumors from 2004 to 2017, with a total of 771 patients. We included following tumors: Osteosarcoma (OS), Chondrosarcoma (CS), Ewing Sarcoma (ES), Leiomyosarcoma (LMS), undifferentiated pleomorphic Sarcoma (UPS), Myxofibrosarcoma (MFS), Liposarcoma (LS) and sinovial Sarcoma (SS). Histological diagnoses were classified according to the current WHO classification, and reconfirmed by an experienced pathologist specialized in bone sarcoma at our hospital. All patients were followed up at our department every three months during the first two years, every six months during the third to fifth year and in 12-month intervals thereafter. The laboratory data were obtained a week prior to the biopsy or to the first surgical treatment. Pre-operative assessment of CRP was available in 724 patients. The statistical data were performed using SPSS Statistic 25 (IBM). The study was approved by the local ethics committee of the Technical University of Munich (Number 48/20S).

Pearson’s correlation models were performed to evaluate the association between CRP and overall survival. In our bivariable analysis, CRP was associated with survival exclusively in patients with LMS (PCC=0.353, p=0.029), UPS (PCC=0.240, p=0.022), ES (PCC=0.373, p=0.01) and the strongest correlation was found in patients with CS (PCC=0.309, p=0.0004).

We demonstrated that preoperative elevated CRP levels are associated with a poor outcome in distinct sarcoma entities. In LMS, UPS, ES and CS our data gave evidence that preoperative CRP can be a prognostic factor for survival.
The molecular portrait of TSC1/2- mutated vs TSC1/2-wildtype PEComas.

Ms. Lea Holzer1, Mr. Florian Kocher1, Mr Andrew Elliott2, Mr Dietmar Dammerer3, Mr Benjamin Henninger4, Mr. Johannes Lanbach5, Mr. Alexander Perathoner6, Mr. Andrew Rosenberg7, Mrs. Katja Schmitz8, Mr. Martin Thaler9, Mr. Jonathan C. Trent10, Mr. Kai Zimmer1, Mr Andreas Seeber1

1Department of Hematology and Oncology, Comprehensive Cancer Center Innsbruck, Medical University of Innsbruck, Innsbruck, Austria, 2Caris Life Sciences, Phoenix, United States, 3Department of Orthopaedics, Comprehensive Cancer Center Innsbruck, Medical University of Innsbruck, Innsbruck, Austria, 4Department of Radiology, Comprehensive Cancer Center Innsbruck, Medical University of Innsbruck, Innsbruck, Austria, 5Department of Radiotherapy, Comprehensive Cancer Center Innsbruck, Medical University of Innsbruck, Innsbruck, Austria, 6Department of Visceral, Transplant and Thoracic Surgery, Centre for Operative Medicine, Comprehensive Cancer Center Innsbruck, Innsbruck, Austria, 7Department of Pathology and Laboratory Medicine, University of Miami, Sylvester Comprehensive Cancer Center, Miami, United States, 8INNPATH, Institute of Pathology, Innsbruck, Austria, 9Department of Plastic, Reconstructive and Aesthetic Surgery, Comprehensive Cancer Center Innsbruck, Medical University of Innsbruck, Innsbruck, Austria, 10Department of Medicine, University of Miami, Sylvester Comprehensive Cancer Center, Miami, United States

Introduction:
PEComa is a rare mesenchymal neoplasm composed of perivascular epithelioid cells. TSC1/2 mutations occur frequently in PEComas and are linked to the activation of the PI3K-Akt-mTOR pathway. We conducted this study since the molecular landscape and the composition of the tumor microenvironment (TME) of PEComa remains largely inconclusive.

Methods:
Thirty-five PEComa samples were analysed centrally at a CLIA certified laboratory (Caris Life Sciences, AZ, USA). NextGen DNA sequencing (NextSeq, 592 gene panel or NovaSeq, whole-exome-sequencing), whole-transcriptome RNA sequencing (NovaSeq) and immunohistochemistry were performed. Gene expression profiling (GEP) was performed by unsupervised hierarchical clustering. For RNA deconvolution analysis the Microenvironment Cell Populations (MCP)-counter method was used to quantify immune cell populations.

Results:
Within this cohort TP53 (47%), ATRX (32%), TSC1 (11%), TSC2 (29%) and MSH3 (17%) were the most common mutations. Interestingly, TP53 mutations occurred less frequently (25 vs 60%, p=0.055) in TSC1/2-mutated (TSC1/2-mt) compared to TSC1/2-wildtype (TSC1/2-wt) tumors, whereas MSH3 (25%, n=1/4) and ERCC2 (14%, n=2/14) mutations were exclusively observed in TSC1/2-mt cases. All mTOR signalling pathway alterations were mutually exclusive. 33.3% (n=2) of TSC2-mt PEComa showed an upregulation of PIK3-Akt-mTOR pathway activity, while 100% (n=3) of TSC1-mt tumors had lower activity. Deficient mismatch repair and high tumor mutational burden were rare (2.9%, n=1 each) and observed concurrently in absence of PD-L1 expression. Overall, PD-L1 expression was observed in 21.9% (n=7) of patients.

Conclusion:
This study revealed a heterogeneous molecular landscape with a high prevalence of TSC1/2 mutations that were in part associated with transcriptional up-regulation of the PIK3-Akt-mTOR pathway. This might explain why only a part of PEComa patients benefitted clinically when treated with the mTOR inhibitor nab-sirolismus. Additionally, the relatively immune-cold Tumor microenvironment of PEComas we compared with melanomas, suggests increased lymphocyte infiltration may be required to increase the efficacy of immune checkpoint inhibitors for PEComa.
Hemipelvectomy with iliosacral resection in patients with sarcoma – clinical outcome and evaluation of a novel classification system

Mr. Helmut Ahrens¹, Mr. Georg Gosheger¹, Mr. Kristian Nikolaus Schneider¹, Mr. Niklas Deventer¹, Mr. Tymoteusz Budny², Mr. Philipp Dreher², Mr. Wolfgang Hartmann², Mr. Christoph Theil¹
¹University Hospital of Muenster, Department of General Orthopedics and Tumor Orthopedics, Münster, Germany, ²University Hospital of Muenster, Gerhard-Domagk Institute for Pathology, Münster, Germany

Introduction:
The resection and reconstruction of pelvic sarcomas, particularly with sacral involvement, remains a major challenge in orthopedic oncology and there is no universal classification system. This study proposes a novel classification S1-6 for extensive hemipelvectomies with iliosacral involvement and investigates clinical results as well as oncological survival.

Method:
This is a retrospective analysis of hemipelvectomies with iliosacral resections performed at a single center between 2007 and 2019 in patients with sarcoma and included 151 patients in this study. The proposed classification differentiates the extent of iliosacral resection and defines types S1-S6 (S1 resection through the sacroiliac joint, S2 resection through the sacral massa lateralis ipsilateral to the neuroforamina, S3 resection through the ipsilateral neuroforamina, S4 resection through the spinal canal ipsilateral, S5 and S6 contralateral sacral resections). Descriptive statistics and the chi-squared test were performed for categorical variables and the Kaplan-Meier method were used to analyze the clinical outcome and overall survival. The median follow-up amounted to 43 months in survivors.

Results:
The resections were classified as S1 in 17% (25/151), S2 in 46% (70/151), S3 in 22% (33/151), S4 in 11% (17/151), S5 in 3% (4/151) and S6 in 1% (2/151). 25% (38/151) of patients had an external hemipelvectomy with hindquarter amputation. The most common types of tumors were osteosarcoma in 32% (48/151), chondrosarcoma in 27% (41/151), Ewing sarcoma in 22% (33/151), pleomorphic sarcoma in 11% (17/151) and others in 8% (12/151).
15% (24/151) had local recurrence (LR) with S3, S5 and S6 resections showing the highest rate of LR (p=0.038). 31% of patients (47/151) had metastasized diseases and 44% (66/151) of patients died after a median time of 10 months.

Conclusion:
The proposed classification can be used to communicate results more uniformly and compare different surgical and reconstructive approaches in these challenging cases.
Interventional procedures in the treatment of bone and soft tissue tumors: a pictorial review

Nina Softic, Jasminka Igrec, Rupert Horst Portugaller, Hannes Deutschmann, Michael Fuchsjäger

1LKH Univ. Klinikum Graz, Univ. Klinik für Radiologie, Graz, Austria

Background:
Image-guided techniques can be used in a palliative (ablation of metastases) or curative intent (benign bone tumors, single metastasis) or in poor surgical candidates.
In comparison with surgical treatment, percutaneous image-guided techniques have numerous advantages: shorter procedure time, ability to guide the procedure in almost every anatomical plane, no weakening of bone structures, less soft tissue injury, minimal blood loss, general anaesthesia is rarely needed, shorter hospitalization, better tolerated with minimal recovery time, and lower overall cost.

Findings and procedure details:
Tumor ablation is defined as the direct application of chemical or physical therapies to eradicate or substantially destroy a focal tumor.
The principal role of image-guided musculoskeletal tumor ablation lies in the palliative targeted minimally invasive ablation of painful metastases secondary to advanced cancer disease. Also percutaneous ablation may be utilized with curative intent either for benign bone tumors such as osteoid osteomas or for single metastasis in poor surgical candidates.

Based on our clinical practice, following percutaneous techniques will be presented:
- Radiofrequency ablation
- Microwave ablation
- Transarterial embolization

Conclusion:
Percutaneous ablation may be curative in some bone tumors, resulting in significant palliation of pain or other tumor-related symptoms, prevention of morbidity from skeletal related events, including fracture or neurologic compromise, and durable local tumor control.
Pre-operative embolisation provides numerous advantages including shrinkage of tumor volume and bloodless surgical field allowing safe resection, reduction of perioperative haemorrhage, palliation of peri-operative pain and increase in tumor sensitivity to chemotherapy.
Interventional radiology procedures simplify orthopaedic surgeries by reducing complications with reduced morbidity and improving post-operative recovery.
Close interdisciplinary cooperation between interventional radiologist and ortho-oncologist allows for management of advanced oncologic cases which are otherwise considered inoperable, and prevents unnecessary amputations.
The reconstructive role of dermal substitutes after wide excision of soft tissue sarcomas.

Mrs. Benedetta Spazzoli¹, Mr. Marco Focaccia¹, Mrs. Laura Campanacci¹, Mr. Luca Cevolani¹, Mr. Tommaso Frisoni¹, Mr. Davide Maria Donati¹
¹Istituto Ortopedico Rizzoli, Bologna, Italy

Introduction:
Gold standard for the coverage of full-thickness skin defects is autologous skin grafting (ASG). Wide surgical excision for soft tissue sarcoma may leave patients with defects requiring complex reconstructive surgery. If structures such as tendons, capsule or bone are exposed, skin graft frequently fail because of lack of a healthy wound bed and local or free-flap surgery is necessary. Dermal skin substitutes have been applied, recently, as part of the reconstructive ladder as an option between plastic surgery and ASG. Matriderm is a highly porous dermal substitute consisting of a native (non-cross-linked) collagen matrix (collagen types I, III and V) supplemented by an elastin hydrolysate.

Methods:
We conducted a retrospective study of 22 patients treated with Matriderm from 2018 to 2021 in Rizzoli Institute for skin defect after excision of soft tissue sarcoma. Histological diagnosis was myxofibrosarcoma in 8 patients, wide margins were gained in 21, defect dimension were bigger than 10cm in 10 patients, in 9 was between 5cm and 10cm. In two cases, preoperative radiotherapy (RT) was performed; one had RT postoperative. Ten patients had single-stage procedure using 1mm-thickness Matriderm in combination with meshed ASG in the same surgery; twelve had two-stage procedure, 2mm-thickness Matriderm and afterword application of ASG.

Results:
With single-stage procedure, five of ten patients (50%) had complete wound healing in a medium time of 60 days. Among twelve who and two-stage, wound healing was obtained in ten (83,3%) in a medium time of 45 days after second surgery. Medium time between first and second surgery was 35 days.

Conclusion:
Two stage procedure seems to allow for better vascularization of the wound bed in order to ensure the survival of the skin graft. Irradiated wounds showed worst results because of ipovascularity of wound bed, even if the granulation tissue formation is satisfying.
Clinical Outcomes of Patients Treated with Carbon Fiber Nails: An International Study

Mr. Santiago Lozano-Calderon¹, Mr. Zeger Rijs², Mr. Nelson Merchán¹, Mr. Caleb Yeung¹, Ms. Emily Berner¹, Vania Oliveira³, Giuseppe Bianchi⁴, Eric Staals⁴, Debora Lana⁴, Davide Maria Donati⁴, Ortal Segal⁵, Stefano Marone⁶, Raimondo Piana⁶, Simone De Meo⁶, Pietro Pellegrino⁶, Nicola Ratto⁶, Carmine Zoccali⁷, Maurizio Scorlione⁸, Cecilia Tomai⁸, Guido Scoccianti⁸, Domenico Andrea Campanacci⁸, Lorenzo Andreani⁹, Silvia De Franco⁹, Michele Boffano¹⁰, Thomas Cosker¹¹, Varunprasanth Sethurajah¹¹, Manuel Peleteiro Pensado¹², Irene Barrientos Ruiz¹², Esperanza Holgado Moreno¹², Eduardo Jose Ortiz-Cruz¹², Michel Van de Sande¹²

¹Massachusetts General Hospital, Boston, United States, ²Leiden University Medical Center, Netherlands, ³Oporto Hospital Center, Portugal, ⁴Instituto Ortopedico Rizzoli, Italy, ⁵Tel Aviv Sorasky Medical Center, Israel, ⁶Centro Traumatologico Ortopedico, Italy, ⁷Instituto Regina Elena, Italy, ⁸Careggi University Hospital, Italy, ⁹University Hospital of Pisa, Italy, ¹⁰Regina Margherita Children’s Hospital, Italy, ¹¹Oxford University Hospital, England, ¹²La Paz University Hospital, Spain

Introduction:
Hardware in orthopaedics typically consists of the successful use of nails, plates, and screws made from titanium or cobalt-chromium alloys. However, these implants create artifacts on imaging studies. These artifacts have an impact on oncologic follow up and in radiation planning in patients with metastatic bone disease. Carbon fiber implants have become an attractive option for the oncologic patient given their radiolucency. Additionally, their modulus of elasticity is closer to the one from bone when compared to titanium implants. The aim of this study was to evaluate the imaging, indications, and complications from carbon fiber implants, specifically looking at carbon fiber nails.

