Established in 1871

SMW

Swiss Medical Weekly

Formerly: Schweizerische Medizinische Wochenschrift

Supplementum 204

ad Swiss Med Wkly
2014;144
June 11, 2014

The European Journal of Medical Sciences

Annual meeting of the Swiss Society of Orthopaedics and Traumatology

St. Gallen (Switzerland), June 25–27, 2014

EMH Media
SCHWEIZERISCHER ÄRZTEVERLAG
EDITIONS MEDICALES SUISSES

Supported by the Swiss Academy of Medical Sciences (SAMS), the FMH (Swiss Medical Association) and by Schwabe AG, the long-established scientific publishing house founded in 1488

Official journal of the Swiss Society of Infectious Diseases, the Swiss Society of Internal Medicine and the Swiss Society of Rheumatology

Suppl. 204
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2014;144
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Swiss Medical Weekly
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ISSN printed version: 1424-7860
ISSN online version: 1424–3997

FM1

Effect of muscle weakness and joint inflammation on the onset and progression of osteoarthritis in the rabbit knee

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Introduction: Biomechanical disturbances and joint inflammation are known risk factors, which may provoke or advance osteoarthritis (OA). However, the effect of interactions of such risk factors on the onset and progression of OA are still poorly understood. Therefore, the goal of this study was to investigate the in vivo effects of muscle weakness, joint inflammation, and the combination of these two risk factors, on the onset and progression of OA in the rabbit knee.
Methods: Thirty 1-year-old skeletally mature female New Zealand White rabbits were used in this study. The animals were divided into four experimental groups: (i) surgical transection of the nerve branch of the common femoral nerve leading to the vastus lateralis (VL) muscle; (ii) muscle weakness of the quadriceps muscles induced by a chronic intramuscular injection of Botulinum toxin A (BTX-A); (iii) intraarticular injection in the experimental knee joint with sterile Carrageenan solution (CA) to induce a transient severe inflammatory reaction; (iv) administration of both intraarticular injection of CA and intramuscular injection of BTX-A. In each animal, one hind limb was randomly assigned to the experimental intervention, while the contralateral side acted as its own control. Ninety days following intervention, cartilage histology of the femur, femoral groove, tibia and patella were assessed and microscopically analyzed using the OARSI histology score.
Results: Histologic assessment of the cartilage showed that weakness of the VL resulted in significantly higher OARSI scores in the patella and femoral groove, but not the tibiofemoral articulation. The administration of BTX-A resulted in significant cartilage damage in all four compartments of the knee (patella, femur, tibia, femoral groove). Intraarticular injection of CA did not result in significant cartilage damage in any compartment compared to those of the contralateral knee. The combination of BTX-A and CA resulted in severe cartilage damage in all four compartments. The most severe damage was detected on the medial side of the tibiofemoral joint and the lateral side of the patellofemoral joint.
Conclusion: A transient local inflammatory stimulus alone did not promote cartilage degradation, nor did it overtly enhance cartilage degradation when it was combined with muscle weakness. This result is surprising and adds to the literature the idea that severe but transient inflammation alone may not be an independent risk factor for OA.

FM2

THE INTERACTION BETWEEN ACL GRAFT STRAIN AND GRAFT TUNNEL INCORPORATION: AN EXPERIENCE WITH A SMALL ANIMAL ACL RECONSTRUCTION MODEL

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Introduction: There has been increasing focus on "anatomic" ACL reconstruction to reestablish the ACL femoral footprint. There is evidence that these ACL grafts experience higher in situ forces relative to transtibial ACL grafts with knee motion. A recent study reported differences in terms of revision rates between anteromedial and transtibial grafts, which raises the possibility that different in situ ACL graft forces may affect healing of the ACL graft. The objective of this study is to evaluate the role of ACL graft force on graft-bone tunnel incorporation in a novel rat ACL model.
Methods: 52 Sprague-Dawley rats underwent unilateral ACL resection followed by reconstruction using flexor tendon autograft. The animals were allocated into 2 groups: ACL reconstruction (1) with a "high tension" ACL graft, or (2) with an "isometric" ACL graft. For the "high tension" ACL graft, the femoral tunnel is oriented so that there is an increase in ACL in situ graft force with knee flexion. An external fixator was applied to eliminate ACL graft load during cage activity. Early controlled knee motion was then started on post-operative day #3 where the animal was sedated and the knee was ranged using a computer-controlled mechanized device (ROM 0-90°, 50 complete cycles). Outcomes measured included biomechanical, μ-CT, and histologic analyses at 3 and 6weeks.
Results: The load-to-failure of the femur-ACL graft-tibia complex was higher for isometric ACL grafts than high-tension grafts at 3weeks (9.91 ± 3.36N vs. 5.9 ± 2.75N, $p = 0.04$) and 6weeks (24.16 ± 5.72N vs. 17.84 ± 4.84N, $P = 0.02$). μ-CT demonstrated significant more bone content in isometric femoral graft tunnels than high-tension femoral graft tunnels at both time points. Histologically, there was a greater number of osteoclasts along the graft-bone tunnel interface in high tensioned ACL grafts.
Conclusion: Contemporary anatomic ACL reconstructions may result in improved rotatory knee stability at the expense of higher in situ graft forces. Compared to isometric grafts, ACL grafts that experienced high graft forces had a lower graft pull-out force at both time points in our study. Our results provide some preclinical evidence that higher graft strain may impair graft healing. This data has implications for post-operative rehabilitation, and suggests that traditional ACL rehabilitation regimens may need to be modified when using ACL reconstruction techniques that place higher in situ forces on the ACL graft.

FM3

Heterotopic Ossification and Voluven – An Experimental Study using a Plasma Expander in a Murine Model

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Introduction: Heterotopic ossification (HO) is a frequent complication following both orthopedic and trauma surgery. It may lead to substantial morbidity as many affected patients suffer from severe pain and restriction of joint movement.
Much is yet unknown regarding the exact causes for HO to form. However, it is assumed, that one of the key mechanisms lies in the inappropriate differentiation of pluripotent mesenchymal cells into osteoblastic stem cells. Local tissue hypoxia is believed to hereby influence this differentiation.
Current prophylactic measures include NSAID's and local radiation. However, disadvantages such as delayed fracture healing and impaired ossification as well as other side effects have been reported. For this reason, we set out to search for a new approach for further optimizing HO prevention. Our goal was to influence the environment conducive to heterotopic osteogenesis by optimizing microcirculation and thereby preventing local tissue hypoxia.
Hydroxy-ethyl starch (HES, Voluven®) has been proven to reduce local hypoxia by enhancing tissue oxygen tension and regulation of microcirculation.
Using a murine model, we hypothesized that administration of HES would have an inhibitory effect on HO formation.
Methods: A well-established murine model was used where HO has been shown to reliably reproduce following Achilles tendon tenotomy. Following the procedure, specimens were randomly assigned to a control or treatment group. The treatment group received a total of two intravenous HES injections perioperatively, the control group received tenotomy only. After ten weeks, the mice were euthanized and micro CT scans of the hind limbs were performed. HO was manually identified and quantitatively assessed.
Results: Mean bone volume in the control group was 2,276 mm^3 and 0,271 mm^3 in the HES group respectively. A Mann-Whitney U Test showed a highly significant difference within rank distribution with a benefit for the treatment group compared to the control group ($p = 0.005$).
Discussion: We found a substantial reduction of HO formation following administration of HES. We believe that this simple addition to current prophylactic measures might lead to a more effective prevention of HO in the future.

FM4

Canine Notochordal Cell-Secreted Factors Protect Murine and Human Nucleus Pulposus Cells From Apoptosis by Inhibition of Activated Caspases -9, and -3/7

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Introduction: Effective therapies that may stop or even reverse disc degeneration remain elusive. A minimally invasive method through which nucleus pulposus cell viability could be achieved would revolutionize the treatment of degenerative disc disease.
With the presented work, we have investigated if non chondrodystrophic (NCD) canine disc (IVD)-derived notochordal cell conditioned medium (NCCM) and chondrodystrophic (CD) canine IVD-derived conditioned medium (CDCM) are able to protect murine and human NP cells from apoptosis.
Methods: We developed NCCM and CDCM from hypoxic culture of freshly isolated NPs from NCD and CD canines respectively. We obtained murine NP cells from 9 different C57BL/6 mice and human NP cells from 4 patients who underwent surgery for discectomy. The cells were cultured with aDMEM/F-12 (control media), NCCM or CDCM under hypoxic conditions (3.5% O2) and treated with IL-1β+FasL or Etoposide. All media were supplemented with 2% fetal

bovine serum. We then determined the expression of specific apoptotic pathways in the murine and human NP cells by recording activated caspase-8, and -9 and -3/7 activity.
Results: murine- In the murine NP cells, NCCM inhibits IL-1β+FasL- and Etoposide- mediated apoptosis via suppression of activated caspase-9 and caspase-3/7, CDCM demonstrated an inhibitory effect on IL-1β+FasL mediated apoptosis via caspase-3/7 (fig. 1-A).
human- In the human NP cells, NCCM inhibits Etoposide- mediated apoptosis via suppression of activated caspase-8, caspase-9 and mainly caspase-3/7. CDCM demonstrated an inhibitory effect on Etoposide- mediated apoptosis via suppression of activated caspase-8, caspase-9 and mainly caspase-3/7, though not as effective as NCCM (fig. 1-B).
Conclusion: Soluble factors secreted by the NCD IVD NP strongly protect murine and human NP cells from induced apoptosis via suppression of activated Caspase -9 and -3/-7.
A better understanding and harnessing of the restorative powers of the notochordal cell could lead to novel cellular and molecular strategies for the treatment of DDD.

FM5

In Vitro study of new combinations for local antibiotic therapy with calcium sulphate – Near-constant release of Ceftriaxone offers new treatment options

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Introduction: Antibiotics are commonly applied locally in order to treat bone and joint infections. It allows getting around poor penetration of systemically administered antibiotics, reduces toxicity risks to distant organs and supports the management of dead space left by debridement. However, there lacks a wide antibacterial spectrum and additional operations are needed to remove the carrier material. A larger choice of antibiotics, optimization of release kinetics, and resorbable carrier would be welcome. Calcium sulphate (CaSO4) provides a dissolution time that only slightly exceeds the duration of most antibiotic treatments administered for bone infections and it appears to be compatible with many antibiotics.
Objectives: Evaluate release characteristics, compatibility, stability and antibacterial activity of various antibiotics in combination with CaSO4 as carrier material for local application.
Materials: CaSO4 pellets were manufactured using alpha-hemihydrate, antibiotic powder added to 4% weight, and demineralised water. Excess water was removed by drying in a dessicator. Elution of the antibiotics from these pellets was examined at various time points for up to 6 weeks at 37 °C, once in PBS, and once in bovine plasma. The elution fluid was exchanged daily. Antibiotic concentration was measured by liquid chromatography with tandem mass spectrometry from samples stored at –80 °C. Antimicrobial activity was double-checked with a classical agar diffusion test, using either S. aureus ATCC 25922 or E. coli ATCC 35218 depending on the antibiotic examined.
Results: While piperacillin-tazobactam, ceftazidime, cefepime, and meropenem showed fast reduction of concentration and activity, flucloxacillin and cefuroxime remained present in relevant concentrations for 4 weeks, ciprofloxacin, levofloxacin and clindamycin even for 6 weeks. Initially quinolones were in cell toxic concentrations. The profile of ceftriaxone showed a release with only a small reduction of concentration and activity from 130 to 75 mg/l. Elution profiles from PBS and plasma were comparable
Conclusion: CaSO4 as a resorbable carrier provides new possibilities in the local treatment of bone infections. Ceftriaxone appears to be of particular interest in combination with this carrier material. Not only does it persist at clinically promising concentrations, but also it appears to have a depot-like slow release from calcium sulphate, with only a small reduction in activity and concentration over 6 weeks.

FM6

Influence of locally delivered Zoledronate on the bone quality around screws in an osteoporotic rat model

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Introduction: Due to an increasing aging of the population, more and more old people suffer from low energy fractures resulting from simple falls. Reducing and fixing these fractures can be really challenging, as most of these people have poor bone quality due to the presence of osteoporosis. Bisphosphonates are potent inhibitors of bone resorption and have become the leading systemic osteoporosis treatment in the last years. Local administration of bisphosphonates is a very promising approach to improve fracture fixation in osteoporotic bone.
Aim of the study: We want to improve both the primary and the secondary stability of screws in osteoporotic bone with a degradable drug delivery system.
Materials & Methods: Female Wistar rats are ovariectomized to induce bone loss. 4 weeks later we implant a miniature screw with a bone plug in each femoral condyle. Several treatment groups, differing only by the components of the bone plugs are established. Micro-CT scans evaluate the bone density and confirm the bone loss induced by the ovariectomy. Micro-CT scans realized after the screw implantation evaluate the bone remodelling around the implanted screws. The images obtained are used for a dynamic histomorphometry analysis, a new technique based on the comparison of micro-CT images taken at different time points. After two months the animals are sacrificed, the femurs are dedicated either for histology or mechanical pull-out tests.
Preliminary results: The bone resorption process is probably not stabilized 4 weeks after the ovariectomy, as the micro-CT scans show that all the rats continue loosing bone mass. However, in the Zoledronate group the situation stabilizes. The plugs with Zoledronate express a much more sustained osteoinductive effect in the so far analyzed images.
Discussion: So far nobody investigated more in detail the mechanism of action of locally administered Zoledronate, an information that is essential to optimize the delivery mode as well as the concentration of Zoledronate to be administered. Dynamic histomorphometry should enable us to identify bone resorption and bone formation sites and evaluate the bone remodelling triggered by local Zoledronate release. With this technique, we hope to learn more about how bone formation/resorption is triggered by Zoledronate, a knowledge that is crucial to better understand how locally delivered Zoledronate can improve implant fixation.

FM7

THE USE OF HUMAN PLACENTAL-DERIVED ADHERENT STROMAL CELLS IMPROVES TENDON HEALING IN A PRECLINICAL MODEL OF TENDON INJURY

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Introduction: Due to limitations in tendon healing, cell-based approaches are emerging as a method to improve healing. There is evidence that placental and amnion-derived cells may have application for healing of musculoskeletal tissues. Cells from these tissues have anti-inflammatory properties, and they are an attractive allogenic source of cells because of their relative lack of immunogenicity and availability. Our research objective was to evaluate if the use of human placental-derived adherent stromal cells (hpASCs) can augment tendon healing in a preclinical model of tendon injury.
Methods: Sixty Male Sprague-Dawley rats underwent collagenase-induced patellar tendon injury in both limbs. Six days later, tendons were randomly assigned to receive either an injection of hpASCs (2.0 x 10^6 cells) or saline. Carboxyfluorescein diacetate succinimidyl ester (CFSE) labeling of the placental-derived ASCs for cell viability and RT-PCR for gene expression analysis were performed at 4, 7, 14, and 28 days after injection. Tendon healing was assessed with biomechanical and histological analyses at 1, 2, and 4 weeks.
Results: CFSE-labeled hpASCs were still viable 4 weeks following injection. The hpASCs group demonstrated a significantly higher load-to-failure at 2-weeks following injection when compared to the control group (77.0 ± 10.5 N versus 58.9 ± 12.0 N, p = 0.012). They also had a higher mean load-to-failure (83.7 ± 15.3 N versus 78.2 ± 21.7 N) and stiffness (31.4 ± 6.1 N/mm versus 27.9 ± 6.6 N/mm) at 4-weeks, but this did not reach statistical difference when compared to the control group.
Tendons treated with hpASCs demonstrated higher proteoglycan deposition and collagen birefringence. They also showed greater areas of proteoglycan deposition and collagen content along the insertion sites at 1, 2, and 4 weeks. RTqPCR analysis revealed that the hpASCs may affect tendon healing by altering the levels of inflammatory cytokines following injury, including elevated levels of IL-1β and IL-6.
Conclusions: HpASCs demonstrated the potential to improve the tendon healing response following injury in this preclinical model of tendinopathy. Tendons treated with hpASCs had improved early biomechanical properties as well as tissue histological appearance following collagenase-induced injury. They warrant further clinical investigation as a potential treatment option for tendon injuries.

FM8

Bone formation after implantation of composite grafts with non-expanded adipose tissue derived human vascular fraction cells at an orthotopic implantation site

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The osteogenic potential of the human adipose stromal vascular fraction (SVF), a heterogenous cell population comprising i.a. mesenchymal and endothelial progenitors was demonstrated ectopically after addition of a low dose of osteoinductive growth factor (GF). The present study tests the hypothesis that at an orthotopic site the secretion of GFs after a bone lesion will suffice to induce differentiation in the implanted cells.
SVF cells were isolated from adipose tissue via enzymatic digestion and density gradient isolation. A fibrin gel was then used to cellularize a porous granulated hydroxyapatite carrier. Following animal protection laws ("KVet Basel-Stadt", permission no. 2357) unilateral critical size defects were created in the femora of 18 adult male athymic rats (Crl:NIH-Foxn1mu, Charles River, Germany). In 12 rats (treatment group, cells of 6 donors) cellularized grafts were implanted before angular stable plate fixation with the RatFix system (RISystem AG, Switzerland). In 6 control animals equivalent cell free grafts were used. After 8 weeks in viva femora were taken for histologic and biomechanical analysis. Cells were additionally analysed according to their clonogenicity and surface markers.
SVF cells-loaded constructs led reproducibly to stability of the osteosynthesis, in 4 instances bridging the defect. In 2 cases biomechanical stability similar to those of healthy femora was reached. Histology revealed evidence of bone formation and vascular structures of human origin from 4/6 donors. Implantation of cell free constructs consistently led to pseudoarthrosis and failure of the osteosynthesis without evidence of bone formation, vascularity or the possibility of biomechanical testing. Analysis of surface markers for mesenchymal, endothelial and hematopoietic markers showed a rather homogenous pattern of distribution though without relation to the performance of the respective grafts.
The present study demonstrates that non-expanded SVF cells from human adipose tissue, processed and implanted using a technique compatible with an intra-operative one-step approach, can enhance fracture healing through direct contribution of the osteoblastic and endothelial cell components. The addition of external growth factors does not seem necessary for the induction of differentiation at the orthotopic site. Although no markers predictive of graft performance were identified, the study paves the way for a translation of the approach into a clinical trial.

FM9

Flow cytometry-based cellular phenotyping of the subchondral bone unit

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Introduction: Clinically, it is well established that the subchondral bone tissue undergoes structural changes that contribute to osteoarthritis (OA) disease progression. As the cellular component is thought to be responsible for the structural changes in this tissue, its isolation for direct phenotypical analysis is critical, but technically difficult. Advanced flow cytometry (FACS) techniques have been used to phenotypically characterize and isolate cells from a variety of soft tissues, but not yet bone. The aim of this study is to assess the feasibility of using FACS analysis to characterize differing cell phenotypes present in sclerotic versus non sclerotic OA bone.
Methods: Tibial plateaus were obtained from OA patients undergoing total knee replacement surgery. Plateaus were divided into sclerotic and non-sclerotic sides, stripped down to the subchondral and underlying marrow space (subchondral bone unit) and processed for rapid collagenase digestion (4 hours). Digest medium was then isolated from the remaining undigested bone fragments and directly immunostained for cellular surface markers enabling the identification of specific cell populations.
Results: Regardless of plateau type (sclerotic versus-non sclerotic), 18% of the total particles detected by FACS in the digest medium were identified as being nucleated cells through detection of DAPI staining. The following populations were able to be reliably identified based on their specific surface markers: osteoblasts ($CD45^-/ALP^+/OC^+$), osteoclast progenitors ($CD45^+/CD11b^-/HLA\text{-}DR^-/CD115^+$), macrophages ($CD11b^+/HLA\text{-}DR^+/CD115^+/CD14^+/CD68^+$) and monocytes ($CD11b^+/HLA\text{-}DR^+/CD115^+/CD14^+/CD68^-$). Directly comparing percentages of cells derived from sclerotic versus non-sclerotic regions, the following increases for sclerotic-derived cells were found: phagocytic macrophages (60% more), Osteoblasts (14% more), osteoclast progenitors (6% more).
Conclusion: The subchondral bone units of opposing tibial plateaus from the same osteoarthritic joint harbor phenotypically different populations of cells, as demonstrated by direct FACS analysis of digested bone. Therefore, this study presents for the first time immune-phenotyping of native cells from bone directly after tissue extraction. This proof-of-principle paves the way for direct cell isolation and characterization of specific cell populations active in bone-based diseases.

FM10

Periacetabular Osteotomy Performed Through the Pararectus Approach – A Cadaveric Feasibility Study

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Introduction: The common goal of all surgical approaches for periacetabular osteotomy (PAO) is to provide accurate and adequate exposure for the osteotomies and the reorientation of the acetabulum and at the same time minimize morbidity. While the Pararectus approach had initially been developed for anterior intrapelvic management of acetabular fractures, the purpose of this study was to assess feasibility and safety of this approach for performance of PAO. We proposed to compare fragment mobility and correction potential to a modified Smith-Petersen approach and investigate possibilities for fragment fixation.
Material and Methods: Preoperative CT scans of four cadaver pelves were obtained and three-dimensional models were reconstructed. In a supine position, four Smith-Petersen and four Pararectus approaches were established. Dynamic reference bases were affixed to the pelvis and the acetabulum and the anterior pelvic plane was digitized. The osteotomies were performed either according to the traditional technique or in an inside-out technique for the Pararectus approach. An experimental navigation system was used to assess acetabular version and inclination and to track movement of the acetabular fragment. One single examiner reoriented the acetabulum to a maximum in four degrees of freedom: extension, internal rotation, external rotation and medialization.
Results: The inside-out osteotomies were achieved without intraarticular penetrations or transsection of the posterior column. The median values Pararectus versus Smith Petersen were: extension 21° (range 13 to 27) versus 20° (14 to 32), internal rotation 10° (range 10 to 29) versus 11° (8 to 22), external rotation 33° (range 20 to 37) versus 25° (11 to 44), medialization 12 mm (range 8 to 26) versus 10 mm (8 to 26). Screw fixation through the Pararectus approach was achieved safely in all pelves with one screw into the posterior column, one into the supraacetabular bone stock and another through the superior pubic ramus.
Discussion: Performance of PAO through the Pararectus approach is feasible, allowing for safe extraarticular osteotomies. Management of the acetabular fragment from inside the pelvis yields fragment mobility equal to that of the conventional technique and permits rigid screw fixation. One limitation is the impossibility for anterior hip arthrotomy in cases of concomitant cam impingement.

FM11

FACET JOINT OSTEOARTHRITIS IN LUMBAR SPINAL STENOSIS: HISTOLOGICAL EVALUATION OF CELLULAR PATHOMECHANISMS

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Introduction: Lumbar spinal stenosis (LSS) is a degenerative, age-related narrowing of the lower spinal canal that causes pressure on the nerves, leading to pain and reduced mobility. Osteoarthritic changes to the facet joint are commonly detected using magnetic resonance imaging (MRI). However, the pathomechanisms of facet joint osteoarthritis (OA) at a cellular and molecular level are poorly understood and have been scarcely studied. In this study we sought to investigate the histological features and to uncover cellular pathomechanisms of facet joint OA.
Methods: Fifteen patients undergoing surgical decompression due to degenerative LSS were included in this study. Severity of facet joint OA was assessed in MRI images using the Weishaupt grading system. Tissue morphology was evaluated using histology. The presence of macrophages, blood vessels and nerve fibers was investigated using immunohistological staining for their respective markers CD68, CD34 and PGP9.5. Functional osteoclasts were visualized using tartrate-resistant acid phosphatase (TRAP) staining.

Results: OA was evident in MRI images as evidenced by joint space narrowing, bone edema and cysts and hypertrophy of articular processes. The severe OA phenotype in facet joints from LSS patients was confirmed at a histological level by complete loss of proteoglycan staining, $CD34^+$ vessel penetration, and fissuring of cartilage tissue. In all samples, subchondral marrow spaces contained $CD34^+$ blood vessels and $CD68^+$ mononuclear macrophages. $CD68^+$ multinucleated osteoclasts were detected in resorption pits at the bone surface in 80 percent of the patients. Functionality of osteoclasts was confirmed by positive staining of multinucleated bone cells for TRAP in serial sections. Osteoblast activity was demonstrated in 60 percent of the patients and predominantly characterized by large areas of intramembranous bone formation near the osteochondral junction. Innervation of subchondral marrow by PGP9.5-positive nerve fibers was scarce and exclusively found near arterioles.
Conclusion: Facet joints in LSS patients display radiological and histological features of OA. Two major OA phenotypes can be distinguished based upon cellular pathomechanisms in subchondral bone tissue: 1) osteoblast-rich intramembranous bone formation and 2) osteoclast/macrophage rich remodeling. Imaging modalities using bone-seeking radiotracers (i.e. SPECT/CT) might enable differential diagnosis of facet joint OA subtypes.

FM12

Arthroscopic Suture Retrievers and Suture Shuttles: The Force Required for Tendon Penetration and Residual Defect Size

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Introduction: Numerous instruments and tools for arthroscopic surgery of the shoulder have been designed by different manufactures to improve efficacy and expand the indications for reconstructive arthroscopic surgery. These instruments play an essential role in the success of surgeries and their corresponding clinical outcomes. Based on our observation that certain instruments require higher forces for tendon penetration leading to considerable defects within the tendon or labral complex, we conducted this biomechanical investigation. We also determined the size and pattern of the lesions that are generated due to concerns about iatrogenically provoked tendon substance failure. Instruments were categorized as straight and angled suture retrievers (n = 12) or suture shuttles (n = 9).
Materials and methods: Twenty-one instruments were tested ten times each in thawed sheep infraspinatus tendons. The force applied to pierce the tendon was measured using a specifically designed measurement setup. Bone wax plates were used to image perforation marks and to quantify the lesions each instrument created.
Results: *Force measurement:* The force required to pierce the tendons was from 5.6 N/mm to 18.5 N/mm. The suture retrievers needed a higher force than the suture shuttles (mean ± standard deviation: 9.8 ± 1.3 versus 11.7 ± 4 N/mm, $p > 0.05$). Within the group of suture retrievers, the straight instruments showed significantly lower force required than the angled instruments (8.7 ± 2.9 versus 13.2 ± 3.9 N/mm, $p < 0.05$). Within the group of suture shuttles, there was no significant difference between the force required for straight and angled instruments (9.4 ± 1.3 versus 10 ± 1.4 N/mm, $p > 0.05$). Overall, straight suture retrievers needed the lowest force (8.7 N/mm) and angled suture retrievers the highest (13.2 N/mm, $p < 0.05$).
Lesion Size: We found a range of lesion areas from 2 mm^2 to 7 mm^2. The suture retrievers produced a significantly larger lesion area compared with the suture shuttles (4.9 ± 1.2 versus 3.1 ± 0.8 mm^2, $p < 0.05$). Within the suture retrievers, the straight instruments showed a slightly, but not significantly higher lesion size than the angled instruments (5.1 ± 0.9 versus 4.9 ± 1.4 mm^2, $p > 0.05$). There was also no significant difference between the straight and angled suture shuttles (3.3 ± 0.8 versus 3 ± 0.8 mm^2, $p > 0.05$). The angled suture shuttles showed the smallest lesion area (3 mm^2), while straight suture retrievers showed the largest (5.1 mm^2, $p < 0.05$).
Comparing the designs, straight suture retrievers showed a significantly larger area than straight suture shuttles (5.1 ± 0.9 versus 3.3 ± 0.8 mm^2, $p < 0.05$). Moreover, angled suture retrievers also showed significantly larger lesion areas than angled suture shuttles (4.9 ± 1.2 versus 3 ± 0.8 mm^2 $p > 0.05$).
Conclusion: Instruments designed and used for arthroscopic suture stitching were tested in an experimental setting. There were considerable differences between the tools regarding the force needed for tendon penetration and the size of the hole created. Angled suture retrievers need a higher force to perforate tendons and created larger lesions than suture shuttles did. These differences should be considered in the context of the additional features these tools offer, such as allowing the manipulation of sutures in the joint with the suture retriever. Even though the lesions created in the tendon are usually not visible during surgery, the possible damage created may be mechanically and biologically important.