Methods:
We performed a review of 274 patients involving 11 institutions from around the world who have used carbon fiber nails. Data was collected internationally through Castor EDC.

Results:
141 patients (51%) were females, 132 (48%) were males, and 1 (0.4%) was unknown. The average patient age was 60 years. Of the 283 patients, 133 (47%) had a pathological fracture. 30 (11%) of these patients had a primary musculoskeletal tumor, 181 (66%) had metastatic disease, 14 (5%) had a benign musculoskeletal tumor, 46 (17%) had multiple myeloma, 2 (0.7%) resulted from trauma, and 1 (0.4%) was unknown. Regarding location, 154 patients (56%) received femoral intramedullary nailing, 97 (35%) received humeral intramedullary nailing, and 23 (8%) received tibial intramedullary nailing. 7 (0.3%) implants failed due to structural failure, 1 (0.4%) failed due to infection, and 1 (0.4%) failed due to non-infected wound adhesion.

Conclusion:
Carbon fiber implants are a safe alternative for the treatment of pathologic fractures. Their radiolucency facilitates the use of X-ray, MRI, and CT for surveillance purposes. There is also potential benefit for radiation planning. Implant failure rate and infection rates are low with the use of this technology.
Increased risk of venous thromboembolism with aspirin versus low molecular weight heparin for chemoprophylaxis in patients undergoing surgery for metastatic bone disease

Mr. Santiago Lozano-Calderon, Syed Mohammed Karim, Joseph Schwab, Erik Newman, Kevin Raskin

1Massachusetts General Hospital, Boston, United States

Introduction:
Venous thromboembolism (VTE) is a common adverse event after orthopaedic surgery, and patients with cancer are at higher risk given the hypercoagulable state conferred by malignancy. While there is considerable literature on VTE prophylaxis in elective joint arthroplasty, data comparing VTE prophylaxis regimens in patients undergoing surgery for metastatic bone disease are lacking.

Methods:
Prospective, randomized trial comparing two VTE prophylaxis regimens in adult patients after surgery for pelvic or lower extremity bone metastases: oral aspirin 325 mg daily (ASA) versus subcutaneous enoxaparin 40 mg daily (LMWH). Planned enrollment was 239 patients per treatment arm. Investigation for VTE was based on treating clinicians’ suspicion rather than a pre-defined surveillance protocol. Timing and duration of follow-up were not prescriptive and were at the surgeons’ discretion. The primary outcome was incidence of VTE: deep venous thrombosis (DVT) and/or pulmonary embolus (PE).

Results:
23 patients were randomized: 14 patients to aspirin; 8 patients to LMWH; 1 patient was excluded due to fat embolism during surgery. 19 patients were treated with internal stabilization for femoral metastases, and 3 underwent total hip arthroplasty. No significant differences existed between treatment groups in terms of adjuvant chemotherapy or radiotherapy. In the aspirin group, the primary outcome occurred in 5 patients (35.7%): 3 lower extremity DVTs, 1 upper extremity DVT, and 1 PE. In the LMWH group, the primary outcome did not occur. The trial was stopped early due to the difference in the rate of VTE between treatment groups.

Conclusion:
The rate of VTE after orthopaedic surgery for pelvic and/or lower extremity bone metastases is higher when aspirin is used for prophylaxis versus LMWH. These results suggest that aspirin-based regimens that are commonly used for VTE prophylaxis in non-oncologic orthopaedic surgery should not necessarily be applied to patients undergoing surgery for metastatic bone disease.
Ollier disease: Two Case Reports

Medeine Silene Markevičiūtė², Ms. Vetra Markevičiūtė², Mindaugas Stravinskas¹

¹Lithuanian University of Health Sciences, Kaunas Clinic, Clinic of Orthopedic Traumatology, Kaunas, Lithuania, ²Lithuanian University of Health Sciences, Kaunas Clinic, Clinic of Plastic and Reconstructive Surgery, Kaunas, Lithuania

Introduction:
The disease in which a patient is diagnosed with multiple enchondromas is called Ollier disease or enchondromatosis. The incidence of the disease is 1:100,000. Ollier disease is not inherited, but there is a high risk of transformation into chondrosarcoma, therefore constant monitoring indicated for the patient.

Methods:
A retrospective analysis of 2 clinical cases of patients treated for Ollier disease in the Lithuanian Health Science University’s Kaunas Clinic’s.

Results: 46-year-old man. In 6 years, the patient underwent 7 surgeries and underwent adjuvant chemotherapy 6 courses. In 2015 studies have shown multiple zones of destruction, sclerosis in the distal femur, and increased bone density in the proximal tibia. In January 2016, a biopsy was performed, during which he was diagnosed with high-grade chondrosarcoma. In March 2016, tumor resection and left knee replacement surgery were performed, followed by chemotherapy. After the first surgery, the patient underwent 6 more surgeries in 5 years due to recurrences: 4 limb-preserving surgeries, 1 amputation in the middle third of the thigh, 1 hip disarticulation. Patient died in January of 2021 due to progression of the disease.

The 32-year-old man has been actively treated and followed for 2-years for Ollier’s disease. In 2 years, the patient was hospitalized 7 times, during which 21 surgeries were performed in total, 1 distal phalanx amputation due to chondrosarcoma in the hand, 13 excochleations, most of which were performed with spongioplasty. The left foot was operated 4 times, 1 second toe amputation and 3 excochleations with spongioplasties, the proximal part of the left tibia was operated 3 times, resection for chondrosarcoma and knee endoprosthesis surgery with an oncological prosthesis.

Conclusions:
The risk of transformation from enchondroma into chondrosarcoma during the disease is high. The literature suggests that the risk is 5-50%.
Review of treatment results of bone sarcomas in the Department of Orthopedics and Traumatology of Lithuanian Health Science University’s Kaunas Clinic’s in 2002-2020

Ms. Veta Markeviciute¹, Mindaugas Stravinskas¹
¹Lithuanian University of Health Sciences, Kaunas Clinic, Clinic of Orthopedic Traumatology, Kaunas, Lithuania

Introduction:
Primary bone tumors most commonly originate in the bone and their malignant forms manifest as osteosarcoma, chondrosarcoma, and Ewing’s sarcoma. While these tumors account for less than 1% of all diagnosed cancers, they are associated with significant morbidity and mortality.

Methods:
A retrospective analysis was performed of patients with bone sarcoma treated in the Department of Orthopedics and Traumatology of Lithuanian Health Science University’s Kaunas Clinic’s in 2002-2020. Data analysis was performed using the Stata program, data was considered statistically significant when p<0.05.

Results:
In 2002-2020, 84 patients were treated with a histologically confirmed diagnosis of bone sarcoma: 45 women and 39 men, with a mean age of 46,41 years. Patients were followed-up from surgery for an average period of 48,6(+46,5) months. Osteosarcoma was diagnosed in 28 patients and chondrosarcoma in 45 patients. 11 patients were diagnosed with other bone sarcomas. The most common location was the distal thigh (21 patients) and the lower leg and foot (26 patients). Wide resection was the most common surgery (51 patients), 11 patients underwent primary amputation, and 16 patients underwent amputation during treatment. Local recurrences were diagnosed in 21 patients: osteosarcoma 7, chondrosarcoma 14. Lung metastases were diagnosed in 12 osteosarcoma patients and 13 chondrosarcoma patients. Patient 5-year survival (95%CI) in osteosarcoma – 77,85 54,27/90,25, chondrosarcoma – 71,03 51,98/83,62, patient 10-year survival (95%CI) in osteosarcoma 54,22 25,49/76,02, chondrosarcoma 63, 14 39,74/79,52. Patient 5-year survival with lung metastases (95%CI): osteosarcoma patients 58,67 21,58/83,07, chondrosarcoma patients 38,46 14,05/62,80.

Conclusions:
Wide tumor resection with reconstruction was usually performed - to preserve the limb, amputations were performed only in cases when reconstruction was not possible. Survival in the presence of lung metastases, and 5-year survival in patients with chondrosarcoma is lower compared to osteosarcoma.
Intraoperative radiotherapy in soft tissue sarcomas. Assessment and monitoring of a historic series.

Mr. Fausto González-Lizán¹, Mr. Israel Pérez-Muñoz¹, Ms. Isabel Delgado-Martínez¹, Mrs. María Sanz-Pascual¹, Mr. Raúl Hernanz-de-Lucas¹, Mrs. Teresa Muñoz-Migueláñez¹, Mr. José Domínguez-Rullán¹, Mr. Rafael Colmenares-García¹

¹Ramón Y Cajal Universitary Hospital, Madrid, Spain

Introduction:
Intraoperative radiotherapy (IORT) consists of high dose radiation during surgery, with the aim of improving local control disease and reducing the risk of complications. In this way, the surgical exposure allows high dose of radiation right on the operative field, minimizing the dose on the surrounding healthy tissues. Our aim is to evaluate its complications, and the oncological and functional results of IORT in soft tissue sarcomas (STS).

Material and Methods:
This is retrospective cohort study of 280 patients with STS treated at our institution between 2007 and 2019. We collected demographic data, oncological and functional results and complications. It is stratified in two cohorts: the first one includes surgical treatment plus IORT and EBRT (external beam radiotherapy); the second one surgery plus EBRT.

Results:
There are 280 patients with STS treated by surgery and adjuvant radiotherapy, with or without intraoperative radiotherapy. The Median age is 57, with median follow-up of 60 months. No statistically significant differences in oncological outcomes or complications were observed.

Conclusion:
Treatment of STS is essentially wide margin tumor resection. The use of radiotherapy as an adjuvant in limb preservation surgery is widely developed in the literature. IORT can provide advantages without changing the oncological results and no further complications: dose concentration in the sarcoma bed, protection of noble structures, as well as reducing dose on healthy tissues and total treatment time.
The role of perioperative chemotherapy in primary high-grade extremity soft tissue sarcoma: A risk-stratified analysis using PERSARC

Mrs. Ibtissam Acem1, Ms. Anja Rueten-Budde2, Mr. Dirk Jan Grünhagen1, Mr. Hans Gelderblom2, Mr. Winan Van Houdt1, Mr. Cornelis Verhoef1, Mr. Michiel Van de Sande2

1Erasmus MC Cancer Institute, Rotterdam, The Netherlands, 2Leiden University Medical Center, Leiden, The Netherlands

Introduction:
The level of evidence for perioperative chemotherapy (CTx) in primary soft tissue sarcoma of the extremities (eSTS) is often debated. Recent studies suggested beneficial outcomes of perioperative CTx in a selected group of high-risk patients. Therefore, the aim of this study was to evaluate whether we could identify a group of high-risk patients that may benefit from perioperative CTx based on the predicted PERSARC baseline risk.

Methods:
Patients with primary high-grade eSTS surgically treated with curative intent were included in this retrospective cohort study. The effect of anthracycline and ifosfamide-based CTx was investigated in two risk groups (high-/low-risk) created using the PERSARC prediction tool. The risk groups were defined as a risk lower and higher than the 66% quantile of the predicted 5-year overall survival (OS) distribution of the cohort. The effect of CTx in these risk groups was investigated using a multivariable Cox proportional hazards model.

Results:
This study included 5977 patients with a median follow-up of 4.41 years (95%CI 4.20-4.57). The low-risk group had a predicted 5-year OS of $\geq 75.7\%$ and the high-risk group had a predicted 5-year OS of $< 75.1\%$ at baseline. There was no significant difference in OS between patients who received CTx and patients who did not receive CTx in the low-risk group (HR 0.710; 95%CI 0.434-1.15). However, a significant difference of OS in favor of CTx for high-risk patients was found in the multivariable Cox model with a HR of 0.627 (95%CI 0.480-0.819). The absolute OS difference at 5-year in the high-risk group was 14.9% ($p=0.009$).