FM13

The grade of cartilage lesions correlates significantly with bone tracer uptake using SPECT/CT

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Introduction: SPECT/CT is increasingly recognized as important imaging modality in orthopaedics. To date there is growing evidence of the clinical usefulness of SPECT/CT in patients after joint replacement. In contrast there is only little knowledge about SPECT/CT evaluating chondral and/or osteochondral lesions of the knee. The purpose of this study was to investigate the correlation of MRI and SPECT/CT findings in patients with chondral and/or osteochondral lesions of the knee.
Materials and methods: MRI and SPECT/CT images of 63 knees (mean age 49 ± 13 years) were prospectively collected and retrospectively analyzed after approval by the ethical committee. Cartilage lesions were graded in MRI using modified Noyes' grading scale (0 = intact; 1 = fibrillations; 2 = <50% defect; 3 = >50%; 4 = 3+subchondral changes) and measured in two dimensions. 99mTc-HDP-SPECT/CT bone tracer uptake (BTU) was volumetrically quantified using a validated software (Introspect, OrtholmagingSolutions Ltd., London/UK). Maximum values of each subchondral area (patellofemoral/medial and lateral femorotibial) were quantified and ratio was calculated in relation to a reference region in the femoral shaft, which represented the BTU background activity. Grades of cartilage lesions and BTU were correlated using independent t-test and ANOVA. A p value <0.05 was considered statistically significant.
Results: BTU was low (mean relative uptake of 1.82 ± 1.28) in knees without any present cartilage lesion. In knees with grade 3 and 4 cartilage lesions the relative ratio was significantly higher (3.77 ± 2.31; $p < 0.01$) than in knees with grade 0-2 lesions (1.73 ± 1.05). The larger the diameter of the cartilage lesion, the higher the BTU. Lesions larger than 4 cm^2 showed a significant higher BTU than smaller lesions ($p < 0.01$).
Conclusion: SPECT/CT significantly correlates with the degree of cartilage lesion in MRI. Grade 3 and 4 cartilage lesions of the knee joint as well as larger lesions (4 cm2) correlate with a high BTU. Using this information the orthopaedic surgeon is now able to choose a chondral or osteochondral repair strategy.

FM14

A critical analysis of mortality reports as a quality indicator for total joint replacement surgery

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Introduction: The Swiss Health Ministry (BAG) reports regularly on mortality after prosthetic joint replacement in Swiss hospitals. These reports are based on hospital discharge data from the Swiss Federal Statistical Office. The intention is to monitor and improve the quality of high specialized medicine, but the discussion about the reports is also public (among non-specialist) and has a considerable impact on public health politics.
Methods: We analyzed the mortality data for year 2011 as published and free accessible on the homepage of Swiss Ministry of Health, Bern. Only data for knee and hip total prosthetic replacement were extracted from the data set and the names of the hospitals removed. The influence of deaths due to chance on performance of smaller hospital has been studied. The presentation of data as reported by BAG in original plots and the effect of case load on mortality rate after clustering of low volume hospitals has been analyzed. Alternative plots have been designed in order to present the mortality data without distortion in favor of high volume hospitals.
Results: We identified three main factors distorting the results of mortality as presented by BAG. The first factor is the number of deaths in low volume hospitals due to chance. The second factor is amplification of negative effects when expected mortality is applied to correct the observed mortality for comorbidity. The third factor is presentation of mortality data in plots where hospitals without death cases in the observed period are clustered at the baseline. Alternative methods for comorbidity correction and presentation of results are proposed.
Conclusion: The reports on mortality after total knee and hip prosthetic replacement are not suited as quality monitoring tool and should be omitted.

FM15

Injection-induced low-grade infection of the shoulder joint: preliminary results

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Background: Purulent arthritis of the shoulder has been widely reported. Low-grade post-operative infections of the shoulder have also been observed. Low-grade infections of the shoulder without prior surgery have not been reported in the literature. The purpose of this study is to present our experience of 7 patients with low-grade infections of the shoulder without a history of prior surgery.
Methods: We retrospectively reviewed 7 patients, mean age of 45 years, that originally presented with diffuse shoulder pain, with or without stiffness. None had prior surgery but all had prior injections, average 5.6, into the shoulder. All patients were treated with various arthroscopic procedures. All had harvesting of 4 tissue probes identifying low-grade infection. Pre/Post-operative pain score, pre/post operative range of motion, intraoperative findings, post-operative Constant score, Subjective Shoulder Value and pre/post operative radiographs were analyzed. Post-operative antibiotic therapy was recorded.
Results: All patients showed synovitis without pus or any other sign of infection. Propionibacterium acnes were identified in 5, coagulase-negative Staphylococcus in 2, and Staphylococcus saccharolyticus in 1 shoulder. One patient had a mixed infection (Propionibacterium acnes and coagulase-negative Staphylococcus). Therapy consisted of oral antibiotics for 1 to 6 months. Four patients had a satisfactory and 3 an unsatisfactory outcome
Conclusions: Diffuse shoulder pain with or without stiffness in patients without prior surgical history can be caused by low-grade infection. Treatment using oral antibiotics has unpredictable outcomes. Further studies are necessary to analyze this pathology.

FM16

Evaluation of 104 periprosthetic hip joint infections within five consecutive years

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Introduction: Periprosthetic hip joint infections (PHJI) are a severe complication following total hip arthroplasty. They are the second most common reason leading to revision surgery of the hip. PHJI results in significant patient morbidity and is an ongoing challenge for the orthopaedic community. Recently more standardised treatment regimens have been introduced. We present the outcome of 103 patients with a PHJI, with a minimum follow-up period of one year, and analyse the treatment regimen applied.
Materials and Methods: All patients with a proven PHJI (i.e. positive bacterial culture result in intraoperative tissue specimen) treated in our institution, between January 2008 and December 2012, were enrolled in this study. The information was retrieved from the patient- and microbiological information system, as well as the digital radiological system. An independent investigator retrospectively collected and analysed the data.
Results: A total of 104 PHJI met the inclusion criteria. The infections were defined as early (<3 months) in 29%, as delayed (3–24 months) in 36% and as late (>24 months) in 35% of the cases. In 5% we performed a surgical debridement alone, in 18% a debridement with change of the mobile parts, in 20% a one-stage exchange, in 44% a two-stage exchange and in 13% a Girdlestone procedure without reimplantation. Only 33.3% of the two-stage revisions received a spacer in the interval. The mean interval between explantation and reimplantation was 12.2 weeks. The mean number of revisions after removing the implant was 1.6.
S. aureus and CNS were the most common pathogens, followed by polymicrobial infections. The mean duration of antibiotic treatment was one month iv and three months po.
The overall success rate was 86.2%, defined as no clinical or radiological signs of infection at follow-up >1year (after last surgical intervention). The mean of follow-up was 16.7 months.
Conclusion: PHJI remain a complex condition to diagnose and to treat. The appliance of stratified treatment algorithms facilitates the effort to achieve a good and comparable outcome. In the treatment of chronic PHJI, two-stage revision is a safe option even without the use of spacers.

FM17

Two-stage joint replacement performed early after septic arthritis: first experiences in seven patients

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Introduction: Treatment options for severe septic arthritis are limited. Joint lavage with appropriate systemic antibiotics and arthrodesis are among the options as well as joint replacement after a disease free interval of six months to one year to prevent reinfection. These options unfortunately often come with poor functional outcome for arthodesis or are associated with a long period of pain and disability before joint replacement and a low functional outcome. It is reasonable to think that septic joint arthritis with important joint destruction is almost analogous to prosthetic joint infection. Therefore two-stage arthroplasty with an antibiotic-impregnated cement spacer in the interval might be an option.
Material: We report seven cases of native joint infection (five knees, one hip and one shoulder) treated by removal of the infected articular surfaces, placement of an antibiotic-impregnated cement spacer followed by total joint replacement. The first stage was performed in all patients within 24 weeks after the diagnosis of septic arthritis The second stage was performed in all patients within 6 weeks except for one patient (3 months).
Results: Outcome was successful in all of the seven patients as there was important pain reduction, no infection recurrence and all of the patients showed a satisfying functional outcome at their last follow up!
Conclusions: Most of patients with joint destruction due to infection will sooner or later need surgery and there is no need to prolong the interval between diagnosis and definitive treatment. Two-stage joint replacement provides a safe and early "definitive" treatment of severe septic arthritis and reduces greatly the suffering and pain of patients.

FM18

Outcomes of 10 enterococci's PJI (Prosthetic Joint Infection)

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Backround: Enterococci spp are considered as difficult-to-treat bacteria. We evaluated the outcome of these types of microorganism.
Methods: All the patients hospitalized in CHUV for a PJI were included during the period between 1999 to 2012. PJI was defined as growth of the same microorganism in ≥2 tissue or synovial fluid culture, visible purulence, sinus tract or acute inflammation on tissue histopathology. Outcome analysis was performed at outpatient visits, followed by contacting patients, their relatives and/or treating physicians afterwards.
Results: 10 patients with PJI due to enterococci spp were identified, two with total knee arthroplasty and eight with total hip arthroplaty. The median age was 73.5 (range: 69–81); 50% were women. Meidan hospital tay was 83.3 days (14–198) and patient were followed for a mean of 24.41 months (1.3–114). The primary reason of joint replacement was osteoarthritis (n = 9) and one for traumatic reason. One infection was diagnosed as early, one as delayed and eight as late.
Seven patients underwent a two-stage exchange, two a debridememt without change of mobile parts, and one a Girdlestone. Two patients had to be reoperated to eradicated a persistent infection; one with an amputation and with debridement without change of mobile parts. Eight had a single germ infection and two with multiple microorganisms.
Microbial outcome were good for all the patients but functional were poor for 20% (due to one amputation and one girdlestone).
Conclusion: Enterococcus PJI can lead to serious surgical complication and increase morbidity and mortality.

FM19

Analysis of the yield of a 14 days incubation protocol for tissue biopsies in orthopaedic device-associated infections

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Introduction: Microbiological cultures of tissue samples remain the mainstay for the diagnosis of infection. Prolonging incubation and increasing the number of samples has been proposed to optimize sensitivity of cultures, in order to detect slow-growing bacteria present in orthopaedic implant-associated infections. This study was performed to assess the yield of a 14 days incubation protocol for tissue biopsies from joint replacement and internal fixation device revisions in a general orthopaedic and trauma surgery setting.
Methods: Retrospective analysis of the time to culture positivity of a prospectively collected cohort of cases of orthopaedic and trauma revision surgery from a single institution, where tissue biopsies had been sampled between August 2009 and March 2012. Only the first revision was considered in order to avoid bias through multiple reoperations of aggressive bacteria.
Results: A total of 499 tissue biopsies had been sampled in 117 cases. At least one sample showed microbiological growth in 70 cases (60%). Among these 70 cases, 58 (83%) were classified as infections, whereas 12 (17%) were considered as contaminants. The median time to positivity was 1 day (range 1–10) in case of infection, and 6 days (range 1–11) in case of contamination. Cultures were positive within 7 days of incubation in 56 (96.6%) of the cases of infection.
Conclusion: This study shows a benefit for prolonging microbiological culture incubation up to 7 days, but not beyond. While longer incubation might be of interest in particular situations, where the prevalence of slow-growing and anaerobic bacteria is higher, it does not appear to be productive in this setting of general orthopaedic and trauma surgery.

FM20

Knee arthrodesis with Wichita Fusion Nail® after infected TKA

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Introduction: Knee arthrodesis is an established option for limb salvage after infected total knee arthroplasty (TKA) in case of recurrent infection, soft tissue damage, reduced bone stock or deficient extensor mechanism. Walking after arthrodesis is more efficient and less costly in energy expenditure than above-knee amputation. Surgical technique includes arthrodesis nails, external fixator and plate.
We present our results of knee arthrodesis using the modular Wichita Fusion Nail® in patients with treatment failure after infected TKA.
Methods: Fourteen patients with irretrievably failed TKA because of infection treated with Wichita Fusion Nail® from 2004 to 2012 were retrospectively reviewed to asses fusion rate, time to fusion, complication rate, including new infections, and ambulatory status.
Results: Eleven out of fourteen medical records were available for review. Mean follow-up was 35 months (6–132). Four patients died during follow-up of unrelated cause. At last visit, all patients were walking full weight-bearing on a fused arthrodesis. Mean time to union was 5 months (3–6). Three patients necessitated a re-arthrodesis to get union after a mean of 5 months after the last prcedure. Two patients needed re-operation for wound dehiscence and one for suspicion of late new infection after fusion was acquired, without evidence on deep samples. One patient had sciatic nerve palsy due to stretching during surgery.
Conclusion: Arthrodesis with Wichita fusion Nail® provides satisfactory results in patients with local failure after infected TKA, with 73% primary union rate, and no new infection at last follow-up visit. Although burdened with a high complications rate, it represents an acceptable option for limb salvage in this particular pathology.

FM21

Whole Body MRI In The Diagnosis And Management Of Chronic Recurrent Multifocal Osteomyelitis (CRMO): A Case Series Of 31 Patients

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Introduction: Chronic recurrent multifocal osteomyelitis (CRMO) is a benign and non-infective autoinflammatory bone disorder characterised by multiple and recurrent inflammatory bone lesions. It is often more appropriately termed non-bacterial osteitis (NBO). Commonly diagnosed in children and young adults, patients classically present with insidious onset bone pain, tenderness and swelling. Lesions can occur in any bone, however the clavicle is most frequently affected. No diagnostic criteria exist and management protocols differ between institutions. We manage CRMO with non-steroidal anti-inflammatories (NSAIDs) ± bisphosphonates, with anti-TNF therapy and surgical excision reserved for severe and refractory cases.
Objectives: To assess the role of whole body MRI (WB-MRI) in the diagnosis and management of patients with CRMO.
Methods: Retrospective review of CRMO diagnoses since 2008 at a specialist orthopaedic and metabolic bone disease hospital. Cases were identified from electronic patient records, and clinical information was collated from radiology and histopathology records and individual case notes.
Results: 72 new CRMO diagnoses were identified since 2008. Thirty-one had one or more WB-MRI [mean age 21 years (range 6–53); 10 males, 21 females]. The number of WB-MRI per case ranged from 1 to 5 [median 1.6], and none required bone biopsy. WB-MRI identified multifocal lesions in 25 patients. The clavicle, tibia and femur were most frequently involved. All cases were managed with oral or intravenous bisphosphonates, with none requiring anti-TNF agents or surgical resection.
Conclusions: In the absence of specific diagnostic criteria, WB-MRI in combination with clinical assessment can aid in the prompt diagnosis of CRMO and help monitor response to treatment. WB-MRI avoids the morbidity of bone biopsy and has almost entirely replaced bone biopsy in the diagnosis of CRMO at our institution.