Conclusion:
This study did not find a beneficial effect of perioperative CTx on OS in the total population of eSTS patients. However, in a selected group of high-risk patients perioperative CTx may be beneficial. The PERSARC prediction tool could be used to identify these high-risk patients.
Primary and secondary malignant giant cell tumours of bone

Ms. Floortje G.M. Verspoor1,2, Ms. Gitte G.J. Krebbekx2, Ms. Vaiyapuri Sumathi1, Mr. Scott Evans1

1Royal Orthopaedic Hospital, Birmingham, United Kingdom, 2Amsterdam University Centers, Amsterdam, Netherlands

Background:
Giant cell tumours of bone (GCT-B) are rare benign but aggressive tumours, which mostly occur around the epiphysis of long bones. Generally, they affect young adults with a fully-grown skeleton. GCT-B can be locally aggressive and is associated with a significant risk of recurrence. Incidental cases of benign metastatic, primary malignant or malignant transformation of GCT-B are described, however always controversial. At present, we evaluated GCT-B patients to identify these transformations.

Methods:
We retrospectively evaluated 522 patients with potential GCT-B presented at the Royal Orthopaedic Hospital (Birmingham), between January 1985 and August 2013. The malignant cases were reviewed by an experienced musculoskeletal pathologist.

Results:
After exclusion of 14 patients with primary giant cell rich osteosarcoma, 501 patients with histopathological confirmed GCT-B were further evaluated. Overall 12 patients were diagnosed with a malignancy (2.8%), five with primary malignant GCT-B, seven with secondary malignant transformation (n=5 secondary malignant GCT-B, n=2 secondary osteosarcomas). Figure 1.

Three benign cases developed pulmonary metastatic disease (0.6%), on average 38 (IQR 15-53) months after primary diagnosis. Time interval between primary diagnosis and malignant transformation varied; secondary malignant GCT-B occurred after a mean 90 (IQR 8-211) months and secondary osteosarcoma after 18 and 35 years.

Patients with secondary malignant GCT-B lesions were more likely to die of disease (80%) compared to patients with primarily malignant GCT-B lesions (20%) or a secondary osteosarcoma (0%).

Conclusion:
This study confirms benign GCT-B is able to develop benign metastasis and to become secondary malignant in two different histopathological ways; differentiation to malignant GCT-B or to osteosarcoma. These different malignant and/or metastatic forms of GCT-B seem to have different morbidity and mortality characteristics.
Challenges in the orthopedic nursing of tumor patients receiving a tumor prosthesis in the lower extremities

Ms Marina Golemac1, Ms. Müjgan Yılmaz2, Mr Michael Mørk Petersen2
1Rigshospitalet, Denmark

Background:
Bone sarcomas are often localized in the lower extremities, and the surgical treatment is often with tumor prostheses. Giant cell tumors are not categorized as malignant, but they are locally aggressive and will sometimes be treated as bone sarcomas.

Aim:
to evaluate challenges in the nursing aftercare of orthopedic tumor patients receiving a tumor prosthesis in the lower extremities.

Materials and methods:
In a retrospective cohort study, we included 15 patients (F/M=11/4, mean age 42 years (range: 18-72)) treated at Rigshospitalet between 05.11.16 - 01.4.20 with a tumor prosthesis in the lower extremities (proximal femur (n=4), distal femur (n=5), proximal tibia (n=4), femoral shaft or total femur (n=2)) due to Ewing sarcoma (n=3), osteosarcoma (n=5), chondrosarcoma (n=4), giant cell tumor (n=2) or myxofibrosarcoma (n=1). Medical record review with a focus on challenges related to nursing aftercare were performed. One patient had an amputation postoperatively due to arterial thrombosis leaving 14 patients included.

Results:
The mean duration of hospital stay was 13.2 days (range: 5-32). Six patients had neoadjuvant chemotherapy before surgery. Nine patients needed a blood transfusion during surgery and/or postoperatively (SagM n=68, fresh frozen plasma n=26, thrombocytes n=9, human albumin n=3). Four patients had extra supervision from an anesthesiologist due to severe pain, 7 patients needed medication more than 5 times a day besides planned medication. All patients were treated with cefuroxime 1.5g x 3 postoperatively (mean: 8 days, range: 4-22), 3 patients (no. 6, 12, 15) were treated with other antibiotics after termination of cefuroxime, 3 patients (no. 2, 10, 12) had leakage from the surgery wound after 5, 6 and 8 days. The mean days until the first attempt to mobilization to the bed edge were 3.3 days (range: 2-4).

Conclusion:
Orthopedic nurses can help minimize the challenging aspects during hospital stay identified in this study.
Does Bone Grafting Reduce Fracture Risk After Curettage of Atypical Cartilaginous Tumors?

Ms. Gitte G.J. Krebbekx1, Mrs. Felix J. Fris1, Dr. Stein Janssen1, Dr. Gerard R. Schaap1, Dr. Floortje G.M. Verspoor1, Dr. Jos A.M. Bramer1

1Amsterdam University Centers, Amsterdam, Netherlands

Introduction:
Curettage of bone lesions in the treatment of atypical cartilaginous tumors (ACT) may result in a defect which weakens the affected bone. The purpose of this study was to determine the difference in fracture risk between no augmentation and allograft bone graft augmentation of defects after curettage of ACT. In addition, we assessed risk factors for fracture after curettage of these tumors.

Methods:
322 patients after curettage of a histopathological confirmed ACT followed by phenolisation and augmentation were retrospectively reviewed at our tertiary care orthopedic oncology referral center (January 2008- May 2019). Tumor size was documented by musculoskeletal radiologists and the presence of subsequent fracture was radiologically diagnosed during follow-up by the orthopedic oncologist.

Results:
199 (62%) females and 123 (38%) males were included, with a mean age of fifty-six years (range: 17-87). The mean follow-up period was 42.5 months. The majority of the patients received allograft cancellous bone chips (n=203, 62%) or allograft femoral head bone graft (n=77, 24%). The defect was left empty in a smaller group (n=31, 9.8%). Others received cement (n=11, 3.4%), autograft bone (n=4, 1.2%), or DBX putty (n=1, 0.3%). The mean diameter of the lesions was 4.4 (SD: 2.8) cm. No significant result in fracture risk was found between no augmentation and allograft bone chip/graft augmentation after curettage (p=0.102). We did found a higher risk of fracture among men (p=0.035) (Fig. 1), and lesions larger than 3.7 cm (p=0.007) (Fig. 2).

Conclusion:
Results showed no difference in fracture risk based on the type of augmentation. Male patients with a lesion ≥ 3.7 cm appeared to have a higher fracture risk which should be taken into account when performing surgical curettage of ACT.
Outcomes of Distal Radial Endoprostheses: A Single Centre Experience over 15 years

Ms. Rachel Mahoney1, Mr. Vineet Kurisunkal1, Mr. Scott Evans2, Mr. Lee Jeys1
1Royal Orthopaedic Hospital, Birmingham, Birmingham, United Kingdom

Introduction:
Endoprosthetic replacements are widely used for the reconstruction of bone defects following resection of both malignant and benign aggressive bone tumours, however there is limited literature regarding their use in distal radius reconstruction. We report the largest single centre, retrospective study over 15-years, evaluating clinical and functional outcomes following excision of the distal radius and subsequent reconstruction, comparing outcomes in arthrodesis and arthroplasty.

Methods:
Nine patients underwent reconstruction with a distal radius endoprosthesis (DREPR) between 2005 and 2020. Data was collected retrospectively from a prospectively maintained electronic database, and prospectively via telephone patient consultation. Patient ages ranged from 18 to 79 years (mean 46.2), six males and three females, with giant cell tumour of bone the commonest diagnosis. Further surgery was required in six patients, three for implant complications and three for local recurrence. Functional outcomes were evaluated using Musculoskeletal Tumour Society (MSTS) score and Patient Rated Wrist Evaluation (PRWE) at a minimum of 1 year post-operatively.

Results:
Five patients were available for follow-up (range 2.3 – 11 years post-operatively). Two patients had died from metastatic disease, one from unrelated causes and another implant had been amputated for local recurrence. At last follow-up, 8 of 9 patients subjectively reported good function and five patients had returned to work in jobs with a high functional demand. MSTS were available for seven patients; one patient who underwent an amputation and another died of unrelated causes prior to scoring. The mean score was 72% (range 53-90, higher score indicates better outcome) and PRWE scores were available on five patients, with a mean score of 49.9/100 (range 38.5-60, lower score indicating better outcome).

Conclusion:
Distal radius endoprosthetic replacements offer acceptable functional outcomes in our series. A predictable pattern of possible complications can aid discussions with patients regarding either an arthrodesis or arthroplasty reconstruction.
Percutaneous Stabilization of Symptomatic Sacral and Acetabular Column Metastatic Lesions with Photodynamic Nails

Mr. Santiago Lozano-Calderon, Mitchell Fourman, Duncan Ramsey, Erik Newman, Kevin Raskin, Daniel Tobert

Massachusetts General Hospital, Boston, United States

Introduction:
The treatment of symptomatic osteolytic lesions in the pelvis and sacrum is particularly challenging. Current technologies are limited by their non-radio-opaque nature and inability to accommodate curved anatomy. Here we discuss our early experience using photodynamic nails (PDN, IlluminOss®, IlluminOss Medical, Providence RI, USA) to stabilize osteolytic lesions within the acetabular columns and sacroiliac articulation.

Methods:
An IRB-approved retrospective analysis was performed of patients who presented with symptomatic metastatic lesions in their pelvis/sacrum to a large tertiary referral cancer center from 9/1/2020 to 4/1/2021 and underwent PDN with minimum 6-week follow-up. The primary outcome was 6-week pain status, assessed with visual analogue pain score (VAS). PDN were placed using surgical navigation (O-arm, Medtronic, Minneapolis MN, USA) (Figure 1). Supplemental procedures were performed after percutaneous pelvic/sacral stabilization. Mann-Whitney U test was used to compare pre- and 6-week post-PDN VAS. Data are written as mean ± standard deviation (median) or proportions as needed.

Results:
A total of 24 PDNs were performed on 17 sequential patients. Five supplemental total hip replacements, five femoral intramedullary nails, and one tibial intramedullary nail were also performed on these patients. Mean age was 64.2 ± 7.3 years (70.7 years), eight patients were male (47%), and the mean BMI was 27.6 ± 6.0 (26.0). Mean Age-Adjusted Charlson Comorbidity Index (ACCI) was 10.2 ± 2.0 (10.0). One 90-day mortality occurred for non-cardioembolic reasons. No infections (0%), two postoperative DVTs (11.8%), and one superficial dehiscence requiring OR (5.9%) occurred over a follow-up of 3.1 ± 1.5 months (2.5 months). VAS dropped from 7.1 ± 1.9 (8.0) pre-operatively to 2.5 ± 2.1 (2.5) 6-weeks after surgery (p < 0.0001).

Conclusion:
PDN imparts early pain relief to vulnerable hosts with metastatic lesions of the pelvis and sacrum. We plan to continue using this technique as a component of our standard of practice.
Assessing the Safety and Utility of Wound VAC Temporization of the Sarcoma or Benign Aggressive Tumor Bed Until Final Margins are Achieved

Mr. Santiago Lozano-Calderon, Mitchell Fourman, Duncan Ramsey, Erik Newman, Joseph Schwab, Yen-Lin Chen, Yin Hung, Ivan Chebib, Vikram Deshpande, G. Petur Nielsen, Thomas De Laney, John Mullen, Kevin Raskin

1Massachusetts General Hospital, Boston, United States

Background:
Local recurrence of microinvasive sarcoma or benign aggressive pathologies can be limb- and life-threatening. While frozen pathology is reliable, tumor microinvasion can be subtle or missed, impacting surgical margins and post-operative radiation planning. Our service has begun to temporize the tumor bed following primary tumor excision with a wound VAC pending formal margin analysis, with coverage performed in the setting of final negative margins.

Methods:
An IRB retrospective analysis included all patients managed at a tertiary referral cancer center with VAC temporization after soft tissue sarcoma or benign aggressive tumor excision from 1/1/2000 to 1/1/2019 with at least 2 years of oncologic follow-up. The primary outcome was local recurrence. Secondary outcomes were distant recurrence, unplanned return to OR for wound/infectious indications, thromboembolic events, and tumor-related deaths. Descriptive statistics were performed using Prism 9.0, with data presented as mean ± standard deviation (median, 95% confidence interval) or proportions as indicated.

Results:
Sixty-two patients were VAC temporized. Mean age was 62.2 ± 22.3 years (median 66.5 yrs, 95% CI 61.7 to 72.5), and mean age-adjusted Charlson Comorbidity Index was 5.3 ± 1.9. The most common tumor histology was myxofibrosarcoma (32/62, 51.6%), mean volume was 124.8 ± 324.1 cm³, and 35.5% (22/62) of tumors were subfascial (Table 1). The majority (51.6%) of tumors were AJCC stage IIIA or IIIB, and 46.8% (29/62) were grade 3. Local recurrences occurred in 8.1% (5/62) of patients, of whom 3 had planned positive margins due to the significant comorbidity associated with further soft tissue resection. An unplanned return to the OR was required in 17.7% (11/62) of patients (Table 2).

Conclusions:
VAC-temporized management of microinvasive sarcoma and benign aggressive pathologies yields favorable local recurrence and unplanned OR rates that are suggestive of oncologic and technical safety. This will be validated in a future randomized-controlled trial.
Effect of negative pressure wound therapy after surgical removal of deep-seated high-malignant soft tissue sarcomas of the extremities and trunk wall – study protocol for a randomized controlled trial

Ms. Müjgan Yilmaz¹, Ms. Andrea Thorn¹, Ms. Michala Skovlund Sørensen¹, Mr. Claus Lindkær Jensen¹, Mr. Michael Mørk Petersen¹
¹Rigshospitalet, department of orthopedic surgery, Denmark

Introduction:
Soft Tissue Sarcoma (STS) surgeries are often combined with pre- or postoperative radiation therapy and are high-risk procedures concerning wound complications. A retrospective study [1] showed that Negative Pressure Wound Therapy (NPWT) reduced the risk of wound complications in patients with lower extremity STS and the use of NPWT was not associated with an increased risk of local recurrence.

Methods:
Study design: Prospective RCT (no blinding) where the patients will be randomized to wound closure using staples and NPWT (PREVENA PLUS™ Incision Management System) for 7 days or a conventional wound dressing (Figure 1: enrollment).
Hypothesis: The use of NPWT will result in fewer postoperative wound complications after surgical removal of deep-seated high-malignant STS of the extremities or trunk wall compared to a conventional wound dressing.
Primary study endpoint: A major wound complication defined as in O’Sullivan et al. [2] within 4 months after surgery.
Based upon sample size calculation using previously published data [2] we have decided to include 154 STS patients, 77 in each group, and to make allowance for dropouts we plan to include 160 patients. Approval from the Scientific Ethical Committee (H-21013549) and the Data Protection Agency (P-2021-150) has been obtained and the study is registered at clinicaltrial.gov.
This study did not apply for any external funding.

Discussion:
Many new medical devises and technical solutions are currently introduced and even though some documentation regarding the use of NPWT e.g. in joint replacement surgery exist [3-5] it is also important to seek documentation for this treatment principle in STS surgery.

References
What is The Influence of Negative Pressure Wound Therapy on High-Risk Wounds?

Mr. Motaz AlAqeel1, Mr Amirul Adlan1, Mr. Jonathan Stevenson1, Mr Michael Parry1, Prof Lee Jeys1

1Royal Orthopeadic Hospital, Birmingham, United Kingdom

Background:
Hindquarter amputation (HQA) is known to have a high incidence of postoperative wound complications. We aim to use HQA procedure as a model to investigate the potential advantages of negative pressure wound therapy (NPWT) on wound healing in high-risk surgical wounds.

Questions:
(1) Does the use of NPWT dressing following HQA decrease the incidence of return to operating theatre due to wound complication within 30 days compared to conventional dressing? (2) Does the use of NPWT decrease the total incidence of wound complications compared to conventional dressings?

Methods:
A retrospective analysis of all patients undergoing hindquarter amputation between January 2009 and November 2020 was conducted at a single tertiary center. We compared the incidence of return to operating theatre, wound complications, and local recurrence between the group who received NPWT compared to those without NPWT.

Results:
106 patients were included in the study with a mean age of 52.3 (9-83). 43.4% (46 patients) had NPWT. There was no difference in the reoperation incidence in the patient group who received NPWT and did not have radiotherapy compared to the group with conventional dressings (odds ratio [OR], 1.01; p=0.983, 95% confidence interval [CI], 0.365-2.8). However, the use of NPWT decrease the incidence of reoperation among the patient who had NPWT who had received radiotherapy [OR], 0.087; p=0.033, 95% CI, 0.009-0.818). The incidence of wound complications has declined with increasing use of NPWT between 2009-2020. There was no difference in the incidence of local recurrence at 2 years between patient groups with and without NPWT.

Conclusion:
The application of NPWT should be considered to reduce the incidence of wound complications, especially in high-risk wounds. We had demonstrated a reduction in the incidence of reoperation due to wound complications in patients who received NPWT using HQA procedure as model for high-risk wounds.
The Validity of The Birmingham Atypical Cartilage Tumour Imaging Protocol (BACTIP) to Predict Survival Outcomes and Guide Surgical Decision-Making.

Mr. Motaz AlAqeel\textsuperscript{1}, Mr. Ali Ridha\textsuperscript{3}, Mr. Amirul Adlan\textsuperscript{1}, Mr. Vineet Kurisunkal\textsuperscript{1}, Mr Scott Evans\textsuperscript{1}, Mr. Guy Morris\textsuperscript{2}, Mr. Mark Davies\textsuperscript{1}, Prof Lee Jeys\textsuperscript{1}

\textsuperscript{1}Royal Orthopaedic Hospital, Birmingham, United Kingdom

Introduction:
Central cartilage tumours (CCT) of bone range from the typical benign enchondroma to the unusual chondrosarcoma. While Enchondroma and Grade 1 Chondrosarcoma have little or no metastatic capacity, differentiating between Enchondroma and Grade 1 and Grade 1 from Grade 2 remains challenging. We aim to investigate the validity of the Birmingham Atypical Cartilage Tumour Imaging Protocol (BACTIP) to predict survival outcomes and guide Surgical decision-making.

Methods:
Over a 10-year duration, 216 Patients were identified with a CCT in the proximal humerus, distal thigh, and proximal tibia, who were referred to a single system either from primary/secondary care or tertiary care straight to Royal Orthopaedic Hospital, an expert orthopedic oncology service. The cases were categorized into one of seven types according to the Birmingham Atypical Cartilage Tumour Imaging Protocol (BACTIP). The survival analysis, including (Overall survival, Distant metastasis-free survival, and Local recurrence), type of surgical procedure, and the final histological diagnosis, were analyzed.

Results:
The Median OS was 124 months, and the estimated 5 years OS for the whole group was 85.9%. Increased OS is associated with a lower BACTIP Grade. The 5 years OS was 100%, 92%, and 69% for BACTIP grade1,2 and 3 respectively (P=0.020). The 5 years DMFS for Patients with BACTIP grades 1 and 2 was 100% vs. 77% for Patients with BACTIP grade 3 (P=0.0001). The odds of higher final histological grades significantly increase with ascending BACTIP grades OR (16.3) (P=0.001).

Conclusion:
This retrospective study confirms the BACTIP as a valuable tool in prognosticating the oncological outcome and predicting tumor behavior. The close correlation between the BACTIP grading system and the final histological grade guide physician and patients to make the best surgical decision.
Does Size and Percentage of Dedifferentiated Chondrosarcoma Influence Survival?

Mr. Motaz AlAqeel1, Mr. Koichi Ogura1, Ms. Meera Hameed, Mr. John Healey1, Mr. Patrick Boland1
1Memorial Sloan Kettering Cancer Center, New York, United States

Introduction:
Dedifferentiated chondrosarcoma (DDCS) is a subtype of cartilaginous neoplasm characterized by two distinct components, a low-grade chondrogenic part adjacent to a high-grade non-chondroid sarcoma component. Several studies have shown the influence of various prognostic factors on the overall survival of DDCS. The relationship between the volume, percentage, and dedifferentiated type of DDCS and its influence on overall survival is poorly studied. We, therefore, aimed to 1) evaluate the influence of the tumor volume of the dedifferentiated component on overall survival (OS) and Distant metastasis survival (DMFS).2) to investigate the relationship between the percentage of dedifferentiation of the tumor and OS and DMFS. 3) to assess the influence of the type of dedifferentiation on OS and DMFS.

Methods:
A total of 86 patients were identified to have DDCS. We investigated oncological outcomes, including histology subtypes, percentage of dedifferentiation, size and dimension of the tumor and its dedifferentiated part, and treatment variable include use of chemotherapy, radiotherapy, and the management of the primary tumor.

Results:
Patients with a higher tumor volume of the dedifferentiated part of chondrosarcoma, specifically more than 20mm3, have worst overall survival than patients with a smaller tumor volume. (HR:4.9[95%CI 2.04 to 11.7], P<0.001. Similarly, The overall survival for patients with a higher percentage of dedifferentiation of their tumor >25% is worse than patients with a lower percentage <25% (HR:3.39[95%CI 1.5 to 7.4], P<0.002. There is no difference in overall survival rate between patients with Osteosarcomatious dedifferentiation type vs. patients with Undifferentiated pleomorphic sarcoma (UPS), HR:0.83 (p=0.49).

Conclusion:
While The prognosis for patients with dedifferentiated chondrosarcoma remains poor, the volume and percentage of the dedifferentiated part play an important role in overall survival and Metastatic free survival. The type of dedifferentiated chondrosarcoma does not have an influence on survival outcomes.
Biomechanical Evaluation of a Patient Specific 3D Printed HemiPelvis Implant Used for Surgical Treatment of Pelvic Chondrosarcoma: A Finite Element Analysis

Mr. Ali Kiapour1, Mr. Mohammadjavad Einafshar2, Mr. Patrick Tompsett3, Mr. Kerim Gene3, Mr. Santiago Lozano-Calderon4

1Department of Neurosurgery, Massachusetts General Hospital, Boston, United States, 2Department of Biomedical Engineering, Amirkabir University of Technology, Tehran, Iran, 3Synopsys Inc., Mountain View, United States, 4Department of Orthopedic Surgery, Massachusetts General Hospital, Boston, United States

Introduction:
The advent of 3D printing has dramatically changed the process behind hemipelvectomy, a surgical procedure for the treatment of Pelvic Chondrosarcoma (Woo et al., 2020). With this procedure the patients no longer have to suffer through the drastically low survival rates (27% for five years post-op), acute/chronic pain, and wound complications characterized by more traditional procedures. Rather, patient-specific implants can match patient’s pre-existing anatomy, and allow for osseointegration at bone-implant interface (Xia et al., 2019). Limited studies have focused on biomechanical performance of hemi-pelvis implants. This study evaluated the biomechanical effect of a patient specific 3D printed truss-based Hemipelvis implant.

Methods:
A Finite Element model of the pelvis was built using CT images of the pelvis of a 33-year-old male, originally diagnosed with a low-grade chondrosarcoma in the left pubic bone, and treated with a patient-specific 3D printed hemipelvectomy implant. An intact model of the pelvis was first built by mirroring the 3D geometry of healthy sided of the pelvis wrt. Mid-sagittal plane (Fig. 1). All major anatomical tissues were modeled mathematically using patient’s own data and data reported in the literature. The intact model was then modified to simulate the surgical procedure by instrumentation of the PS hemi-pelviotomy implant. Anatomical loads were applied to the top of sacrum and range of motion across SIJ was compared between intact and instrumented models.

Results:
The AP displacement of the Sacrum reduced from 0.85mm to 0.45mm following the instrumentation. The range of motion at SIJ decreased from 1.85° to 0.9° in Flexion/extension, 0.7° to 0.4° in lateral bending and 1.1° to 0.6° in axial-rotation motion in intact versus instrumented pelvis (Fig. 2).

Discussion:
The patient specie hemipelvectomy implant was able to provide significant stability to the treated segment by reducing the range of motion up to 50% of the intact bone.
BCOR Expression in Synovial Sarcoma Predicts Improved Disease-Free and Overall Survival

Mrs. Ana Larque³, Mr. Santiago Lozano-Calderon¹, Mr. Yin Hung³, Mr. Vikram Deshpande³, Mr. G. Petur Nielsen¹, Mr. Ivan Chebib¹

¹Massachusetts General Hospital and Harvard Medical School, Boston, United States, ²Hospital Clínic de Barcelona, Barcelona, Spain

Introduction:
Synovial sarcoma (SS) is an aggressive soft tissue malignancy characterized by SS18-SSX rearrangement. Recently, BCL6 corepressor (BCOR) has been identified as a fusion partner of a distinct subset of small round cell sarcomas. BCOR is involved in gene silencing through the polycomb repressive complex-1 (PRC1) by histone modification. It is predicted that localization of SS18-SSX to PRC1-complex proteins, which include BCOR, results in parallel colocalization of SWI/SNF-complex proteins associated with the SS18-SSX fusion, thereby averting histone modification and enhancing aberrant gene expression. BCOR expression has been recently described in synovial sarcoma, but the clinical significance of BCOR expression has not been evaluated.

Methods:
A cohort of patients with SS who were treated uniformly at one institution, between 1990-2015, were identified. Tissue microarrays (3-mm cores) were created from formalin-fixed paraffin-embedded tissue blocks of synovial sarcoma. Detailed clinical and pathology data was collected, including survival information. Immunohistochemical staining was performed for BCOR. Nuclear expression was semi-quantitatively scored as: 0-no expression; 1-weak expression; 2-strong expression. BCOR expression was assessed in relation to overall and disease-free survival (Cox proportional hazard model).

Results:
There were 24 patients with SS, 8 females, 16 males (mean age 37 years, sd=15 years, range 12-74 years). For BCOR expression, 14 patients showed no expression (score 0), 8 patients had weak expression (score 1) and 2 patients showed strong expression of BCOR (score 2). Patients with SS expressing BCOR showed improvement in disease free survival compared to synovial sarcoma without BCOR expression (hazard ratio: -1.27, 95% CI [-2.85, 0.31]). Similarly, patients with SS expression BCOR showed improvement in overall survival compared to those without BCOR expression (hazard ratio=-1.41, 95% CI [-3.62-0.79]).