FM22

Worse prognosis in osteosarcoma patients expressing IGF-1 in a tissue microarray

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Introduction: Currently, it is not possible to define osteosarcoma (OS) patients at greatest risk for short survival times. Valuable biomarkers for OS remain barely studied. Insulin-growth factor-1 (IGF-1) has been controversially discussed as a biomarker for OS, but has not been studied as an indicator of prognosis so far. A valuable tool to investigate tumor biomarkers in a large number of tissue samples is a tissue microarray (TMA). Our goal was the investigation of IGF-1 in regard to patient demographics and survival time in OS patients using a TMA.
Materials and methods: Tumor tissue specimens from surgical primary tumor resections were collected from bone tissue of 67 patients with OS. A TMA was set up and sections were stained with anti-IGF-1. Grading was performed in a semi-quantitative manner by two independent investigators who were blinded to clinical information. Kaplan-Meier curves were used to calculate overall patient survival and the log-rank test assessed statistical differences between groups.
Results: We analyzed immunohistochemical expression of IGF-1 in a human OS TMA. Follow up data was available for every patient and the mean clinical follow up time was 98 (range 7 to 213) months. The overall 5-ysr was 73%. Twenty-two (33%) patients stained negatively and 44 (66%) patients stained positively for IGF-1. Kaplan-Meier survival analysis did not show significant differences between groups stratified for gender ($p = .808$) or tumor type ($p = .345$). Significantly shorter survival was seen in patients ≥40 years ($p = .003$), axial tumors ($p = .0008$), local recurrence of the tumor ($p < .0001$), non-responders to chemotherapy ($p = .0007$) and metastasis ($p < .0001$). Significantly shorter survival was also detected with expression of IGF-1 ($p = .007$). The 5-ysr for patients expressing IGF-1 was 63% compared to 92% in patients without expression of IGF-1. Non-responders to chemotherapy, who stained positively for IGF-1 manifested a significantly ($p = .002$) shorter survival. The shortest survival time of 50 ± 10 months ($p < .0001$) was found in patients with metastasis and expression of IGF-1.

Conclusion: OS patients ≥40 years, axial tumor location, non-responders to chemotherapy, local recurrence, metastasis and expression of IGF-1 in primary tumor tissue are prone to significantly shorter survival times. Expression of IGF-1 in primary tumor tissue appears to significantly affect the aggressiveness of OSs and may predict survival time, irrespective of the presence of metastasis.

FM23

Retrospective analysis of three preoperative embolization techniques in patients with vertebral metastases

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Introduction: Embolization between T4 and L5 for metastatic spinal tumors prior to surgery is often performed to reduce intraoperative blood loss. The purpose of this study was to assess the effect and safety of three different preoperative embolization techniques (coil, coil-particles or particles) on intraoperative blood loss in patients undergoing a corpectomy and posterior decompression and stabilization procedure.
Methods: A retrospective analysis of 47 vertebral metastases embolization procedures was performed. In 23 patients, only coils were used for the proximal occlusion of the segmental arteries. Six metastases were embolized distally with particles and 18 patients received a combined embolization with coils and particles. All patients underwent an anterior corporectomy followed by a posterior decompression, instrumentation and fusion. We analyzed intraoperative blood loss compared with the embolization technique and co-variants (tumor, age, gender, tumor location, surgical procedure).
Results: Mean intraoperative blood loss in patients embolized with coils and particles was 4194 ml, compared with 1833 ml in patients embolized with particles and 2967 ml in the coil group. No statistically significant differences between the three groups were detected. Although no statistical significance is given, female patients tend to have higher intraoperative blood loss than males ($p = 0.19$). Metastases located in a thoracic vertebral body tend to bleed more than those located in the lumbar spine ($p = 0.17$).
Conclusion: No statistically significant difference between the three embolization techniques was detected although there is a trend to higher blood loss in the coils and particles group. Our data confirms existing studies concerning the scope of intraoperative blood loss using different embolization techniques. The benefit of coil-particles embolization compared with particles or coils alone embolization is questionable.

FM24

Cryoablation in the management of soft tissue and bone metastases

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Background: Overall survival of cancer patients improved over past decades. Palliative treatment of metastates is important to improve life quality. In an attempt to optimize local control and limit local morbidity, we introduced cryoablation of bone and soft tissue metastases into our practice. Cryoablation consists in freezing (–40°) lesions under CT/US control. It may be combined with fixation of (impending) pathologic fracture and/or cementation of bone metastases. We report preliminary results of cryoabaltion of soft tissue and bone metastases.
Methods: Eight patients suffering from bone and soft tissue metastases treated with cryoablation were retrospectively reviewed to assess impact on pain and local control.
Tumor progression was assessed with radiographs, MRI or PET-CT. Pain was evaluated pre-operatively, immediately after the procedure and in periodic oncologic medical visit.
Results: No complications were recorded. Average follow-up was 5.5 month (1–15). Two patients died of the disease (25%). Five patients (62.5%) declared significant pain reduction immediately after the intervention (24–48h). The remaining patients with unrelieved pain had undergone simultaneous fixation of impending fractures. Six out of 8 patients reported satisfactory pain control at last visit. Four patients (50%) had stable disease at last radiological examination; the remaining four (50%) displayed progressive local disease.
Conclusion: Percutaneous cryoablation seems promising for selected patients with soft tissue and bone metastases. It allows for better pain control and transitory local control of the disease. More studies are necessary to confirm the potential benefits of percutaneous cryoablation in local control and life quality.

FM25

Early loosening of cementless Tumor-Endoprostheses in irradiated bone

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Rationale: Whether uncemented or cemented joint arthroplasty following irradiation is superior is discussed controversially. Our standard in Tumor reconstruction is to use Megaprostheses with cementless fixation. In all three patients with prior irradiation of the bone cementless fixation resulted in early loosening. Following revision with cementation stable fixation could be achieved.
Materials and methods: Patients:
S.R. *1981: At 15 years of age she was treated for an embryonal rhabdomyosarcoma with invasion of the hip joint by neo-adjuvant radiotherapy with 52 Gy followed by resection including part of the acetabulum. At 29 years she developed a rapid femoral head necrosis. Reconstruction was performed with a Pedestal Cup and an Alloclassic shaft (Zimmer®). Loosening of the cone of the Pedestal cup was evident 21 months postoperatively. Revision was performed with a cemented Lumic Prosthesis (Implantcast®), while the stable Alloclassic shaft was left in situ.
H.H. *1935: At 75 years of age the patient was treated for a high grade pleomorphic sarcoma originating in the M. vastus medialis with neo-adjuvant radiotherapy of 50 Gy. An extraarticular en bloc resection of the knee joint was performed and reconstructed with an uncemented MUTARS endoprosthesis. 2 weeks later the tibial shaft showed loosening with cutting anteromedially. It was revised with a longer cemented tibial shaft. At over 2 years f/u the patient is diseasefree with a stable reconstruction.
J.T. *1961: At 43 years of age the patient presented with an epitheloid leiomyosarcoma of the peroneal muscle group, which was resected en bloc followed by radiotherapy with 66 Gy and chemotherapy. No local recurrence, but evidence of lung metastases 16 months and biopsy proven bone metastasis in the distal femur with invasion of the knee joint 2 years later. An extraarticular resection was performed. While the femoral anchorage remained stable, loosening of the tibial component developed after 2 months. Revision was performed with a cemented stem. The reconstruct remained stable until the patient died from systemic metastases 16 months after the last revision.
Conlusion: Fixation of endoprostheses in irradiated bone may be different whether it is mostly trabecular bone or cortical bone. Experience after irrradiation surely is limited. In our series of endoprostheses following irradiation all cementless fixations in trabecular bone became loose quickly, while the cemented revision remained stable.

FM26

Shorter survival time in patients with osteosarcoma expressing MSH2 and MSH6 in a human tissue microarray

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Introduction: Currently, it is not possible to define osteosarcoma (OS) patients at greatest risk for short survival times. Valuable biomarkers for OS remain barely studied. Recently, soft tissue sarcomas have been linked to a deficiency in mismatch repair (MMR) genes. However, MutS protein homolog 2 (MSH2) and 6 (MSH6) are MMR proteins that have not been reported as biomarkers for OS. Our goal was the analysis of two possible biomarkers, MSH2 and MSH6 in regard to survival time in OS patients using a tissue microarray (TMA).
Materials and methods: Tumor tissue specimens from surgical primary tumor resections were collected from bone tissue of 67 patients with OS. A TMA was set up and sections were stained with MSH2 and MSH6. Grading was performed in a semi-quantitative manner by two independent investigators who were blinded to clinical information. Kaplan-Meier curves were used to calculate overall patient survival and the log-rank test assessed statistical differences between groups.
Results: We analyzed immunohistochemical expression of MSH2 and MSH6 in a human OS TMA. Follow up data was available for every patient and the mean clinical follow up time was 98 (range 7 to 213) months. Fifty-eight (87%%) and 57 (85%) OS patients stained negatively, compared to 9 (13%) and 10 (15%) OS patients staining positively for MSH2 and MSH6 respectively. Survival time and expression of MSH2 ($p = 0.292$) were not significantly correlated. However, significantly shorter survival was seen with expression of MSH6 ($p = 0.026$) and a combination of MSH2 and MSH6 (MSH2/6) ($p = 0.018$). The 5-year-survival rates (ysrs) for patients expressing MSH6 and MSH2/6 were 50%, compared to 77% and 63%. Also,

significantly shorter survival was seen in non-responders to chemotherapy with expression of MSH6 (p <0.0001) and MSH2/6 (p = 0.028). The same holds true for patients with metastasis and expression of our studied markers (p <0.0001), for example 17 ± 5 months, compared to 203 ± 7 months for MSH2/6.
Conclusion: Expression of MSH6 and MSH2/6 appears to significantly affect the aggressiveness of OSs and may predict survival time. Non-responders to chemotherapy and patients with metastasis, who stain positively for MSH6 or MSH2/6 may be at risk for very short survival times. Expression of MSH2 in metastasis also seems to be associated with significantly worse survival times. Even though commonly reported as a repair system, MMR proteins may favor worse prognosis in OS.

FM27

Treatment of aneurysmal bone cysts with alcoholoc preparations

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Rationale: The standard of treatment of aneurysmal bone cysts (ABC) is aggressive curettage, however followed by a high rate of recurrence and possibly mutilating effects to neigboured joints.
Surccessful Treatment with alcoholic preparations has been reported repeatedly [1] and we wish to draw the attention to this with our experience.
Materials and methods: 6 consecutive patients were treated with either Ethibloc® or Polydocanol (e.g. Aethoxysclerol®, Sclerovein®) injection under CT-control. One patient additionally had embolisation, one had thromobocyte concentrate injection and a third DBX (demineralized bone matrix filling). Additionally other patients were treated with Polydocanol in developing countries.
Results: These six patients the process healed with complete or sufficient new bone formation without the necessity of extensive additional local measures with f/u 7 y to 6 months.
Conclusion: Local treatment of ABC with alcoholic prepartions in these consecutive patients appeared superior to traditional aggressive curettage. This treatment modality should therefore considered as an option. Unfortunately the Ethibloc paste is no longer available and alcoholic solutions need to be used more cautiously as they may drain into venous outflow of the lesions, which in the hands of these authors is monitored by injection iodine contrast media before instillitation of the alcoholic preparations.

Free communications III

FM28

Revision Rate after Major or Minor Lower Extremity Amputation in Diabetic or Peripheral Arterial Disease Patients

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Introduction: Lower extremity amputation is performed as the last possible surgical management option in patients with unresponsive infections, chronic non-healing wounds, necrosis, and uncontrollable pain. The amputation is performed at the most distal level of the lower extremity that still enables adequate blood supply for primary wound healing and a functional stump. The aim of this study was to evaluate the revision rate and possible risk factors for revision surgery in patients with diabetes or peripheral arterial disease (PAD) after major or minor lower extremity amputation was performed.
Methods: Retrospective data was collected from 421 (129/30.6% female) diabetic or PAD patients that underwent amputations of the lower extremity at our institution between 2002–2012. Data such as demographic factors, history of diabetes, PAD (graded by Fontaine stadium 0 to 4), level of amputation, revision at the same level or a more proximal level, time from amputation to revision, polyneuropathy, diabetic nephropathy, previous angioplasty or peripheral bypass were extracted.
Results: Mean patient age at time of amputation was 68.84 years ± 12.72 years with a mean body mass index of 27.13 ± 6.53. 106 (revision rate of 25.18%) revision surgeries were performed, 53 of these were at the same amputation level and 53 at a more proximal level. 28 patients had type I diabetes (6.7%) and 243 patients(57.7%) had type II diabetes. The mean time from diagnosis of diabetes to amputation was 20.56 years ± 11.87. PAD patients with Fontaine stadium: 0 (134/31.8%), 1 (47/11.2%), 2a (40/9.5%), 2b (37/8,8%), 3 (13/3.1%), 4 (150/35.6%). 201 (47.7%) patients underwent prior to amputation angioplasty and 44 (10.5%) a peripheral bypass. The median time from amputation to revision was 50.5 days (15–1801). Risk factors for revision were diabetic nephropathy (35.7%), and polyneuropathy (28.9%). Diabetic patients had a higher rate of revision to a more proximal level compared to non-diabetic patients (15% to 8%) (p <0.05).
Conclusion: To our knowledge, this is the largest retrospective cohort study evaluating revision rates following all levels of lower extremity amputation in the patient population. We were able to demonstrate that patients with polyneuropathy or diabetic nephropathy had a significant higher rate of revisions compared to the control group. Diabetic patients had a higher rate of revisions requiring a more proximal level of amputation compared to non-diabetic patients.

FM29

Dixon-based MRI for Assessment of Muscle-fat Content in Phantoms, Healthy volunteers and Patients with Achillodynia:

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Objective: To quantify the muscle fat-content (MFC) in phantoms, volunteers and patients with achillodynia using 2-point Dixon-based MRI (2pt-MRIDIXON) in comparison to MRspectroscopy and visual assessment of MFC.
Methods: 2pt-MRIDIXON was used to measure the MFC of 15 phantoms containing 0-100% fat-content and calf muscles in 30 patients (13 women; 57 ± 15years) with achillodynia and in 20 volunteers (10 women; 30 ± 14years) at 1.5T. Accuracy of 2pt-MRIDIXON in quantification of MFC was assessed in-vitro using phantoms and in-vivo using MR-spectroscopy (MRS) as the standard of reference. Fat-fractions derived from 2pt-MRIDIXON (FFDIXON) and MRS (FFMRS) were related to visual assessment of MFC (Goutallier-grades 0–4) and Achilles-tendon quality (grade 0–4).
Results: Excellent linear correlation was demonstrated for FFDIXON with phantoms and with FFMRS in patients (pc = 0.997/0.995; p <.001). FFDIXON of the gastrocnemius muscle was significantly higher (p = .002) in patients (7.0% ± 4.7 %) as compared to volunteers (3.6% ± 0.7%), whereas visual-grading showed no difference between both groups (p >.05). FFMRS and FFDIXON were significantly higher in subjects with (>grade 1) structural damage of the Achilles-tendon (p = 0.01).
Conclusion: 2pt-MRIDIXON allows for accurate quantification of MFC, outerperforming visual assessment of calf muscle fat. Structural damage of the Achilles-tendon is associated with a significantly higher MFC.

FM30

The radiologic prediction of ankle arthritis in pes cavovarus

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Introduction: In pes cavovarus the raised medial arch, the forefoot adductus, and the hindfoot varus lead to elevated anteromedial ankle joint contact stresses with potential evolution to ankle arthritis. Little data exists about the radiological characteristics of the cavovarus deformity and its correlation to the risk of developing ankle arthritis.
Material and Methods: Weight bearing dorsoplantar and lateral radiographs of the foot of 100 patients with neurogenic and idiopathic cavovarus deformities were analyzed and compared to an age and gender matched control group without foot deformities.
Results: Significant higher grades of arthritis were seen in the cavovarus group, with no difference between idiopathic and neurogenic deformities. Significant forefoot adduction was seen reflected by a difference in the dorsoplantar talo-1st metatarsal angle (8.8° vs. –1.3 °) and the talonavicular coverage angle (0.6° vs. –10.7°). This forefoot adduction was significantly more pronounced in neurogenic than in idiopathic deformities (talo-1st metatarsal angle 17.1° vs. 6.0°; talonavicular coverage 8.8° vs. –2.2°).
The lateral views revealed a significantly higher lateral talo-1st metatarsal (Meary's) angle (15.8° vs. 1.5°) and increased navicular height (45.7 mm vs. 34.4 mm). Talus and calcaneus presented a significantly dorsiflexed position (talar inclination 9.2° vs. 16.7°, calcaneal pitch 27.1° vs. 22.7°) and a lower talocalcaneal divergence (36.2° vs. 39.4°). The talar head was significantly plantarflexed compared to the talar axis (talar head to talar axis 104.6° vs. 99.5°). No significant differences between neurogenic and idiopathic cavovarus feet were seen for abovementioned measurements. Ordinal regression analysis revealed a correlation of age and plantarflexion of the forefoot (Meary's angle) with substantial ankle arthritis grade 3 or 4, whereas gender and forefoot adduction had no influence. Every 5° increase of Meary's angle and every 10 years of age independently led to a 2-times higher risk of ankle arthritis.
Conclusion: Radiologic characteristics of idiopathic and neuropathic cavovarus deformities are evaluated. While all angles measured displayed significant differences between cavovarus deformities and controls, only the difference of forefoot adduction between idiopathic and neuropathic deformities reached the level of significance. Age and Meary's angle displayed a significant correlation with the risk to develop ankle arthritis.

FM31

Gait Variability in Ankle Osteoarthritis, Ankle Arthodesis and Total ankle Replacement

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Introduction: Stride to stride gait variability (GV) has come up as a useful indicator of gait deviation and fall risk in old age and various neurological conditions e.g. multiple sclerosis, parkinsonism, depression, etc. However importance of GV in foot and ankle (F&A) pathologies are not well studied. Hence the aim of this study was to evaluate the level of GV in ankle osteoarthritis (AOA) and its two common surgical treatments, Ankle Arthrodesis (AA) and Total Ankle Replacement (TAR).
Method: Spatio temporal (STP) gait parameters and their variability were assessed in 98 participants, who were divided into four groups: 23 AOA, 25 TAR, 18 AA, and 32 controls (CON). Gait Assessment was performed using 3 D inertial sensors (Physilog, BioAGM, CH). Participants performed a 50 m walking trial, twice, at a normal walking pace. Mean, median, standard deviation, coefficient of variation (CV) and interquartile range (IQR) of each measured parameter were calculated over the two trials and compared with the CON using the Wilcoxon rank sum test($p < 0.05$).
Results: Comparing the STP parameters in TAR and AA with CON showed similar results, with difference in cadence, stride, shank mobility and peak swing speed (PSS) ($p < 0.05$) while AOA group showed difference in all studied parameters ($p < 0.05$). While GV results showed increased variability in AOA and AA group while TAR results were comparable to controls. CV results are given in following sequence (AOA/ AA/ TAR/ CON) with (* $p < 0.05$) compare to CON; cadence (25.(0.75)*/ 2.36(1.47)*/ 2.11(0.64)/ 1.58(0.66)), Double support (8.81(3.87)*/ 7.76 (4.27)*/ 7.03 (4.43)*/ 13.01 (6.95)), Shank ROM (2.04 (0.95)*/ 1.91 (0.97)*/ 1.57/ (0.81)/ 1.24 (0.64)), stride (2.7 (1.19)*/ 2.3 (0.92)*/ 1.83 (0.84)/ 1.8 (0.83)), speed (3.5 (1.81)*/ 3.13 (1.75)*/ 2.8 (0.81)/ 2.61 (0.78)), PSS (4.13 (2.2)*/ 4.1(2.67)*/ 2.92 (1.6)/ 2.69 (1.11))
Variability in cadence, double support, shank mobility, stride, speed, PSS in both AOA and AA were significantly different compare to control. While in TAR group only double support showed variability significantly different to controls.
Conclusion: STP results of this study are similar to previous gait studies. The CV results of the study reported high GV in AOA and AA groups compared to controls while TAR group showed improve gait with no significant GV. However, there are a number of factors behind the variability in a gait hence GV is not a worthwhile parameter in assessing outcome of AOA surgeries.

FM32

Mid- to long-term outcome of modified Triple Arthrodesis

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Introduction: Isolated talonavicular and subtalar fusion through a single medial approach has been advocated as an alternative to triple arthrodesis in correcting acquired adult flatfoot deformity. The purpose of this study was to critically look at the mid- to long-term outcome, union rates and reoccurrence of flatfoot deformity due to secondary deformity in the adjacent joints.
Methods: Ninety-seven consecutive diple arthrodeses (85 patients) were included. All patients were treated by one of two surgeons between 2005 and 2011. The mean age of the patients was 66 years (range, 39–86 years). All of them presented with a symptomatic, rigid flatfoot deformity due to a posterior tibial tendon dysfunction. In severe valgus deformity a medial displacement osteotomy of the calcaneus was additionally performed. Furthermore, 11 patients underwent a fusion of the medial tarsometatarsal joint due to collapse of the medial column. Union rate, loss of correction and secondary deformity were analyzed on radiographs.
Results: One patient was lost to follow up. The clinical and radiographic outcomes of 96 feet were analyzed with an average follow-up of 60 months (range, 2.5–8.5 years). Radiographic examination revealed progression of ankle valgus deformity in seven cases and collapse of the medial arch in eight cases. Nonunion was observed in eleven feet (four in the talonavicular, three in the subtalar and four in both joints). Five cases were asymptomatic and six needed revision. In three cases avascular necrosis of the lateral talus body was observed. Two were treated with total ankle replacement, the third was asymptomatic. A further case required revision due to overcorrection. Wound healing problems were limited to the superficial skin layer. Eight patients needed either a complete or partial removal of the arthrodesis screws
Conclusion: Diple arthrodesis showed a good clinical and radiological mid- to long-term outcome. The main complications were secondary valgus tilt in the ankle in 6%, collapse of the medial arch in 9% and nonunion in 12%. Avascular necrosis of the talus is a rare complication (3%). Despite the isolated medial approach, nonunion rates are comparable with other hindfoot fusion techniques using an additional lateral approach. In conclusion we found that diple arthrodesis provides reliable mid- and longterm results for the correction of rigid flatfoot deformity.

FM33

First metatarsophalangeal arthrodesis: Fusion Rate of a novel dorsal Fusionplate

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Introduction: Fusion of the first metatarsophalangeal (MTP) joint is considered a „gold standard" procedure for hallux rigidus, severe hallux valgus deformity and as a salvage procedure for previous failed MTP arthroplasty and failed hallux valgus surgeries. Numerous fixation techniques are described in the literature including crossed screws and dorsal plates.
Methods: Retrospective data was collected from 78 consecutive patients (84 arthrodesis/ 74.36% females) that underwent arthrodesis of the first MTP joint with a novel fusion plate (2.7 mm VAR Synthes MP fusionplate, Oberdorf, Switzerland) at our institution between January 2011 and December 2012 with a minimum of one year follow up. Data such as demographic factors, indication for fusion, rate and area of fusion at 6 weeks was determined by CT scans. Standard weight bearing radiographs were used to measure the pre- and postop alignment of the first ray, and the complication rate was extracted.
Results: The mean age at the time of surgery was 60.73 years (range: 29–83). The mean body mass index was 26.28 kg/m^2 (range: 14.4–39.64). The diagnosis of hallux rigidus was in 65 cases (77.38%) the indication for fusion. 16 patients (19.04%) presented after prior hallux valgus surgery. The mean pre- and postoperative MTP angle

was 21.52° (±14.95°), respectively 13.92° (±6.78°). The mean postoperative dorsal extension of the hallux measured on sagittal CT scans was 20.41° (±6.67°). 6 weeks postoperative 12 (16.67%) arthrodesis showed complete fusion, 55 (76.39%) partial fusion, and 5 (6.94%) no fusion (n = 72). Of the partial fusions 48 cases (87.27%) showed a fusion predominately at the dorsal area of the fused MTP joint. 4 patients underwent CT scans 3 months postoperative and they all showed complete fusion. In 6 patients hardware removal was performed due to painful hardware. And in one patient a revision arthrodesis had to be performed due to pseudoarthrosis.
Conclusion: To our knowledge this study is the first to evaluate fusion rates of first MTP arthrodesis facilitating a CT scan at 6 weeks postoperative. The majority (93.06%) of first MTP arthrodesis with the novel dorsal fusion plate showed fusion at 6 weeks. An excellent reproducible sagittal and horizontal alignment of the hallux could be achieved.

FM34

Realignment osteotomy in fibular malunion: mid-term results in 19 consecutive patients

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Introduction: The most frequent posttraumatic malunions of the fibula are shortening and malrotation, occurring in up to 33%. It has been demonstrated that substantial fibular displacement may substantially increase the contact pressures in the ankle joint. Therefore distal fibular malunion is a risk factor for development of posttraumatic ankle osteoarthritis. The objectives of this study were to (1) describe our treatment algorithm and surgical technique in patients with posttraumatic fibula malunions; (2) determine intra- and postoperative complications rates, and (3) to describe mid-term clinical and radiological outcomes and quality of life.
Methods: 19 consecutive patients (11 male, 8 female, mean age 42 years, range 19–68) with symptomatic fibular malunions were included into this prospective study. The initial injury was Weber B and C fracture in 7 and 12 ankles, respectively. The mean time between the injury and reconstructive surgery was 17 months (range 6–101). In all patients a z-shaped osteotomy of the fibula was performed to achieve the appropriate length/rotation of the fibula. All patients were evaluated pre- and postoperatively (mean follow-up 4.9 years, range 3.2–6.7). Radiological outcomes were assessed using standardized weight-bearing radiographs. Clinical outcomes were assessed using visual analogue scale (VAS), American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot scale, and SF-36 questionnaire.
Results: There were no intraoperative complications. In two patients early wound healing problems were observed, and resolved with i.v. antibiotics. Osseous healing was observed in all ankles within 10 weeks after surgery. The length and rotation of the fibula was improved in all patients, according to Weber criteria. All patients experienced significant pain relief (VAS: 6.5 ± 1.1 to 0.9 ± 0.8, P <0.001) and functional improvement (AOFAS hindfoot scale: 48.4 ± 14.5 to 85.7 ± 7.4, P <0.001; ROM:37° ± 6° to 46° ± 5°, P <0.001). The SF-36 score also significantly increased in all 8 subgroups. In 11 patients hardware was removed due a discomfort after a mean of 11.8 months (range 7.2–22.8).
Conclusion: A z-shaped osteotomy is an efficient and successful method to restore fibula length and rotation in patients with posttraumatic malunion. Our findings in this series of 19 ankles confirm that this realignment surgery results in significant pain relief and functional improvement.

FM35

Mid- to long-term biomechanical outcome of joint preserving realignment surgery for ankle osteoarthritis

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Introduction: Joint preserving surgeries have gained popularity as treatment of asymmetric early and mid-stage ankle osteoarthritis. However, only limited long-term data on strength and walking biomechanics are available. Therefore, the purpose of this study was to quantify isometric plantar- and dorsiflexion strength and gait parameters (dynamic range of motion, peak moments) in patients who underwent realignment surgery.
Methods: Eight patients, a minimum of seven years after realignment surgery (age: 44.7 ± 7.0 years); body mass index (BMI): 27.2 ± 4.6), and eight age-and gender matched healthy controls (age: 44.3 ± 6.6 years; BMI: 25.2 ± 3.4 kg/m^2) were included in the study. The measurements consisted of 1) an instrumented gait analysis with a six camera motion analysis system (Vicon, Oxford, UK) and two force plates (Kistler, Winterthur, Switzerland) to assess ankle, knee, and hip kinematics and kinetics, and 2) an isometric torque measurement (torque transducer: SM-500N, Interface Inc., Scottsdale AZ, USA) to assess the plantarflexion and dorsiflexion strength in neutral joint position. Quality of life was assessed using the SF-36 questionnaire. Differences between the patients' affected and the controls' non-dominant leg, as well as between the patients' healthy and the controls' dominant leg were analyzed using Student's t-test.
Results: The gait analysis showed that the patients walked slower (–7%, p = 0.033), and on their affected leg with a smaller ankle range of motion (–40%, p <0.001), and external dorsiflexion moment (–15%, p = 0.015) than the controls. For the patients' affected leg, lower isometric torques (–30%) were measured than for the controls, but the differences were not statistically significant. No differences to the controls were seen for the bilateral knee and hip biomechanics, the ankle biomechanics of the healthy leg, and the SF-36 score.
Conclusion: The main difference in the patients' gait pattern was the smaller ankle range of motion. As the gait biomechanics of the other joints were not different compared to controls, the available ankle range of motion was likely sufficient for walking. The patients reported a similar quality of life as the matched controls, indicating that realignment surgeries are a promising treatment option for patients with asymmetric ankle osteoarthritis.