Conclusions:
A subset of SS express BCOR, a potential diagnostic pitfall with other sarcomas harboring BCOR-fusions. BCOR expression in SS is associated with improved disease-free and overall survival.
Ankle Arthrodesis Nail combined with Locking Compression Plate to stabilize two-level pathologic tibial fractures caused by multiple myeloma

Mr. G. Ulrich Exner1, Natasha Forster4, Gerardo J. Maquieira3, Pascal A. Schai2
1Orthopaedie Zentrum Zuerich, Zurich, Switzerland, 2KSL Wolhusen, Wollhusen, Switzerland, 3FussZentrum Hirsladen, Hirsladen, Switzerland, 4SWISSPARC, Zurich, Switzerland

Introduction:
Treatment of fragility fractures of the distal tibia in the elderly is demanding because of osteopenic bone quality, the delicate soft tissue cuff and often critical circulation. We report on a case treated using a retrograde ankle arthrodesis nail.

Patient and Methods:
The 83 year old lady developed a proximal meta-diaphysial tibia periprosthetic fracture through osteolysis caused by plasmacellmyeloma. Stabilizing the proximal fracture zone and prophylactically the distal osteolytic zone was planned using a locking nail fixation. After reaming it was impossible to forward the nail over the isthmus and the proximal fracture only was stabilized with a short plate. The patient could walk painfree for 4 months, then developed incapacitating pain caused by the fragile distal osteolysis with impending fracture. To stabilize the entire tibia the short plate was exchanged to a contured long LCP tibia plate.

Skin necrosis developed distally exposing the tibial tendon with contamination of Pseudomonas aeruginosa. Angioplasty of the Aa. poplitea, tibialis anterior and posterior, resection of the exposed tibialis anterior tendon, repeated débridements, split skin grafting, VAC-treatment, and parenteral antibiotics (Colistin and Zavicefta) led to secondary wound healing and normalization of infective serum parameters. Because of the two-level fracture-instability with persistent periprosthetic pseudarthrosis weight bearing tolerable stabilization of the entire tibial bone was mandatory.

The distal pseudarthrosis was stabilized with a long T2 ankle arthrodesis nail Stryker® and the proximal persistent fracture by an overlapping LCP tibia plate (Fig.). Tibio-talo-calcaneal arthrodesis was omitted to reduce additional soft tissue compromise.

Immediately postoperative the patient was comfortable at rest and having only minimal pain around the hind foot with protected weight bearing using canes. Wounds healed primarily.

Conclusion:
In this patient retrograde nailing proved to be very satisfactory. Tumor cases often present ‘non-standard problems’ and therefore frequently ask for ‘non-standard’ solutions.
DEFINITION AND ASSESSMENT OF QUALITY INDICATORS OF SARCOMA WORK-UP USING A TRANSDISCIPLINARY REAL-WORLD DATA PLATFORM

Mr. Bruno Fuchs, Mr. Philip Heesen, Ms. Gabriela Studer, Ms. Beata Bode, Mr. Stefan Breitstein

Swiss Sarcoma Network, Winterthur, Switzerland

Sarcomas belong to the rare diseases and its management requires a transdisciplinary approach of several disciplines. Overall progress has been rather slow mainly because each single discipline assesses their own data. However, to be able to report on quality, the capacity of assessing real-world data is a prerequisite, as well as to have a common source of definition on the quality indicators of sarcoma work-up (QI).

Methods:
The Swiss Sarcoma Network (SSN) created a real-world data platform by combining the management of the weekly sarcomaboard with the sarcoma registry. This platform allows the collection of patient data, the analysis of each parameter in combination, as well as the validation through patient reported outcomes. The SSN has inaugurated an international advisory board of world renowned sarcoma experts, among others to define 18 QI’s. These 18 QI’s were then programmed into the digital platform such that they can be instantly assessed in real-time. Starting in 2020, the data have been assessed prospectively.

Results:
Our efforts involving numerous institutions throughout Switzerland using a digital platform, to create a real-world data base registry allow now to assess the demographics of all sarcomaboard presentations and patients including all disciplines and decisions instantly in real time. A versatile analysis of all combinations of demographic data as well as QI’s allow the definition of outcome and quality parameters. Benchmarking among involved institutions, as well as on the international level becomes possible. Further, our efforts prove that the definition of QI’s is possible and that these efforts need to be extended for each single discipline possibly throughout the geography. In a next step, PROMS/PROVEs will be included.

Conclusion:
Such real-world data registry with the capacity to report on QI’s paves the way to create a novel ecosystem for sarcoma patient care in the future.
Surgical management of sacral chordoma

Mr. Elmar Musaev, Mrs. Irina Bulytcheva¹, Mr. Nikita Babkin¹, Mr. Eugene Sushentsov¹, Mr. Denis Sofronov¹
¹Moscow City Hospital №62, Moscow, Russian Federation

Introduction:
Sacral chordomas are rare, locally invasive malignant tumors. Despite radical surgical resection local recurrences are common. This study reviews our experience of 90 sacral resections at the N.N. Blokhin National Medical Research Center of Oncology.
The aim of the study to analyze results of sacral resection for sacral chordoma.

Material and methods:
Since 1994 90 patients were operated in N.N. Blokhin National Medical Research Center of Oncology. There were 49 male and 41 female. Nineteen patients were presented with local recurrence and had received treatment elsewhere. In seven cases of recurred chordoma combined sacral and rectal resections were performed. The surgical approach depended on the level and extent of the lesion. Last years in cases with gluteal muscles involvement we used rotation rectoabdominal flap for prevention of wound complication (48 cases).

Results:
En-bloc resection with clear margin was achieved in 51 patients. In other 29 cases nonradical (positive margin or wide/contaminated) resections were performed. Two patients were excluded – 1 patient died from deep wound infection and septicemia, another died from cardiovascular disease 7 months after surgical procedure. At remaining 88 patients local recurrence occurred in 27% cases. All patients with LR received radiation. 18 patients died from progressing of LR. Distant metastases occurred only in 7 patients (5 with LR, 2 without LR). Size and previous treatment significantly increased the local recurrence rate.

Conclusion:
Radical resection should be the treatment of choice for sacral chordomas. Despite aggressive surgical management local recurrences are frequent, especially in very large chordoma.
Treatment of local recurrence of osteosarcoma in children

Mr. Vadym Kobys¹, Mr. Vladymyr Konovalenko¹
¹Kyiv Cancer Centr, Kyiv, Ukraine

Introduction:
The results of treatment of local recurrence of osteosarcoma remain unsatisfactory in terms of cancer and function. The survival rate of such patients is 10-15%, most of the operations are amputations.

Materials and methods:
In the children’s department, from 2011 to 2020, 35 patients with a local form of osteosarcoma and 15 children with a metastatic form of osteosarcoma were treated. In 34 children with the local form and 12 with the metastatic form, organ-preserving surgeries were performed. All children received chemotherapy according to the ISG-1 protocol. 3 with 35 (8.5%) with a local form and 4 with 15 (26.6%) had local relapses of the disease.

Results:
All patients with local recurrence received preoperative chemotherapy. The conditions for carrying out organ-preserving surgery were the possibility of radical removal of the tumor with clean surgical margins. In the group with the local form of osteosarcoma, 31 (88.5%) remain alive, 1 out of 3 with local recurrence. In the group of patients with metastatic osteosarcoma, 7 out of 15 patients (46.6%) remain alive, 2 of them with 4 with local recurrence of the disease.

Conclusions:
Organ-preserving surgery for local recurrence of osteosarcoma is possible if the edges of the wound are kept clean, the function of the limb is preserved, and the disease does not progress with distant metastases.
A Comparison of the Microbiology Profile for 2-Stage revision Surgery in Periprosthetic Joint Infection of Knee Arthroplasty and Lower Limb Endoprostheses for Tumour Surgery

Mr. Robert McCulloch, Dr. Amirul Adlan, Dr. Neil Jenkins, Prof. LeeJeys, Mr. Jonathan Stevenson

1The Royal Orthopaedic Hospital, Birmingham, United Kingdom

Aims:
To compare the patient and microbiological profile of prosthetic joint infection (PJI) for patients treated with 2-stage revision for knee arthroplasty and lower limb endoprostheses for tumour resection and limb salvage.

Methods:
118 patients were treated with 2-stage revision surgery for infected knee arthroplasty and lower limb endoprostheses between 1999 and 2019. Patient host and extremity criteria were categorised according to the MSIS Host and Extremity Staging System. Patient microbiological culture, the incidence of polymicrobial infection and multi-drug resistance (MDR) were analysed.

Results:
74 patients had two-stage revision for PJI of knee arthroplasty and 44 had two-stage revision. There were 68 males and 50 females. The mean age for the arthroplasty cohort and endoprostheses cohort were 70.2 years (50-89) and 36.1 years (12-78) respectively (p<0.01). Polymicrobial infection was reported in 16% (12 patients) from knee arthroplasty PJI and 14.5% (8 patients) in endoprostheses PJI (p=0.783). There was a significantly higher incidence of MDR in endoprostheses PJI, isolated in 36.4% of cultures, compared to knee arthroplasty PJI (17.2%) (p=0.01). Gram-positive organisms were isolated in more than 80% of cultures from both cohorts. Coagulase-negative staphylococcus (CoNs) was the commonest gram-positive organism and E Coli was the commonest Gram-negative organism in both groups.

Conclusion:
Within our study there was a significant increase in MDR pathogens within the oncological group. Oncology patients presented with poorer host and extremity criteria. These factors should be considered when managing this complex patient group, in particular when relating to empirical antibiotic management.
Effectiveness of cyber knife for oligometastatic lung lesions of musculoskeletal sarcoma.

Mr. Taketoshi Yasuda1, Mrs. Kayo Suzuki1, Mr. Kenta Watanabe1, Mr. Masahiko Kanamori2, Mr. Yoshiharu Kawaguchi1
1Department of Orthopaedic Surgery, University of Toyama, Toyama, Japan, 2Department of Human Science 1, University of Toyama, Toyama, Japan

Introduction:
Cyber Knife (CK) is one of the stereotactic radiotherapy and the radiation source is X-ray. Indication for CK of lung metastatic lesions (LML) is 1) lesion diameter within 5 cm, 2) less than 3 lesions, and 3) no other lesions. We have performed CK for LML expecting the same effect as surgical treatment. The purpose of this study is to evaluate the effectiveness of CK for LML of musculoskeletal sarcoma.

Methods:
The study included 8 patients (12 lesions) with LML who underwent CK from 2015 to 2019. The mean age at the time of CK was 68 years. All cases are followed up more than 6 months and the average follow-up period was 22 months (range: 6-40). The histopathological diagnose were UPS in 4, liposarcoma in 2, and others in 2. The irradiation method for 1 lesion was 56-60 Gy/4 fr. Lesions were evaluated by CT every 3 months, and effect was assessed using RECIST at 6 months later and the final observation. The response rate was effective when the effect was more than SD. The effective duration was evaluated by the period until regrowth. Adverse events (AE) were evaluated using CTCAE version 4.0.

Results:
1) Therapeutic effect: Good response was obtained in all cases after 6 months: SD in 2, PR in 7 and CR in 3. The effect was maintained until the final observation and there was no regrowth lesion. 2) AE: During irradiation, arrhythmia was observed in 1. Grade 2 pneumonitis was observed in 1 case after 3 months. It improved with medication. 3) Oncological outcome: There were AWD in 5 and NED in 4.

Conclusion:
In the case of lung oligometastases, CK may be a valuable therapeutic tool without severe AE. Early diagnosis of LML is necessary to match the indications for CK.
Outcomes of Two-Stage Revision for Treating Infected Endoprostheses in Tumour Surgery

Mr. Robert Mcculloch¹, Dr. Amirul Adlan¹, Prof. Lee Jeys¹, Mr. Jonathan Stevenson¹
¹The Royal Orthopaedic Hospital, Birmingham, United Kingdom

Aims:
To report the efficacy of two-stage revision surgery to treat periprosthetic joint infection (PJI) of endoprostheses in orthopaedic oncology and to identify the prognostic factors guiding management

Patient and Methods:
44 patients had two-stage revision surgery to treat PJI between 1999 and 2018. There were 25 males and 19 females (mean age of 36.1 years (range 12-78 years)) at the time of surgery. Surgical site was distal femur (22 patients), proximal femur in (5 patients), proximal tibia (16 patients) and total femur with proximal tibia replacement in 2% (1 patient). The mean follow-up period was 6.9 years (range 0.4 - 19 years).

Results:
Coagulase-negative staphylococcus was the most common microorganism isolated in 21 patients (38.2% of total isolated organisms). Infection was successfully eradicated in 54.5% (24) of the patients during the study period. Polymicrobial infection presented in 18% (8) of the cases. Multi-drug resistance (MDR) organisms presented in 48% (21) patients.

Overall infection eradication for the patients was 95.2% at 2 years (95% CI 89 -100%) and 79% (95% CI 67-93%) at 5 years. 25% (11) of the patients had amputations. There was no difference in the incidence of reinfection recurrence and amputation of patients with silver-coated implants.

Conclusion:
We report a slightly higher rate of infection eradication compared to a previous study at the same centre after two-stage revision surgery for infected endoprostheses. There was no difference in the outcomes reported in our patient group with radiation therapy or with silver-coated implants in our cohort.
Salvage of limb salvage in oncological reconstructions of the lower limb with megaprosthesis: how much to push the boundaries?