FM36

Subtalar and Naviculocuneiform Fusion for the Treatment of Hindfoot Valgus with Collapse of the Medial Arch

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Introduction: Adult acquired flatfoot deformity has become a common entity that is attributed mainly to posterior tibial tendon dysfunction (PTTD). A collapse of the medial arch can occur at different levels. Modified triple fusion has become the treatment of choice in patients with PTTD stage III. This procedure corrects the hindfoot valgus deformity but does not sufficiently restore the medial arch in cases with the main destabilization process at the naviculocuneiform (NC) joint. We thus started to fuse the subtalar (ST) and the NC I-III joints, while sparing the talonavicular (TN) joint. The purpose of this study was to assess the obtained radiological correction and the stability in a first consecutive series of patients.
Methods: From June 2009 to May 2012, 28 feet (26 patients; age 66 [44–80] years; female 21; male 5) were treated with a ST and NC fusion. Intraoperatively, the PTT was diseased in 27 feet (96%). When a neutral alignment of the hindfoot could not be achieved solely by ST fusion, a medial sliding osteotomy of calcaneus was added (13 feet, 46%). The following radiographic parameters were measured on standard weight-bearing radiographs preoperative and after 2 and 12 months: talus-first-metatarsal angle ap/lateral, TN coverage angle, lateral talocalcaneal angle, calcaneal pitch angle and the hindfoot offset on the Saltzman view.
Results: Fusion was achieved in all but two feet within 2.6 (2–4) months. Two patients developed an asymptomatic nonunion of the NC I joint. A statistically significant correction was found in all measured parameters after two months. After one year, the average loss of correction was less than three degrees, only one patient showed a progressive collapse of the medial arch. One patient developed partial avascular necrosis of the talus 14 months after surgery. A total ankle replacement was performed with uneventful follow-up.
Discussion: Isolated ST and NC fusion is obviously a successful method to restore hindfoot alignment and medial arch and to achieve a stable triplanar correction. A collapse of the medial arch associated with a valgus deformity of the hindfoot was found not to be a result of PTTD alone; it may result from progressive loss of ligamentous support at multiple levels. With the obtained radiological results in these 28 feet we continue to consider isolated ST and NC fusion as treatment of choice in patients PTTD stage III and destabilization process at the NC joint.

FM37

Total arthroplasty of the metatarsophalangeal joint of the hallux – an average 4 years prospective follow-up study

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Introduction: The current gold standard in the treatment of hallux rigidus is arthrodesis of MTP-I joint, thus accepting the permanent and complete loss of mobility in this biomechanically important joint. In the past, many attempts have been made in total replacement of MTP I joint. Most of them failed due to early loosening and wear. The aim of this prospective study is to evaluate the results of a new unconstrained, modular, three components, porous titanium and hydroxyapatite coated, press-fit prosthesis.
Methods: From 2008 to 2010 we prospectively included 28 MTP I prosthesis in 24 patients in the study. The average age of the patients was 62.8 years (range, 48–87). Pre- and postoperatively at an average of 50.3 months (range, 36–62 months) the patients were evaluated

clinically including the AOFAS forefoot score, visual analogue scale for pain (VAS), joint stability, and ability to wear normal shoes. Pre- and postoperative weightbearing radiographs were obtained to assess forefoot alignment, osteoarthritis grade, osteointegration, and integrity of the total arthroplasty. Fluoroscopy was used to determine the true range of motion of the prosthesis.
Results: Over the follow-up, 4 prosthesis had to be converted to MTP I arthrodesis and 2 patients with three prosthesis died during follow-up. For the remainder, the AOFAS forefoot score significantly improved from 57.6 (range, 29–80) to 82.3 (range, 58–95) and the VAS for pain decreased from 5.4 (range, 0–9) to 0.4 (range, 0-2). Range of motion increased from 39.6° (0–60) preoperatively to 87.2 (range, 45–115) and decreased to 28.6 (range, 11–52) at latest follow-up. The majority of patients had dorsiflexion contracture. All prosthesis components, which were still in place showed stable osteointegration and no migration.
Conclusion: The new design had less loosening compared to other types. With the new prosthetic design good clinical mid-term results with respect to AOFAS forefoot score, pain reduction and daily live activities can be achieved. However, range of motion that was preserved over the years was small. Given the increased long-term risk for revision surgery and complications compared to first MTPJ arthrodesis, first MTPJ replacement has to prove superiority not just equitiy to arthrodesis. To date, this leaves first MTPJ replacement as a viable alternative to fusion for patients with severe hallux rigidus unwilling to have permanent stiffness in this joint for cosmetic or functional reasons.

Free communications IV

FM38

The Triceps Reflecting Approach (Bryan-Morrey) for distal Humerus Fractures

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Introduction: Olecranon osteotomies are commonly used for the approach to intraarticlar distal humerus fractures but are often associated with procedure related complications. We propose the triceps reflecting approach (TRA) with preservation of the extensor apparatus to be a safe alternative technique giving a sufficient exposure to the elbow joint and helping to achieve an anatomical fracture reduction with the intact olecranon as a molding contrapoint.
Methods: In 2 trauma centres 31 skeletally mature distal humerus fractures treated with a TRA were identified. Patient records and radiographs were reviewed to determine injury and operative characteristics, complications, and adequacy of articular reductions. 80% of the patients returned to follow-up (FU) including history recording, physical examination with functional analysis of the operated vs the not harmed opposite site with DASH and Mayo scores, ROM, elbow strength measurement and radiographic documentation.
Results: Mean duration of FU reaches 51 months (range 22 months–12 years) in 24 patients (loss of FU in 7 cases), 13 female, 11 male with an average age of 57.7 years (range 17-89). The AO Classification reveals five A2, one B2, two C1, 9 C2 and 7 C3 fractures. Radiologic control shows adequate fracture reduction (<1 mm step), distal humeral axes and fracture healing in all patients. The DASH scores of both extremity do not show any significant differences. With an average of 10.3 points (range 0–44 points) indicating only mild residual impairment. The Mayo score is equally good. The strength analysis of flexion and extension reveals no statistically relevant loss of strength at a nearly 2 years FU. No wound infections have been detected. 3 patients had transient ulnar nerve palsies. 3 patients had to be re-operated (one for an immediate postoperative secondary displacement, another for a secondary traumatic rupture of the triceps tendon and removal of hardware and a third underwent a hardware removal and neurolysis).
Conclusion: The triceps reflecting approach is a valuable option for ORIF in distal intraarticular humerus fractures. It preserves the normal joint anatomy of the olecranon and avoids the potetial complications associated with olecranon osteotomy. The clinical outcome parameters of our series show no statistically relevant approach-associated impairment compared to the contralateral side.

FM39

The Extended Medial Approach to the Elbow – A Cadaver Study

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Introduction: Various Approaches to the medial elbow exist. Muscle-splits like the Flexor-Carpi-Ulnaris-Split (FCUS) have been described for good exposure of the medial collateral ligament and the sublime tubercle of the coronoid. Whereas, the Hotchkiss-Over-the-Top (OTT) approach mainly exposes the joint and the distal humerus. It was the aim of this study to describe an extended medial approach (EMA), which enlarges the OTT into a distal muscle split and to compare it's exposed osseous area to the FCUS.
Methods: 12 fresh-frozen cadaveric elbows were dissected alternately beginning with the FCUS or the EMA. The EMA was defined using the internervous plane between the flexor-ponator mass and the FCU muscle. The maximal distal extension of the EMA (recurrent branch of the ulnar artery, RBUA) was measured from the medial epicondyle (ME). A calibrated digital image was taken and the surface area calculated (ImageJ software) to compare the exposed osseous area (EMA vs. FCUS).
Results: The mean osseous area exposed by the two approaches did not differ (FCUS: 8.1 cm^2, EMA: 8.4 cm^2, $p > 0.05$). The EMA was distally limited by the RBUA (mean 6.8 cm). The first motorbranch to the FCU muscle limited the FCUS (mean 2.9 cm). In 9 cadavers, a motorbranch to the humeral head of the FCU was found to cross the exposed area.
Conclusions: The OTT approach can safely be extended distally using the EMA, which respects an internervous plane. While the EMA provides equal exposure to the medial ulna compared to the FCUS, the latter is not extendable further proximal and may stress the nervous supply of the humeral head of the FCU.

FM40

COMPARISON OF THE SUBJECTIVE ELBOW VALUE AND THE MAYO ELBOW PERFORMENCE SCORE

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Background: The aim of this study was to evaluate the subjective elbow value (SEV) and to compare it with the Mayo Elbow Performance Score (MEPS). The SEV is defined as the patient's subjective estimation of the elbow revealed as percentage of a normal elbow, which would correspond to 100%.
Methods: The MEPS and the SEV were prospectively assessed in all patients treated for any elbow pathology. Two groups of this consecutive series were analyzed: 1) all first consultations (n = 241), and 2) all patients that had a preoperative consultation, a surgical procedure, and a postoperative consultation (n = 41). Statistical analysis included calculation of correlation and responsiveness of the scores.
Results: For the first consultations, the mean MEPS and SEV were 65 points and 60%, respectively. Both scores correlated (r = 0.671). The strongest correlation was found for female patients (r = 0.733) and for the diagnosis group of joint damage (r = 0.747). The standardized response means were 1.26 for MEPS and 1.01 for SEV indicating that both scores detected an obvious change in the outcome.
Conclusions: The SEV is an easily administered, responsive and valid tool to assess the condition of the elbow. It should be considered an adjunct to currently used scores as it only detects the subjective condition of the elbow.

FM41

Kinematic of the Shoulder Joints in Professional Tennis Players

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Introduction: Shoulder pain and injury are common in tennis players. The precise causes for these pains remain unclear, but it is believed it could result from different factors (e.g., impingements (Gilles Walch's and Christopher Jobe's theories), anterior dynamic (Frank Jobe's theory) and posterosuperior static glenohumeral instability (Stephen Burkhart's theory), scapular orientation, etc.). Impingement at critical tennis positions and glenohumeral instability have rarely been dynamically evaluated in-vivo. The purpose of this study was thus to evaluate the different types of impingement and stability during tennis movements.
Methods: Type and frequency of impingement as well as percentage of subluxation were evaluated in ten intermediate or ex-professional tennis players through a novel dedicated patient-specific measurement technique based on optical motion capture and Magnetic Resonance Imaging (MRI).
Results: All volunteers, nine male and one female, had a clinically functional rotator cuff. No tennis players had 180° range of motion in internal-external rotation. MR images revealed eleven rotator cuff lesions in five subjects (three interstitial of the supraspinatus, three PASTA of the supraspinatus, three PASTA of the infraspinatus and two articular of the subscapularis)and six labrallesions in five subjects (two inferior, two posterior and two posterosuperior). Lateral subacromial, anterior subacromial, internal anterosuperior, and internal posterosuperior impingements were observed in four, three, two and seven subjects, respectively. No instability could be demonstrated in this population.
Conclusion: Tennis players presented frequent radiographic signs of structural lesions that could be mainly related to posterosuperior impingements due to repetitive abnormal motion contacts (Gilles Walch's and Christopher Jobe's theories). This is the first study demonstrating that a dynamic and precise motion analysis of the entire kinematic chain of the shoulder is possible through a non-invasive method of investigation. This premier kinematic observation offers novel insights into the analysis of shoulder impingement and instability that could, with future studies, be generalized to other shoulder pathologies and sports. This original method may open new horizons leading to improvement in impingement comprehension.

FM42

Anabolic Steroids Reduce Muscle Degeneration Caused by Rotator Cuff Tendon Release: An Experimental Study in Sheep

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Aim: To test the hypothesis that anabolic steroids (nandrolone decanoate (ND)) prevent and/or reverse fatty muscle infiltration and atrophy following experimental tendon tears in sheep.
Methods: The infraspinatus tendon was released in 18 alpine sheep. All sheep underwent repair of the retracted musculotendinous unit after 16 weeks and were sacrificed after 22 weeks. 6 sheep served as controls (Group 1), 6 were treated with weekly intramuscular injection of ND starting after ISP repair (group 2) and 6 with ND starting immediately after tendon release (group 3). MRI and CT imaging was performed immediately after ISP release, after 6 weeks, prior to ISP repair and sacrifice.
Results: In the control group the right (released) ISP muscle volume (MRI) decreased to 79.5% after 6 weeks, remained stable at 78.4% after 16 weeks and decreased further to 69.2% after 22 weeks, which was not different compared to group 3. In group 2 however was a significant increase of ISP volume after repair as opposed to the volume decrease in group 1. Compared to the control group, which showed a continuous increase of fatty infiltration (11.7% at tendon release; 16.5% after 6 weeks; 50.1% after 16 weeks and 59.8% after 22 weeks), the animals of group 3 showed a significant reduction of fatty infiltration after 16 weeks (16.1%) and 22 weeks (22%) respectively.
Conclusion: Anabolic steroids have the potential to prevent the onset of fatty muscle infiltration if application starts immediately after tendon release and seem to induce muscle hypertrophy if the application is started after repair.

FM43

"What radial head replacements would tell us if they could speak". A monocentric analysis of radial head implantations and explantations over a 10 year period

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Introduction: Reports on clinical results of radial head replacements are limited. Goal of this monocentric study is to present clinical and radiographical results of all implantations and explantations of radial head prosthesis over a 10 year period.
Methods: Between 2003 und 2013, 16 patients were treated with a cemented bipolar radial head prosthesis for a chronic or acute posttraumatic elbow instability. In the same period, 8 patients underwent explantation of a failed radial head replacement. The evaluation at the final follow-up consisted of documentation of the functional results using the Mayo Elbow Performance Score (MEPS) and a radiological assessment.
Results: The mean age of the patients at the time of surgery was 55 years (31–70) with no significant difference between the two groups. The mean follow-up was 47 months, in the implantation-cohort (99–15), and 24 months (300–12) in the explantation-group. 3 patients (12.5%) were lost prior to follow-up. In the implantation group no revision surgery was recorded until final follow-up. Mean MEPS of these patients was 83 points (50–100). Survival time of the radial head replacement was 86 months (8–333) in the explantation group. The reason for revision was implant failure in 5 cases (loosening or breakage) and ankylosis in 3 patients. In 3 of the 8 explantation further surgical interventions became necessary.
Conclusion: Breakage of the implant and refractory ankylosis were the main reasons for failure of the radial head arthroplasty. Revision of a radial head prosthesis comes along with an increased likelihood for further surgical procedures. With these results the authors feel vindicated in their restrictive attitude in performing radial head replacement.

FM44

Influence of plate size and design upon healing of ulna shortening osteotomies

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Introduction: Different methods of ulnar shortening are used in the treatment of ulnocarpal impaction. Plate fixation is an established method. Besides the risk of loosening, loss of reduction and non-union, the applied hardware often entails discomfort on the implant site and ultimately necessitates plate removal. In order to improve on these shortcomings a new plating system was introduced in 2010. The aim of this retrospective study was to compare this new LCP Ulna Osteotomy System 2.7 mm (Synthes) with the former 3.5 mm LCDCP (Synthes) regarding consolidation, complications and rate of plate removal.
Methods: 129 patients were treated with ulna shortening osteotomies (UOT) in the time of 03/03 to 08/12. 2 different plates were used: Between 03/03 and 05/1075 UOT were performed on 75 patients using a 6- or 5-hole 3.5 mm LCDCP plate (group 1). 74 osteotomies were transverse, 1 oblique.
After its introduction the LCP 2.7mm was used beginning 07/10in so far 55 patients thereof 40 UOT had a follow-up of at least 1 year and were included for evaluation (group 2). The osteotomy was transverse (21) or oblique (19). The 2 groups did not differ in age or indication for surgery. The operative approach was identical and the postoperative treatment didn't differ either.
Results: Average time to complete consolidation of the osteotomy in group 1 was 335 days. Pain at the plate site occurred in 29 patients. Removal of the plate was performed in 28 cases (37.3%), 22 because of pain at the plate site, 3 in addition to other surgeries.There was one major complication (compartment syndrome, following fasciotomy). Minor complications were CRPS (1), plate loosening (1, conservative treatment).
In group 2 average time to complete consolidation was 247 days. 18 patients had pain at the plate site. Removal of the plate was performed in 13 patients (32.5%), 2 in addition to other surgery. One major complication occurred (traumatic avulsion of the plate, repeat plate fixation). Minor complication was a CRPS (7). Interestingly the oblique osteotomies healed faster (218d in group 2) as the transverse ones (337d in Group 1, 273d in Group 2).
Conclusion: In group 2 using the new LCP 2.7 mm less implants had to be removed and the time to consolidation was shorter ($p < 0.05$). Oblique osteotomies healed faster than transverse ones. ($p = 0.158$). However the cost of the implant is 4 times higher.

FM45

A radiolucent, carbon fibre reinforced synthetic plate for distal radius fractures: first experience

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Introduction: Steel and titanium are widely and successfully used implant metals in traumatology. However, some disadvantages are related to metallic implants: They provoke artefacts in computed tomography (CT) and magnetic resonance imaging (MRI). Also, bone healing might be difficult to monitor in x-ray studies due to the invisibility of the bone underlying the implant. Furthermore, hardware removal still remains an issue, especially with titanium implants. In order to avoid these problems carbon fibre reinforced polyetheretherketone (PEEK) implant material has been developed. The main advantages of this synthetic material are radiolucency, artefact-free imaging, good fatigue properties and biocompatibility. In spine surgery carbon fibre reinforced PEEK implants have been successfully used and documented for the last few years. Recently palmar plates for distal radius fractures have been developed.
Methods: Seven consecutive cases of dorsally displaced extra- and intraarticular distal radius fractures were stabilized with a palmar semi-rigid carbon fibre reinforced PEEK plate with angular stable screw fixation (icotec AG, Altstätten, Switzerland). Integrated radiopaque tantalum filaments and metallic screw tips allow correct placement of the plate and make the implant visible under image intensifier. A clinical and radiographic follow-up was performed at 2 and 6 weeks, and at 3 and 6 months.
Results: The ROM at final follow-up was comparable to the contralateral wrist and all patients were pain free 6 month postoperatively. DASH Score continuously increased, bony union was achieved in all cases. We did not record any infections, secondary dislocations, tendon ruptures or other complications. In one case where MRI of the wrist was performed we could compare artefacts of the used implant to Titanium.
Conclusion: We present our first experience on a new carbon fibre reinforced synthetic palmar plate for distal radius fractures. The implant might represent an interesting alternative to metallic implants. Potential advantages are radiolucency, no adherence to surrounding tissues and no artefacts in CT and MR imaging. A disadvantage of the implant is the missing multidirectional screw fixation, making it difficult to use in complex fracture situations.

FM46

Scaphoid Waist Nonunions Treated with Illiac Crest or Vascularized Bone Grafts

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Introduction: We report the results of 57 cases of surgical treatment of traumatic scaphoid nonunion. And the differences between the three used techniques either with an iliac bone graft (19) or an vascularized graft from the palmar (15) or dorsal (23) side of the radius.
Methods: Mean age of patients: 24.8 years. Twenty-four had developed proximal scaphoid pole avascular osteonecrosis (AVON). Operative technique was chosen based on vascularization, location of the fracture, prior failed operations, and availability of a pedicle. We evaluated results retrospectively and compared clinical, functional, and radiological outcomes.
Results: There was union in 46 of the 57 cases (81%). No significant differences in rate of consolidation were found between the 3 treatment groups; the highest, 87%, resulted from treatment with a ventral Mathoulin graft. The greatest improvement in grip strength was found in the iliac crest group (from 70% to 91%). The minor one in the dorsal vascularized graft group (from 81% to 83%). Major improvement in ROM was found in the iliac-crest group from 105 preoperative to 130 postoperative in F/E. The minor improvement was in the group of dorsal vascularized grafts. Even if the improvement in ROM wasn't significant. Fifty of 57 patients returned to work after a median time of 13 weeks, without differences between the treatment-groups. Iliac crest grafts yielded major correction of preoperative angles.
Conclusion: Iliac crest grafts afforded the best reconstructions and the best clinical results in grip strength and ROM, but in these cases there were better circumstances for good healing because of a better blood supply. The vascularized grafts allows a comparable consolidation rate and a similar outcome in the Mayo score, of more difficult cases with AVON. But shows less increase in ROM and grip strenght.
Therapeutic study with a Level of evidence: IIa

FM47

Gram staining in hand phlegmona

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Objective: Gram staining yields a very low sensibility in the predilection of positive microbiological cultures in septic arthritis. The role of Gram and acridine-orange staining in non-arthritic hand phlegmona remains unknown.
Methods: Retrospective study at Geneva University Hospitals. Paediatric patients, atypical pathogens and arthritis cases were excluded. Stains were performed in the hospital-own laboratory by collaborators with long experience in microbiology.
Results: Among 126 episodes of pyogenic hand phlegmona, only 42 episodes (33%) revealed a positive Gram-staining and 16 episodes (13%) revealed a positive acridine-orange staining. When there was an abscess, the Gram-stain was positive in 50% of cases. The Spearman-correlation coefficient between Gram and acridine -staining was 0.49. In a multivariate logistic regression analysis, the presence of an abscess/collection was positively correlated with a positive Gram stain (odds ratio 11.6, 95% confidence interval 3.0–44.3), while the duration of empirical antibiotic therapy (continuous variable) before the first surgical intervention was inversely related (OR 0.2, 95%CI 0.1-0.8). Age, immune suppression, tumefaction, number of fingers involved, fever or the serum C-reactive protein level on admission did not improve the low performance of Gram-staining.Local costs for Gram and acridine-orange staining were 23 and 29 US$, respectively.
Conclusion: Gram-staining is relatively costly and not helpful in the immediate confirmation of clinically suspected infection in hand phlegmona, especially if the patients are pre-treated with antibiotics. Acridine-orange yielded even worse results.

FM48

Short duration of antibiotic administration concomitant to surgical drainage does not enhance recurrence risk of hand phlegmona

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Objective: The ideal duration of prescription of antibiotic agents after surgical drainage for non-mycobacterial hand phlegmona is unknown.
Methods: Retrospective study at Geneva University Hospitals. Only first episodes among adult patients included. Exclusion of atypical pathogens such as mycobacteria, fungi and nocardia.
Results: A total of 126 patients (median age 45 y; 68 females; 9 immune suppressed) with hand phlegmona were retrieved. All patients underwent surgical exploration and drainage for hand phlegmona; together with a median duration of postsurgical antibiotic therapy of 15 days (range, 7–82 d), of which a median of 3 days intravenously (range, 0-55 d). Twenty cases were due to animal bites, the majority were community-acquired trauma with a median delay between onset and first surgical exploration of 3 days. Only eight patients were febrile, ten revealed a proximal lymphangitis and 18 were under antibiotic treatment on admission. Only one surgical intervention was performed in 109 episodes, two in 14, three in 2, and four interventions in one episode, respectively.
There were only three clinical recurrences (or new episodes; 2%) after a median follow-up of 2 years. However, in total 18 patients (14%) suffered from long-term sequalae such as stiffness, functio laesa and pain. In an unmatched multivariate logistic regression analysis adjusting for case-mix, only the presence of a collection/abscess was significantly correlated with long-term sequalae (odds ratio 4.6, 95% confidence interval 1.5–14.1), whereas gender, age, immune suppression, serum C-reactive protein levels, the number of finger involved, or the number of surgical interventions were not. A prolongation of antibiotic treatment beyond 10 days was formally not protective from long-term sequalae or recurrence.
Conclusion: Provided that there is surgical drainage performed, concomitant oral antibiotic therapy for hand phlegmona could be reduced to at maximum of 10 days. The presence of phlegmona with abscesses harbors a worse functional outcome. Prospective randomized trials are needed to confirm this assumption.

FM49

CapFlex-PIP® – A new modular surface-gliding arthroplasty: From the idea to the product placement

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Introduction: Various implants of different materials are currently used for proximal interphalangeal joint (PIP) replacement, but each implant has some disadvantage like instability, large bone resection or missing osteointegration. These knowledge places important requirements in the development of an implant. This study shows the cycles of the development and product placement of a new medical product, illustrated by the modular surface-gliding implant CapFlex-PIP®.
Methods: The development of a medical product includes different steps until the first implantation. Beginning with the idea and the analysis of the clinical problem, about searching of industrial and scientific partners, the construction and realization of the implant, there is a testing phase with some technical tests, first implantation in cadavers as well as following analyses. Clinical use can be initiated after CE registration. From its first implantation in patients the safety and performance of the CapFlex-PIP® implant was evaluated by clinical studies and systematic prospective documentation including clinical examination parameters, patient-reported outcomes and complications, with follow-up at 6 weeks, 3, 6 and 12 months. Further follow-up at 2 and 5 years are planned.
Results: The development of the CapFlex-PIP® implant took 5 years. After the design phase, the biomechanical studies and the risk analysis required for CE mark, the first patient's implantation could be performed. For the clinical trail, approved by the ethic committee, between 09/2010 and 11/2011, 10 patients were included in a pilot study and followed up until 12 months after surgery. Compared to preoperatively, the range of motion increased slightly from 42° to 51° ($p = 0.312$), the pain relief improved significantly from 7.9 to 1.1 ($p = 0.018$), the quickDASH decreased significantly from 43 to 15 points ($p = 0.007$) and adequate joint stability was found in 9 patients. Supported by these promising results, the implant was increasingly used. Until 01/2014 48 operated patients were documented in our local clinical register.
Conclusion: As shown by the example of the CapFlex-PIP® implant, the development and clinical introduction of new orthopedic implants is a long process. Different steps have to be completed, in which laboratory testing and clinical studies are essential. Systematic early documentation should be performed to demonstrate the clinical benefit for the treated patients.

Free communications V

FM50

Influence of Obesity on Revision and Infection Rates after Primary Total Knee Arthroplasty

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Introduction: Obesity is highly prevalent in patients undergoing Total Knee Arthroplasty (TKA). Previous studies assessing the influence of obesity on revision and infection rates after primary TKA have led to controversial results. Our aim was to assess the effect of different categories of BMI on revision and infection rates after primary TKA.
Material and Methods: We conducted a prospective cohort study at the Geneva University Hospitals including all primary TKAs performed in our institution between April 1998 and December 2011. Outcomes were all-cause revision and deep infection as a function of BMI categorized according to WHO classification. Additionally, stratification for sex was performed. Effects were measured using incidence rates and rate ratios (IRR). Adjustment for baseline imbalances was performed using a propensity score.
Results: A total of 2,816 primary TKAs performed in 2,321 patients were included (mean age, 72 years; 69% women). Mean follow-up was 76 months (range, 2–183). Baseline characteristics showed that increasing BMI was associated with a higher proportion of women, decreasing age and more frequent comorbidities. Stratification of these characteristics according to sex revealed that men undergoing TKA were younger and had more medical comorbidities. Over the study period, we observed 70 (2.5%) revisions and 33 (1.2%) infections. Comparing different BMI categories, an increase in both revision and infection rates was noted at a BMI cut-off of 35. There were 7.0 vs. 3.3 revisions/1000 P-yrs and 3.5 vs. 1.5 infections/1000 P-yrs for a BMI ≥35 and <35, respectively. Adjusted IRRs were 2.1 (95% CI 1.2–3.5) for revision and 2.3 (95% CI 1.1–5.1) for infection. Stratification according to sex showed that both men and women with a BMI ≥35 were more at risk for revision and infection than those <35. This difference was more pronounced in men.
Conclusion: We found that primary TKA in patients categorized as obese class II and higher (BMI ≥35) was associated with a two times higher rate of revision (for any cause) and deep infection. The effect was stronger in men than in women.

FM51

Patient-reported outcomes allow to determine treatment success after total knee arthroplasty

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Introduction: Patient-reported outcome measures assessing joint-specific and general health parameters are a cornerstone of outcome assessment following joint surgery. Recently measures of patient satisfaction have risen to prominence as an overarching assessment of outcome. In our study we employed a comprehensive definition of patients' view on treatment success encompassing patient satisfaction, functional increase, pain relief and willingness to undergo the same procedure again.
We aimed at evaluating thresholds of 'treatment success' for the joint-specific WOMAC osteoarthritis index and the EQ-5D questionnaire, a general health measure.
Methods: This is a retrospective analysis of prospective cohort study data, from the TKA registry at the Kantonsspital St. Gallen (Switzerland). Consecutive cases over a 5 year period providing 1-year follow-up data for the WOMAC, the EQ-5D and completing single questions regarding treatment success were included. We considered treatment to be successful, if the patient reported a high level of satisfaction, pain relief, functional increase, and willingness to undergo the same procedure again. This strict criterion allowed to create a dichotomous external criterion for receiver operator characteristics (ROC) analysis to determine treatment success thresholds for the WOMAC and the EQ-5D.
Results: Data from 1051 patients one year after TKA were analysed. 62.6% were female, mean age was 68.9 years (SD 9.8). 75.0% reported high treatment satisfaction, 87.7% reported willingness to undergo the same procedure again, 81.8% reported functional increase, and 89.5% reported pain relief. In total, 68.6% affirmed all four criteria and were classified as 'treated successfully'. ROC analysis on predicting treatment success with the WOMAC showed an area under curve (AUC) of 0.83 (95% confidence interval 0.80-0.86). For the EQ-5D the AUC was 0.77 (95% confidence interval 0.74-0.81, chance in ROC analysis is reflected by an AUC of 0.50). The WOMAC threshold for determining 'treatment success' with equal sensitivity and specificity was 11.5 points when scoring the WOMAC total on a 0–100 scale with high scores indicating poor outcome.
Conclusion: The WOMAC scores are highly predictive of 'treatment success' after TKA at a threshold of 11.5 points. The EQ-5D as a general health measure performs somewhat worse in determining treatment success after TKA. Availability of thresholds may facilitate interpretation of WOMAC scores.