Mr. Matteo Innocenti¹, Mr. Francesco Muratori², Mr. Lorenzo Foschi², Mr. Saverio Bartolini², Mr. Maurizio Scorianz², Mr. Guido Scoccianti², Mr. Domenico Andrea Campanacci²

¹AOU-Careggi Florence, Florence, Italy

Introduction:
Megaprosthesis represent the most commonly used limb salvage method after musculoskeletal tumor resections. Nevertheless, they are still burdened by high complication rate, requiring several surgical revisions ending up, not infrequently, in limb amputation. The aims of this study were to evaluate the effect of rescuing the limb with subsequent revisions on complication rates (a), incidence of amputations (b), and whether complications reduce functional outcome after the first surgical revision (c).

Materials and Methods:
We retrospectively reviewed 444 lower limb megaprosthesis implanted for primary musculoskeletal tumors or metastatic lesions, from February 2000 to November 2017. The study was then focused on 59 patients who received at least one revision megaprosthesis surgery. MSTS score was used to assess final functional results. Incidence of complications was calculated. Complication-revision-amputation free survival rates were calculated both at 5 and 10 years of follow-up.

Results:
Complication free survival, revision free survival and amputation free survival at 10 years were 47% and 53%, 61% and 67%, 90% and 86% among all 444 patients and the group of 59 revised patients respectively. The incidence of further complications after the first complication was 26% in the group treated with no subsequent revision surgeries and 51% in the group with at least one revision surgery. We found a trend of inverse linear relationship between the number of complications needing subsequent revision surgeries and the final MSTS.

Conclusion:
The number of further revision surgeries after limb salvage with megaprosthesis increases the incidence of complications. Repeated surgical revisions, in particular after infection, increase the amputation rate. The most frequent causes of failure were structural failures and infections. MSTS score was superior for patients undergoing limb salvage than amputees. However, MSTS progressively decreased with multiple revisions becoming inferior to the functional score of an amputated patient.
Hemipelvectomy with customized surgical guide without navigation.

Mr. Daniel Salgado

1Caser/redsalud/bupa, Santiago, Chile

Introduction: Customized surgical guides have notably improved precision and quality in orthopedic surgery at a low cost and shorter surgical time compared to computer-assisted surgery.

Objective:
to present the planning, surgery and evolution of a hemipelvectomy with customized surgical guide without the use of navigation.

Methods: patient with a history of glassy cells III C1 uterine cervical cancer operated on 2018 treated with brachytherapy, chemotherapy and radiotherapy. She evolves with right hip pain 2019. Study with images shows a mass in the right iliac bone measuring 4.8x2.4x2.6 cms. CT biopsy suggestive of sarcoma. Surgical planning with CT and MRI fine cuts. The images were processed using the anatomy engineering design software (Materialize NV), which allowed generating a three-dimensional model of the pelvis and tumor resection was planned with oncological margins at 3 cm. On this model, a metal cutting guide was designed tailored to the patient, manufactured by 3D printing.

Results: zone 1 right hemipelvectomy with cutting guide without incident. Control CT shows a discrepancy of 2 mm in relation to surgical planning. In 1 year on follow up, patient wandering without the support of canes without complications of an operative wound without sensory or motor deficits. Biopsy confirms sarcoma with tumor margins approximately 3 cm apart.

Conclusion: the use of a metal 3D-printed patient cut guide improves the precision of ostetomies, reproducing the surgical planning at a lower cost and surgical time. However, a more extensive approach must be performed since the guide must have an exact correlation with the anatomy and be fixed with screws to avoid movement due to the oscillation of the saw. More studies are needed to validate this method as a surgical technique and to be able to dispense with surgical navigation.
Impact of Insurance Status on Chondrosarcoma Diagnostic Stage: Implications for Detection and Outcomes

Ms. Ana Cecilia Belzarena¹, Grettel Castro¹, Valerie Fagundo¹, Jacklyn Garcia¹, Pura Rodriguez de la Vega¹, Juan Gabriel Ruiz Pelaez¹, Puja Yatham¹

¹Miami Cancer Institute, Miami, United States

Introduction:
Chondrosarcomas account for approximately 20% of primary bone tumors. An advanced stage at diagnosis is associated with poor prognosis. The purpose of this study is to evaluate the association between insurance status and the stage of chondrosarcoma at the time of diagnosis in the United States.

Methods:
A retrospective comparative (analytical) cross-sectional study was conducted using the SEER database. Patients with Chondrosarcoma of the limbs and pelvis from 2007-2016 were included. A total of 2351 patients were analyzed; 164 patients were excluded due to incomplete information. Variables of interest included insurance status, age, gender, race, ethnicity, marital status, residence, primary site and stage at diagnosis. Possible associations between the different variables were assessed using the chi-square test. All tests were deemed significant at the 0.05 level.

Results:
A total of 2187 patients were included for statistical analysis. The majority were male (58%), ages 31-50 (32%), white (85%), non-Hispanic (85%), married (60%), living in a metropolitan area (90%), and insured (83%). Localized disease was the initial stage in 1213 (55%) patients, 974 (45%) had an advanced stage. The majority of the patients (1883, 86%) had a non-pelvic tumor. Variables with a significant association with a later stage at diagnosis included being older than 65 (p<0.001), male gender (p<0.001) and pelvic location (p<0.001). The unadjusted relative risk (RR) of late stage at diagnoses for the uninsured was 1.25. After adjusting for other variables, the odds of being diagnosed at a later stage is increased by 77% (p=0.01) in uninsured patients.

Conclusion:
Being uninsured increased the chances of a late-stage diagnosis of Chondrosarcoma. Immediate efforts are required to remediate healthcare access disparities in cancer care. This knowledge will hopefully contribute to improve overall detection and outcomes by emphasizing awareness and promoting interventions in patients who are at risk for a late diagnosis.
Custom-Made 3D-Printed Implants after bone tumor resection in pediatric patients: are new technologies able to improve reconstructive option and results?

Mr. Giovanni Beltrami¹, Mr Guido Scoccianti², Mr Domenico Andrea Campanacci², Mr Rodolfo Capanna³

¹Department Pediatric Orthopedic Oncology, Meyer Children Hospital, Florence University, Italy; ²Department Orthopedic Oncology, Careggi Hospital, Florence University, Italy; ³Orthopedic Unit, Pisa University, Italy

Introduction:
Recently, custom-made titanium 3D-printed prostheses have been introduced for limb salvage surgery in adult patients, but their use has not been described in pediatric patients.

Methods:
A series of 11 pediatric patients (mean age 10.8 years; range 2–13) with skeletal tumors, treated with custom made implants for the reconstruction of bony defects is reported. Reconstruction sites were: 4 upper limbs (scapula, humerus, radius); 2 emipelvis; 5 lower limbs (proximal and distal femur, proximal and distal tibia, calcaneus).

Results:
Patients were followed up every 3 months. Functional results were evaluated by the Musculoskeletal Tumor Society Score (MSTS) for upper and lower limbs. The mean follow-up was 25.7 months (range 14–44). Three patients died after a mean of 19.3 months postoperatively—two because of disease progression and the other from a previous malignancy. Three patients experienced complications related to soft tissues. One patient required device removal, debridement, and antibiotic pearls for postoperative infection. Partial osseointegration between grafts and host bone was observed within a mean of 4 months. At the final follow-up, mean MSTS score was 75%.

Conclusion:
Titanium 3D prostheses in pediatric patients may yield biological advantages due to anatomical reconstructions, sparing of growth plate, possible integration with the host bone and also through the use of vascularized flaps, with overall encouraging results.
A hollow, custom-made prosthesis combined with a vascularized flap and bone graft for skeletal reconstruction after bone tumour resection

Mr Giovanni Beltrami1, Mr Domenico Andrea Campanacci2, Mr Marco Innocenti2, Mr Rodolfo Capanna3

1Meyer Children Hospital, Firenze, Florence University, Italy, 2Department Orthopedic Oncology, Careggi Hospital, Florence University, Italy, 3Orthopedic Unit, Pisa University, Italy

Introduction:
While limb-sparing surgery is now possible for more than 75% of patients with bone tumours, wide resection is often required, necessitating bone reconstruction. This paper aims to present a new surgical technique that combines the advantages of a hollow, titanium, custom-made prosthesis and the biological aspects of microsurgical flaps and bone graft

Methods:
From June 2016 to September 2017 at our institution, six consecutive patients with skeletal tumours underwent one-stage reconstructive surgery with concomitant musculo-cutaneous flap and a 3D-printed prosthesis.

Results:
At an average follow-up of 30 months (range: 18–45), no early complications were observed, and no implant removals were needed. One patient experienced a delayed haematogenous deep infection, which healed after surgical debridement. Three patients died of their underlying disease 18, 22, and 23 months after surgery, respectively. All flaps and custom reconstructions were successful, with primary osseointegration at a mean of four months (range: 2–7). Patients’ average Musculoskeletal Tumour Society score was 23.2 (range: 18–28).

Conclusion:
A hollow, custom-made, titanium prosthesis filled with bone graft, used in conjunction with a microsurgical flap, may offer good osseointegration in different anatomic locations, among a patient population with a high risk of infection, pseudarthrosis, and long-term mechanical complications. The surgical technique’s is demanding and time dispending, but advantages are demonstrated. Further studies with longer follow-up periods and larger sample sizes are required to confirm our findings.
Candidate biomarkers for specific intraoperative near-infrared imaging of soft tissue sarcomas

Mr. Zeger Rijs¹, Mr. Naweed Shifai¹, Mr. Peter Kuppen², Mr. Cornelis Sier², Mrs. Judith Bovee³, Mr. Alexander Vahrmeijer², Mr. Michiel Van de Sande¹, Mr. Pieter Van Driel¹

¹Department of Orthopedic Surgery LUMC, Leiden, Netherlands, ²Department of Surgery LUMC, Leiden, Netherlands, ³Department of Pathology LUMC, Leiden, Netherlands

Introduction:
Surgery is the mainstay of treatment for localized soft tissue sarcomas (STS). Curative treatment highly depends on complete tumor resection, as positive margins are associated with local recurrence and prognosis. However, determining the tumor margin during surgery is challenging. Near-infrared fluorescence (NIRF) imaging can facilitate complete resections by visualizing tumor tissue during surgery. This technique is based on fluorescent tracers binding to tumor biomarkers on malignant cells. Unfortunately, STS specific tracers are presently not clinically available. Our aim was to evaluate STS-associated cell surface-expressed biomarkers, which are currently already clinically targeted with monoclonal antibodies for therapeutic purposes, for their use in NIRF imaging of STS.

Methods:
Clinically targeted biomarkers in STS were extracted from the clinical trial databases (EU Clinical Trials Register and clinical trials.gov) and a PubMed search was performed. Data on biomarker characteristics, sample size, percentage of biomarker-positive STS samples, pattern of biomarker expression, biomarker internalization features and previous applications of the biomarker in imaging were extracted. Biomarkers were ranked and selected utilizing a target selection scoring system. Selected targets are evaluated with immunohistochemistry in 20 myxofibrosarcomas and 20 undifferentiated soft tissue sarcomas.

Results:
A total of 97 articles were included. Eleven cell surface-expressed biomarkers were identified from which 7 were selected as potential biomarkers for NIRF imaging: TEM1, VEGFR-1, EGFR, VEGFR-2, IGF-1R, PDGFRα and CD40. Promising biomarkers in common and aggressive STS subtypes are TEM1 for myxofibrosarcoma, TEM1 and PDGFRα for undifferentiated soft tissue sarcoma and EGFR for synovial sarcoma. Preliminary results from immunohistochemical evaluation identify TEM1 as the most promising biomarker for fluorescence guided imaging.

Conclusion:
NIRF imaging can facilitate complete resections by visualizing tumor tissue during surgery. TEM1 is the most promising biomarker for NIRF imaging in myxofibrosarcoma and undifferentiated soft tissue sarcoma.
What are the resection accuracy and guide fitting errors of patient-specific resection guide using 3D printing for bone tumor resections?

Mr. Wanlim Kim1, Mr. Seung Hyun Lee1, Mr. Jong Seok Lee1
1Asan Medical Center, South Korea

Introduction:
An accurate delineation of bone sarcoma in the operation field is challenging because conventional tumor imaging is based on two-dimensional images. This difficulty may lead to measurement errors and inaccurate or unnecessary bone resection. To overcome this shortcoming, we made 3D printing-based rapid prototypes and patient-specific resection guides (PSRG) to identify the exact location of the tumor and to remove it safely with minimal necessary surgical margin. In this study, we aimed to describe our experiences on PSRG for the treatment of bone sarcomas, especially focused on the resection accuracy and guide fitting errors.

Methods:
We retrospectively reviewed 21 bone sarcoma resection cases using a 3D PSRG based on 3D-CT and 3D-MRI. We evaluated resection amount error, guide fitting error, and guide distortion. Resection error was defined as the difference between our planned resection length and resected bone tumor specimen. Guide fitting error was defined as a gap between the guide and the patient’s bone intraoperatively. Guide distortion was defined as a gap between prototype and PSRG after 1 month of the prototype being made. We each categorized these errors into three groups (<1mm, 1-3mm, and >3mm) respectively to evaluate accuracy.

Results:
Maximum resection error was 2 mm. Resection errors in 11 of 21 cases (52%) were less than 1mm and 10 cases (48%) had 1-3mm resection errors. The maximum guide fitting error was 3 mm. Guide fitting errors in 16 of 21 cases (76%) were less than 1mm whereas 5 cases (24%) had 1-3mm errors. Guide distortions in all cases were less than 1mm.

Conclusions:
Our study suggests that a 3D PSRG is helpful to facilitate accurate bone tumor resection as planned. Guide fitting errors and distortion issues were in the acceptable range in most cases.
Accuracy of MRI Scans in Predicting Intraarticular Joint Involvement in High-Grade Sarcomas Around the Knee

Mr. Vineet Kurisunkal¹, Mr Guy Morris¹, Mr Michael Parry¹
¹The Royal Orthopaedic Hospital, Birmingham South, United Kingdom

Introduction:
Intraarticular (IA) tumours around the knee are treated with extra-articular (EA) resection which is associated with poor functional outcomes. We aim to evaluate the accuracy of MRI in predicting IA involvement around the knee.

Materials and Methods:
We identified 92 cases from a prospectively maintained surgical database of high-grade sarcomas around the distal femur that underwent an EA resection after discussion at the multidisciplinary team (MDT) meeting. The majority of cases were tumours arising from the bone and 5 cases from soft tissue. Suspicion of IA disease in 72 cases, 11 cases had an intraarticular pathological fracture, 5 cases with knee effusion, 2 cases had a prior surgical intervention i.e. curettage/intraarticular intervention and 1 case with an osseous metastasis in the proximal tibia. To ascertain the validity of our study, two musculoskeletal radiologists (R1, R2) reviewed the preoperative imaging (MRI) of 63 consecutive cases six weeks apart, identified radiological criteria for intraarticular disease i.e. tumour extension within the suprapatellar pouch, extension along the medial/lateral retinaculum, presence of intraarticular fracture and extension into intercondylar notch, and confirmed findings with final histopathology resection specimens.

Results: 23 cases (36.5%) showed IA disease involvement compared to 40 cases without IA disease (62%). The intraobserver variability of R1 was 0.88 (p < 0.001) compared to R2 with k = 0.313 (p = 0.010). The interobserver variability was k = 0.2455 (p value = 0.014). Knee effusion was found to be the most sensitive indicator of IA involvement with a sensitivity of 91.3%, and high specificity of 97.5% and 100% when combined with intraarticular pathological fracture or disease in Hoffa’s fat pad.

Conclusion: MRI imaging alone remains an unreliable and poorly reproducible method for determining IA tumour involvement and needs to be correlated with clinical signs. In light of our findings, we would recommend EA resections when imaging shows effusion combined with either disease in Hoffa’s fat pad or retinaculum or pathological fractures.

Mr. Vincent Crenn1,2, Mr. Leonard Vezole3, Mr. Amine Bouhamama3, Mrs. Alexandra Meurgey3, Mrs. Perrine Marec-Berard3, Mr. François Gouin4, Mr. Gualter Vaz2
1Chu Nantes, Nantes, France, 2Centre Léon Bérard, Lyon, France

Introduction:
The biopsy is a prerequisite in the diagnosis and evaluation of a musculoskeletal tumor. It is considered that surgical biopsy provides a more reliable diagnosis because it could obtain more tumor material for pathological analysis. However, it is often associated with a significant rate of complications. Imaging-guided percutaneous biopsy is now widely adopted as an alternative to surgical biopsy, and it appears to be minimally invasive with possibly lower complication rates. This study proposes to evaluate the diagnostic yield of the preferred use of percutaneous radio-guided biopsy in a referral center, its accuracy, and complication rate.

Methods:
For this monocentric study, data relating to the biopsy and the histological analysis were extracted from the bone tumor reference center database, where the percutaneous biopsy is discussed as a first-line option. Data analyzes were performed in SPSS to assess diagnostic parameters and associated results.

Results:
196 bone tumors were biopsied percutaneously between 2016 and 2020. They were located in the axial skeleton in 21.4% (42) of cases, in the lower limb in 58.7% (115), and in the upper limb in 19.9% (39) cases; 7.1% (14) were biopsied under ultrasound, and 92.9% (182) under CT-scan. We obtain a Diagnosis yield of 84.7% and a diagnostic accuracy of 91.7% (n=122/133). The overall complication rate of percutaneous biopsies observed was 1.0% (n=2), consisting of two hematomas.

Conclusion:
Percutaneous biopsy by radio-guided drilling performed in a referral center is a safe, precise procedure with a very low complication rate, which avoids the need for open surgical biopsy. The concerted between pathologist, radiologist and clinician work in an expert reference center makes this technique an efficacy choice as a first-line diagnostic tool.
Clinical Outcomes of Patients Treated with Carbon Fiber Plates: An International Study

Mr. Zeger Rijs\textsuperscript{1,} Mrs. Emily Berner\textsuperscript{2,} Mrs. Amber Weekhout\textsuperscript{1,} Mr. Nelson Merchan\textsuperscript{2,} Mr. Santiago Lozano-Calderon\textsuperscript{2,} Mr. Michiel Van de Sande\textsuperscript{1}

\textsuperscript{1}LUMC, Leiden, Netherlands, \textsuperscript{2}Massachusetts General Hospital – Harvard Medical School, Boston, United States of America

Introduction:
Carbon fiber implants are a promising alternative to current implants due to their radiolucency which allows for precise radiation planning and facilitates visualization of local recurrences. Additionally, their biomechanical properties should theoretically enhance bone healing and reduce complication risks. Our aim was to investigate the indications and complications of carbon fiber plates.

Method:
This international multicenter retrospective registry involved 105 patients who have received a carbon fiber plate for different oncologic indications. Plates were used as a mean for fixation after excision and curettage of bone tumors packed with allograft or cement, intralesional resection and curettage with cement packing of metastatic bone lesions and lastly as a mean of fixation of osteoarticular, hemicondylar, intercalary or hemi-intercalary structural allografts used for reconstruction after wide resection of malignant neoplasms.

Results:
66 (63\%) females and 39 (37\%) males with an average age of 40 years were included. The diagnoses were 34 (32\%) chondrosarcomas or atypical cartilaginous tumors, 23 (22\%) benign primary bone lesions, 13 (12\%) osteosarcomas, 11 (10\%) adamantinomas, 8 (8\%) metastasis, 4 (4\%) multiple myelomas, 4 (4\%) soft tissue sarcomas, 2 (2\%) ewing sarcomas, and for 6 (6\%) patients the diagnosis was not reported. Regarding location, 41 (39\%) received a femoral condyl plate, 25 (24\%) received a proximal humerus plate, 25 (24\%) received diaphyseal plate and for 14 patients (13\%) this was not reported. 9 patients (9\%) with benign bone tumors received an autograft, 39 (37\%) received an allograft and 39 (37\%) received cement. Eight (8\%) plates failed due to structural bone or construct failure, 7 (7\%) due to infection and 4 (4\%) due to soft tissue failure.

Conclusion:
CFR-PEEK plates provide a safe and viable alternative for the treatment of bone tumors. Their radiolucency facilitates a better oncological follow up and surveillance while their complication rates are low.
Predictive and prognostic factors in synovial sarcoma: retrospective study of 130 cases

Ms. Olimpia Mani¹, Mr. Lorenzo Andreani¹, Mr. Federico Sacchetti², Mr. Antonio D’Arienzo², Mr. Fabio Cosseddu³, Mr. Rodolfo Capanna³

¹Department of Orthopaedic and Trauma Surgery, Azienda ospedaliero-universitaria pisana, Pisa, Italy, ²Department of Orthopaedic Oncology and Reconstructive Surgery, Azienda Ospedaliero-Universitaria Careggi, Florence, Italy

Synovial sarcoma (SS) is a rare malignant tumor (5-10% of all STT). It usually affects young adults. Long-term prognosis is poor because late recurrences and metastasis are frequent. The aim of this study was to identify independent prognostic factors for local recurrences, metastasis and overall survival.

We retrospectively reviewed 130 patients with SS treated between 1984-2015. The presence of metastases at diagnosis excluded the enrollment. The follow-up was 10 years. We used Kaplan-Meier analysis, log-rank test and Cox regression analysis. Stata software was used for data analysis. The independent variables analyzed (related to local recurrences, metastasis and survival) were: radiotherapy pre and/or postoperative, chemotherapy pre and/or postoperative, margins of surgical excision, dimension of the tumor, anatomical site, local recurrence, unplanned excisions, age, histology.

The oncologic outcome at 10 years FU was: 59% CDF, 16% DOD, 12% AWD, 10% NED RL, 2% NED MS, 1% DOC. There was no statistically significant relationship between variables analyzed and onset of local recurrences. However, tumor dimension >5cm was related to an upward trend of relapses. Moreover, unplanned surgery had local recurrence risk of 30%, in comparison to 17% after planned surgeries. In our experience, CT and RT was no effective in reducing local recurrences and metastases. Adequate surgical margins had a greater impact on prognosis than RT. Tumor dimension >5cm and recurrences were negative prognostic factors on the onset of metastases, while recurrences and metastases were negative prognostic factors on overall survival. Moreover, the trend of the curves showed that high histological grade and the age of patient were determining the prognosis.

Chemotherapy and radiotherapy pre and/or postoperative didn't determine a difference in the incidence of local relapses and metastases compared to adequate surgical treatment alone. Dimension and local recurrences were directly related to metastases onset. Local relapses and metastases worsened the overall survival.
Dedifferentiated chondrosarcoma of the ring finger: a case report of an exceptional surgical treatment and review of literature

Ms. Olimpia Mani¹, Mr. Lorenzo Andreani¹, Mr. Antonio D’Arienzo¹, Mr. Fabio Cosseddu¹, Mr Federico Di Sacco¹, Mr. Rodolfo Capanna¹
¹Department of Orthopaedic and Trauma Surgery, University of Pisa, Italy

The DDCS is a rare highly malignant tumor characterized by two distinct histopathologic components. Diagnosis is insidious and prognosis is poor. Therapy is primarily surgical. It is possible to associate chemotherapy, if the nonchondrogenic component is a responder one. Very few cases of DDCS of the hand were described, therefore few scientific comparisons were possible regarding diagnosis and therapy.

We decided to present a case of DDCS of the fourth-finger of the left hand in a 54-year-old female, presented with a 7 months history of local pain and swelling. No metastases at the diagnosis. Five years earlier she underwent surgery (curettage and grafting) for the treatment of an enchondroma of the same phalanx, relapsed and treated again 1 year before she came to visit us. The peculiarity of this clinical case is the successful use of target therapy and multidisciplinary collaboration.

The patient underwent amputation of the fourth finger on Nov2019. Few months later pulmonary metastases were found and treated with VATS resection and chemotherapy. On March 2020 she had local (V ray) and pulmonary recurrences. The therapeutic strategy included: enrollment of the patient in experimental chemotherapy protocols based on the results of FoundationOne® CDx (IDH2 R172S mutation), thermal ablations of lung metastases and surgery. The patient refused hand amputation. We performed a sub-amputation, keeping the gripper between thumb and index finger. An arthrodesis between scaphoid, trapezius, trapezoid and the second metacarpus were done using the intermediate phalanx of the amputated finger (disease-free at extemporaneous histological examination). Fasciocutaneous gap was reconstructed with a fascial ulnar flap. Actually, the patient is AWD (FU 20 months), with a good gripper functionality of the hand (MSTS score 22/30).

Identifying specific tumor mutations accelerate diagnosis and makes target therapy possible. Suspicion of pathology and multidisciplinary collaboration in referral centers help to improve DDCS prognosis.
Tenosynovial giant cell tumor of the knee joint - Rapid progression in diffuse subtype - A case report

Jasminka Igrec1, Ann-Katrin Kaufman-Bühler1, Mr. Jakob Steiner1
1Division of General Radiology, Department of Radiology, Medical University of Graz, Graz, Austria

Introduction:
Tenosynovial giant cell tumor (TGCT) is a rare, in most cases, benign neoplastic proliferation of the joints, tendons, and bursae. TGCT usually affects young and adolescent patients in the 2nd to 4th decade. The malignant transformation is exceedingly rare, with infrequent reports of distant metastases within the lymphatic system and the lungs. There are two different subtypes: benign, localized type and the more aggressive, diffuse type. Distinctive radiological features can be identified in both forms. Clinically, patients often undergo a prolonged period until diagnosis because of unspecific symptoms upon presentation, including swelling, pain, and joint effusion without a proper history of trauma. Therapeutic options include arthroscopic and open wide resection, radiation synovectomy and immunotherapy, and rarely chemotherapy.

Case Report and annotated pictorial review:
A 17-year-old woman without a trauma history presented to our institution after being referred by the local trauma clinic. She complained about repetitive joint swelling and pain and underwent an MRI of the knee joint. The initial MRI scan showed a contrast-enhancing mass adjacent to the synovial capsule suggestive of TGCT with typical T2*-artifacts. In the period of forty-two months, the patient underwent multiple arthroscopic and open resections with accompanying diagnostic imaging as shown. Histopathologically, the diffuse subtype was confirmed. In addition, in one specimen, lymphatic infiltration was found. Within the next four years, the patient was additionally treated with radiation synovectomy and immunotherapy. Forty-two months after initial presentation with recurring disease and constant pain, the patient underwent proximal lower limb amputation and is free of the disease.

Discussion:
This case shows the importance of clinical-radiological-pathological correlation in detecting aggressive neoplasms within the spectrum of TGCT, hence providing state-of-the-art patient care.
Extensor tendon reconstruction and wrapping the tumor endoprosthesis with polypropylene mesh

Mr. Ümit Burak Alparslan¹, Mr. Osman Emre Aycan², Mr. Muhammed Coskun Arslan¹, Mr. Ahmet Sevencan¹, Mr. Alper Köksal¹
1Baltalimani Bone Diseases Training & Research Hospital, Istanbul, Turkey

Introduction:
Bone tumors are commonly located in the knee region. Polypropylene mesh use in tumor endoprosthetic reconstructions are reported to provide attachment sites for resected muscles, tendons and ligaments, diminish the size of dead space, cover the surface of endoprosthesis. In this study, direct reattachment (DR) and polypropylene mesh (PPM) mediated reattachment methods in extraarticular and proximal tibial reconstructions were compared in terms of functional results.

Materials and Methods:
36 patients (21M, 15F) operated between 2011-2019 with a minimum follow-up of 20 months were evaluated retrospectively. The mean age was 33.2 (range: 11-63). 14 patients were extra-articular resection and 22 were proximal tibial resection. The reconstruction was performed with PPM in 17 patients and DR in 19 patients. Mean operation delay for reconstruction, intra-op bleeding, postop bleeding were noted. Primary and revision reconstructions were noted with time to revision. Complication profiles were evaluated. Flexion and active extension degrees, MSTS scores at last follow-up were evaluated.

Results:
The patients in PPM group have experienced less complications (p=0.023). The PPM reconstruction have delayed the surgery time with mean 33 minutes. The mean flexion was 102.4 degrees in PPM, 77.9 in DR. The mean extensor lag in PPM was 11.5 and 28.4 in DR at last follow-up. Early complications (2 months) were significantly higher in PPM group however late complications were higher in DR group (p=0.003). Infection rates in PPM group was lower however no significance was shown (p=0.065). MSTS scores in PPM was significantly higher, amount of intra-op bleeding was lower however no significant post-op bleeding difference was shown. Infection rates were lower in primary reconstructions (p=0.002). Extensor lag was significantly lower in primary reconstruction group (p>0.001).

Conclusion:
Primary reconstructions with PPM have better functional outcomes with less complications. We recommend the reconstruction with PPM in revision patients with DR.
Unicameral bone cysts of proximal femur in skeletally immature patients:

Do radiological parameters, pathological fracture, treatment method and recurrence affect the outcomes?

Mr. Osman Emre Aycan¹, Mr Ozan Kaya¹, Mr Muhammed Coskun ArsLAN¹, Mr Alper Köksal¹, Mr Muhammed Mert¹
¹Baltalimani Bone Diseases Training & Research Hospital, Istanbul, Turkey

Background:
Unicameral bone cysts (UBC) are reported to be the underlying lesion in 40% of pathological femoral neck fractures in skeletally immature patients. The purpose of this study was to assess natural history of pediatric proximal femoral unicameral bone cyst, risk factors for pathological fracture and recurrence.

Methods: Medical records were retrospectively reviewed of patients with pediatric proximal femoral UBC's who underwent surgery between 2004 and 2018. We included 51 consecutive patients with pediatric proximal femoral UBC (36 impending/15 pathological fracture). The patients were evaluated regarding localization of the UBC and the activity of the cyst. The cyst parameters were measured and the patients were further assessed regarding the presence of pathological fracture and applied treatment. Pathological fracture group were compared to impending fracture group by means of radiological cyst parameters, management options, healing, recurrences and other related complications.

Results:
The most commonly affected localizations were combined involvement of femoral neck and intertrochanteric (n=21)
The mean cyst index was 3.8±1.2. The cyst index was correlated with pathological fractures.(p=0.048) Higher cyst index values were associated with recurrent cases.(p=0.016) The cyst extension below trochanter minor level was found as a risk factor for pathological fractures.(p=0.021) The most common treatment in our series was curettage, graft packing and plate fixation with 27 patients. According to the healing criteria for UBC's at final follow-up, 36 cysts were completely consolidated, 13 were evaluated as incomplete healing and two were persistent. Recurrence rate was high in UBC's at <10 years of age. (p=0.006)

Conclusion:
With age, the proximal femoral cysts relatively migrate to the weight bearing intertrochanteric area, which may inevitably impose a major risk for pathological fractures. Ensuring stability with a plate even in impending fractures of proximal femur may aid early mobilization and faster recovery.
The usefulness of extracorporeal circulation in popliteal-based free fillet lower leg musculocutaneous flap after hemipelvectomy

**Mr Lorenzo Andreani**, Ms. Olimpia Mani, Mr Fabio Cosseddu, Mr. Edoardo Ipponi, Mr. Antonio D’Arienzo, Mr Rodolfo Capanna

1Department of Orthopaedic and Trauma Surgery, University of Pisa, Italy

Free fillet lower leg flap is a technique described for the first time in 1930. It appeared useful in large hemipelvectomy defect when common flap, such as anterior and posterior hemipelvectomy flaps or rectus abdominus flap, were not amenable for closure.

The prolonged ischemia time of the donor tissue is the weak point of these type of reconstruction. We have developed a technique planned by the senior author, never described before, in order to reduce ischemia time.

We present the case of a patient (37 years old, male) with a relapsed radio-induced osteosarcoma arisen on a custom-made hemi-pelvis prosthesis. The patient was treated several years before for Ewing sarcoma of the iliac wing with RT and CT. At the moment of surgery, the prosthesis was completely exposed and the patient presented colostomy due to previous septic peritonitis from intestinal perforation. He refused palliative therapy. Hemipelvectomy was performed, including removal of portion of bladder, one testicle, one kidney with ureter.

The main advantages of this flap were the availability of large quantities of vascularized tissue and no morbidity of the donor site.

The principal disadvantage is the prolonged ischemia time of the donor site. These flaps are requested after complex and long-lasting demolitive surgery. Furthermore, the patient is rotated during demolition making impossible simultaneous two-team approach.

Harvesting the fillet flap firstly and performing oncologic resection allowing perfusion of the already sculpted flap is a method to reduce ischemia (Yamamoto et al.). A two-stage procedure could be another technique (Boehmlier et al.).

We used ECMO for extracorporeal circulation to perfuse with homologue blood and saline solution the free flap based on popliteal vessel containing muscles from posterior compartment of leg.

In our experience extracorporeal circulation is the safest and most effective method to make the flap vital during long-lasting oncologic dissection.
What are Preoperative Risk Factors for Fibrosarcomatous Transformation in Dermatofibrosarcoma Protuberans (DFSP)

Sarah Almubarak, Matthew R. Claxton, Peter C. Ferguson, Mr. Matthew Houdek, Katherine Mallett, Peter Rose, Kimberly Tsoi, Jay S. Wunder

1Mayo Clinic Department of Orthopedic Surgery, Rochester, United States, 2Mayo Clinic School of Medicine, Rochester, United States, 3University Musculoskeletal Oncology Unit, Mount Sinai Hospital, University of Toronto, Toronto, United States

Introduction:
Dermatofibrosarcoma protuberans (DFSP) is a rare soft tissue sarcoma, with a risk of local recurrence, however typically never metastasizes. DFSP can transform into a high-grade fibrosarcoma (DFSP-FS) which has a risk of metastatic disease. Currently treatment for DFSP includes Moh’s surgery (MMS), but is not recommended for DFSP-FS. Often DFSP-FS is not recognized until the final histological diagnosis, and re-excision of previous Moh’s surgery sites can be morbid. As such identifying risk factors for DFSP-FS are important to appropriately manage patients with a MMS or wide local excision (WLE). The purpose of the study was to analyze patients with DFSP and DFSP-FS to identify factors which may suggest DFSP-FS.

Methods:
We reviewed 368 (174 female, 194 male) patients with a mean age of 42±16 years. Of these, 319 (87%) of patients had a history of DFSP and 49 (13%) had a history of DFSP-FS.

Results:
The mean tumor size was 4±3 cm, and 57 (15%) had a history of a painful mass, with 75 (20%) patients reporting the mass rapidly started to grow. Patients with DFSP-FS were more likely to be older (49 vs. 41 years, p<0.01), female (p=0.01) and have larger tumors (6 vs. 4 cm, p<0.01) compared to patients with DFSP. A history of painful mass (OR 2.63, p<0.01) and a rapidly enlarging mass (OR 22.2, p<0.01) were strongly associated with DFSP-FS.

Conclusion:
Since DFSP-FS is often not diagnosed until the final pathology, dermatologist performing MMS should consider referral of older, female patients with larger tumor displaying either rapid tumor growth or a painful tumor for consideration for WLE. Although MMS can provide local tumor control in DFSP, a microscopic margin around DFSP-FS is likely not adequate for tumor control. As such patients who present with a history of these symptoms should be referred for WLE.
DEFINITION OF THE SURGICAL CASE COMPLEXITY IN THE TREATMENT OF SOFT TISSUE TUMORS OF THE EXTREMITIES AND TRUNK

Stefan Breitenstein¹, Annika Frei², Mr. Bruno Fuchs¹,²,³, Pietro Giovanoli³, Philip Heesen², Mario Scaglioni²

¹Sarcoma Service, Cantonal Hospitals Winterthur, Winterthur, Switzerland, ²Sarcoma Service, Cantonal Hospitals Luzern, Luzern, Switzerland, ³University Hospital Zurich, Zurich, Switzerland

Purpose: Herein, we propose a complexity score for soft tissue tumor surgery to compare the complexity of different soft tissue tumor surgeries which may help to assign soft tissue tumor patients to appropriate treatments.

Method: Based on three pillars, we developed a soft tissue tumor complexity score (SCS-STS). In addition to patient-related factors, also tumor biology and surgery-associated parameters were considered. The SCS-STS was then applied to our sampling group of 711 patients, and the individual scores were calculated for each patient.

Results: The minimal score in SCS-STS was 4, the maximal score 34, the median score 11.2 and the average score 10.0±5.8. The scores of patients with malignant diagnoses (17.2±4.4) were noticeably higher and more widely scattered than those of patients with benign (6.7±1.8) or intermediate malignant tumors (10.0±3.1). In order to better categorize the complexity of individual surgeries, we established four categories using the collected data as a reference dataset. Each of the categories contained approximately a quarter of the registered patients.

Conclusion: The SCS-STS allows soft tissue tumor surgeries to be retrospectively evaluated for complexity. In addition, we provide a rationale to categorize them. The SCS-STS may establish the basis for the creation of a prospective concept, which makes it possible to provide patients with the right intervention or treatment to the right place, which may lead to better results and improved cost-effective overall treatment.
HOW CAN WE ASSESS THE EXPOSURE OF SARCOMA SURGEON?

Mr. Bruno Fuchs\textsuperscript{1,2,3}, Philip Heesen\textsuperscript{2}, Mario Scaglioni\textsuperscript{2}, Georg Schelling\textsuperscript{2}, Carlo Theus\textsuperscript{2}

\textsuperscript{1}Sarcoma Service, Cantonal Hospitals Winterthur, Winterthur, Switzerland, \textsuperscript{2}Sarcoma Service, Cantonal Hospitals Luzern, Luzern, Switzerland, \textsuperscript{3}University Hospital Zurich, Zurich, Switzerland

Introduction:
Sarcoma surgery is the cornerstone of sarcoma therapy, and a highly transdisciplinary discipline. The critical determinant of success depends on the experience of the MDT, in which the sarcoma surgeon plays a pivotal part. With the advent of personalized treatment and geographic regionalization of care, defining the detailed parameters of a surgical procedure is paramount to ultimately define the complexity of a surgical procedure.

Material & Methods:
A web-based real-world data (RWD-) sarcoma surgeon registry has been created to assess the clinical exposure, tumor characteristics, and surgical settings and surgical techniques for both resections and reconstructions of sarcomas.

Results:
The surgical exposure of one sarcoma surgeon is analyzed over one decade as a pilot. During these 10 years, there were 4459 sarcomaboard/MDT meetings to discuss 2270 patients. A total of 1150 patients underwent 1315 surgical interventions on mesenchymal tumors by one single surgeon. These included 652 deep soft tissue tumors (205 benign, 109 intermediate, 301 malignant, 26 simulator, 7 metastasis, 1 blood, 1 others), 124 superficial soft tissue tumors (46 benign, 16 intermediate, 41 malignant, 18 simulator, 0 metastasis, 1 blood, 2 others) and 539 bone tumors (132 benign, 120 intermediate, 189 malignant, 19 simulator, 47 metastasis, 14 blood). Detailed types of resections and reconstructions are analyzed.

Conclusion:
A web-based RWD-sarcoma surgeon registry with transparent real-time descriptive analytics is feasible and allows large scale definition of the surgical complexity of sarcoma interventions. This will be an indispensable instrument to tailor personalized training for the future sarcoma surgeons.
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