FM52

Neuropathic pain after primary total hip and knee arthroplasty

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Introduction: A sizeable number of patients continue to suffer from pain after total joint arthroplasty (TJA). The reason for this is not well established, and the presence of persistent postsurgical pain (PPSP) of neuropathic origin has been suggested. Possible mechanisms include intraoperative nerve injury, local inflammation, and central sensitization. Little is known about neuropathic pain after joint replacement. Leptin could play a role via its pro-inflammatory function. Our objectives were to (1) assess the prevalence of neuropathic pain 2 years after TJA, (2) describe its influence on pain, function, general health and satisfaction after surgery, and (3) identify preoperatively assessed predictors of PPSP of neuropathic origin.
Methods: Prospective cohort study including patients with total hip and knee arthroplasty operated upon for primary OA in a large orthopaedic center between 1 and 12/2010. Prior to surgery baseline characteristics were recorded and leptin concentrations were sampled from blood (n = 175 TJAs) and assessed using an ELISA kit. At 2 years postoperative, the following outcomes were assessed via questionnaire: (1) Presence of neuropathic pain measured with Neuropathic Pain Diagnostic Questionnaire (DN4); (2) Pain, function and general health measured with WOMAC, VAS pain, SF-12; and (3) Satisfaction.
Results: 275 TJAs were included, 161 THAs and 114 TKAs. Mean age was 72 (±9) years, mean BMI 28 kg/m², 62% were women. Neuropathic pain at 2 years postoperative was reported by 5 THA (3.1%) and 11 TKA patients (9.6%). Its presence was associated with significantly higher residual pain levels, lower function, worse general health and low satisfaction. Eight of the 16 patients with neuropathic pain indicated they would not undergo the operation again.
Prior to surgery patients with neuropathic pain (vs. those without) had a significantly higher BMI (32 vs. 27 kg/m²), higher ASA scores, more often OA of contra-lateral joints, greater pain (WOMAC pain 29 vs. 41), as well as significantly higher serum leptin concentrations (37 vs. 24 ng/ml, p = 0.020). The latter association was seen in obese (55 vs. 44 ng/ml) and in non-obese patients (23 vs. 16 ng/ml).
Conclusion: Neuropathic pain is more frequent after knee than after hip arthroplasty. Its presence is associated with poor outcomes. Whether leptin is involved in the pathogenesis and /or a useful preoperative marker of neuropathic pain, merits further investigation.

FM53

The effects of end-of-range grade A+ mobilisation following acute primary TKA

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Introduction: Although the number of total knee arthroplasties (TKA) being performed are increasing worldwide, the rehabilitation protocols following surgery are poorly studied in the literature. Research suggests that exercise therapy and graded mobilisation are recommended in late stages of osteoarthritis. When these options fail, a TKA is required. However, the literature has yet to determine best practice for immediate post operative rehabilitation. Lack of knee range of movement (ROM) is a common postoperative issue following TKA. Our study hypothesised that adding A⁺ graded mobilisation combined with the standard in-hospital rehabilitation protocol could improve ROM without increasing pain.
Methods: We designed a randomised controlled trial and applied it in our university hospital. Outcome measures were performed before surgery and at the first, the third and the seventh day following TKA. 32 patients with a mean age of 71.1 years (±8.9) were allocated to two equal groups via computerized randomisation. Both groups had equal ROM and VAS at baseline. The experimental group (EG) received the standard care plus graded A⁺ knee stretches in flexion and extension, twice a day, using the Joint Active Systems® knee device. The main outcome measure was active and passive knee range of movement using the universal goniometer and VAS-pain score.
Results: There were no statistically significant differences in ROM or VAS in all measurements (p >0.05). Subgroup analysis showed that non-obese patients experienced higher VAS (p = 0.028).
Conclusion: The RCT indicated that graded A⁺ mobilisation combined with the standard protocol is a safe treatment post TKA. However, there was no statistically significant improvement of adding the A⁺ graded mobilisation to the standard protocol, despite some increasing trends in ROM within the EG (compared to the control group). There is unanimous consensus among researchers that the rehabilitation method requires further specific, in depth investigation.

FM54

Patella Baja and Pseudo-Patella Baja after navigated standard TKA – is there a clinical relevance?

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True patella baja (PB) and pseudo-patella baja (PPB) are frequently found radiographic conditions after total knee arthroplasty (TKA). Whereas PB is a real shortening of the patellar tendon, PPB results from an elevated joint line after TKA. However, only little data exists about their clinical relevance. It was the aim of this study to analyze a large and consistent collective of patients after TKA with special focus on the clinical effect of PB and PPB.
Only our standard navigated primary TKAs (LCS, DePuy) that were implanted in a single institution between 2008 and 2012 were included in this study. An independent investigator prospectively collected the clinical data (ROM, WOMAC and revision surgery). PB (modified Insall-Salvati Index (mIS)) and PPB (Blackburne-Peel Index, BP) were assessed retrospectively on lateral radiographs in 30° of flexion (pre-, postoperatively and after 1 year of follow-up (fup)).
A total of 356 TKAs (331 patients (194 female), mean age 69y (48–94)) met the inclusion criteria with a complete clinical and radiographic fup of 1 year. PB was defined as mIS <1.2 and PPB as BP <0.5. The mean mIS (1.45 to 1.40, p <0.01) significantly decreased, whereas the mean WOMAC (51 to 14, p <0.01) significantly improved and the mean Flexion (115° to 114°, p = 0.53) showed no difference from preoperative to the 1-year fup. PB was found in 41 knees (11.5%), PPB in 99 (28%) knees and both were present in 28 (7.9%) knees at the 1-year fup. PB showed no significant influence on the final function, whereas patients with PPB were found to have significantly restricted Flexion (111° vs. 115°, p <0.01) and higher (worse) WOMAC score (17.7 vs. 12.2pts, p <0.01) at the 1-year fup. PB and PPB showed no significant influence on the rate of revision surgery (19 TKAs, 5.3%).
In this study's large collective of patients after primary standard navigated TKA, neither pre- nor postoperative PB showed any significant influence on the functional outcome. However, patients with PPB, defined as <0.5 Blackburne-Peel Index, showed significant functional restrictions at the 1-year fup. Whereas the clinical relevance of restricted Flexion is questionable, the difference in WOMAC score is supposed to be clinical relevant, as the level of minimal clinical important difference (MICD: 26%) has been reached. Thus, respecting this study's finings, an elevation of the joint line resulting in a BP index of <0.5 should be avoided.

FM55

Radiographic accuracy in TKA with a CT-based patient-specific cutting block technique

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Purpose: Patient-specific instrumentation (PSI) technology for the implantation of total knee arthroplasty (TKA) has a rising interest in the orthopaedic community. Data of PSI are controversially discussed. The hypothesis of this paper is that the radiological accuracy of CT-based PSI is similar to the one of navigated TKA published in literature.
Methods: Since 2010 all 301 consecutively performed PSI TKAs (GMK MyKnee©) were included in this study. The radiological assessment consisted in a pre- and postoperative standard x-ray and long-standing x-ray. Changes from the planned to the definitively implanted component size were documented. Postoperative analysis included limb alignment and position of femoral and tibial components (for varus/valgus and flexion or tibial slope).
Results: The postoperative average hip-knee-ankle angle (HKA) was 180.1 ± 2.0°. In the frontal plane a total of 12.4% of outliers >3°, for the tibial components 4.1% of outliers >3° and for the femoral components 4.8% of outliers >3° were measured. A total of 12.3% of outliers for posterior tibial slope and 9% of outliers >3° for the femoral flexion were noted. 10.8% of the 602 planned size components were adapted intraoperatively.
Conclusion: Although it is still unknown which limb axis is the correct one for the best clinical result a technology providing the aimed axis in a most precise way should be chosen. CT-based PSI technology reach better radiological accuracy than conventional instrumented TKA and similar to navigated TKA.

FM56

Early survival and radiological results of 132 consecutive cases of medial Zimmer Unicompartmental High Flex KneeTM Arthroplasties

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Introduction: Ideal treatment for isolated medial unicompartmental knee osteoarthritis is still a matter of debate. UKA is an established surgical option. Aim of this prospective study was to evaluate the clinical and radiological outcomes of 132 consecutively implanted medial Zimmer Unicompartmental High-Flex-Knee System™ (ZUK).
Methods: We present a single-center cohort study from an independent teaching hospital. From September 2006 to November 2010 a total of 132 medial ZUK were implanted in 106 patients. Survival analysis was performed using Kaplan-Meier method with three different endpoints: (a) revision with exchange of any component (b) revision due to aseptic loosening and (c) a worst-case scenario counting cases with aseptic loosening and the UKA with progressive radiolucencies as failure. Clinical outcome was assessed using the American Knee and the Oxford Knee Score. Radiological follow-up was done according to the American Knee Society Radiographic Evaluation and Scoring System adapted for UKA.
Results: The average age at the time of surgery was 69 years (SD 9). Two patients (three UKA) died during follow-up and two UKA were lost to follow-up. Five UKA were revised to a TKA, three for aseptic loosening of the tibia, one because of an acute ACL rupture and one due to infection. Five year survival was 95.2%, 97.5% and 87.7% for the aforementioned endpoints. Component alignment was unchanged during follow-up. Radiolucencies were found in 44 UKA (33%), seven (5%) had progressive radiolucent lines.
Conclusion: The ZUK showed excellent clinical and radiological results in the early follow-up, comparable to data from national registers and other successful designs.

FM57

Early experience with unlinked patellofemoral resurfacing and focal medial femoral condyle resurfacing

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Introduction: Chondral lesions of the knee are difficult to treat. The standard treatment consist of total knee arthroplasty (TKA) or unicompartimental knee arthroplasty (UKA). The purpose of this study is to evaluate the results of focal medial femoral inlay resurfacing and focal trochlear and patella resurfacing in the treatment of full thickness cartilage defect in the medial femoral condyle, the trochlea and the patella of the knee beyond 2 years of treatment, in patients judged too young and with limited cartilaginous lesions to benefit from a TKA or a UKA.
Material and Methods: This a prospective review of our initial consecutive series of 9 patients who met the indications of focal medial osteochondral lesions and focal trochlear osteochondral lesions. There was four males and five females with an average age of 58 years (55–64 yo). All patients had knee arthroscopy 3 months prior to the intervention. The inclusion criteria were a healthy external compartment, a balanced ligamentous knee with no ACL or PCL lesion, and no cartilaginous lesions on the medial tibial plateau. No tourniquet was used. Medial femoral condyle lesions were treated with the Hemicap contoured articular resurfacing implant and the patello femoral arthroplasty (PFA) with the Arthrosurface wave system. The average follow up was 26 months (24-30 months). We measured and evaluated the VAS scale, the WOMAC, the IKDC as well as physical and radiographic evaluation.
Results: No intraoperative complications occurred. All 9 patients noted the disappearance of anterior femoro patellar pain already at 3 months after surgery. All patients were satisfied with their operation at their follow-up (average 30 months) and recommend it. None had an infection or a secondary revision surgery. No loosening were noted on the radiographic follow up control. The follow up total WOMAC score averaged 91 ± 8. On IKDC examination 90% had normal results.
Conclusion: Early results for focal articular medial femoral condyle resurfacing associated to a focal trochlear and patella resurfacing suggest to be an effective reconstruction option for large full thickness cartilage and osteochondral lesions of the knee in middle aged patients. This bone preserving procedure should offer more possibility for long term knee revision surgery if needed.

FM58

Lateral subvastus approach with osteotomy of the tibial tubercle – complication and functional outcome

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Introduction: The lateral subvastus approach is a reputable alternative to the most common medial parapatellar approach. The exposure and the positioning of the femoral component is more accurate especially in valgus deformities and limited patellar tracking. The aim of this study is to compare the complications and the functional outcome between the lateral subvastus approach with tuberosity osteotomy and the medial parapatellar approach.
Method: Starting from February 2006 until August 2012 589 patients underwent primary total knee replacement due to osteoarthritis. In 91 cases we applied the lateral subvastus approach. In comparison we selected 498 cases with the medial parapatellar approach as control group, which were operated under the similar conditions. All patients' data were included in the register and controlled at 12 months postoperatively. The data set contains: demographic data, complications related to tuberosity osteotomy, Range of Motion, WOMAC Score and the Forgotten Joint Score-12. For statistical analysis descriptive analysis, paired and unpaired t-test and the chi-squared test were performed (p-value ≥0.05).
Results: 4 out of 91 patients received a revision because of complications related to the tuberosity osteotomy, three patients needed an additional screw fixation and one patient a revision of failure of wound healing. There was no significant difference in any of the clinical outcome parameter one year after surgery. The WOMAC scores tend to result better in patients with the lateral subvastus approach combined with tuberosity tubercle osteotomy.
Conclusion: One year postoperatively the clinical outcome after TKR using the lateral subvastus approach combined with tuberosity tubercle osteotomy is comparable with those of the medial standard approach. The number of complications related to the osteotomy was low. We conclude that the lateral subvastus approach with osteotomy of the tibial tubercle is a good alternative especially for valgus deformities.

FM59

Medial bony support as an indicator for the selection of the osteosynthesis procedure in complex bicondylar proximal tibia fractures

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Objectives: Various methods for the fixation of complex bicondylar proximal tibia fractures (AO 41-C-type) are published. Lateral locking plate fixation and medial-lateral double plate fixation are based on different biomechanical concepts. Our hypothesis was, that lateral locking plate fixation using a strong angular stable implant yields similar results compared to double plate fixation even in cases with missing medial bony buttress.
Methods: We performed a retrospective radiological analysis of a comparable group of patients treated either with a single less invasive lateral proximal stabilization system (LISS-PLT) or medio-lateral double LCP fixation. Included were local resident patients with complete radiological follow-up until fracture consolidation. The main outcome parameter was the measurement of the medial proximal tibia angle (MPTA) postoperatively and after fracture healing.
Results: From 2002 until 2012, 137 proximal tibia C-type fractures were treated at our institution. 60 patients (30 patients in both groups) were locally resident and could be evaluated. Patient's characteristics were similar in sex, age, fracture classification and concomitant soft tissue injuries. In the LISS group, 18 showed no medial bony buttress. 13 of these showed an increased varisation between two and five degrees, whereas only 1 out of 12 patients with medial bony buttress revealed varisation ($p < 0.001$).
A total of 14/30 patients in the LISS group showed an increased varisation compared to 0/30 patient in the LCP group ($p < 0.001$; OR 4.4)
Conclusion: A unilateral LISS fixation of complex proximal tibia fractures showed to be sufficient in fractures with bony medial support. Due to an increase in varisation, double plate osteosynthesis should be preferred in fractures lacking medial bony buttress.

FM60

An alternative lateral para-patellar approach for nailing of tibia fractures

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Introduction: Medial para-patellar or trans-patellar ligament approaches are commonly used for nail osteosynthesis in tibia fractures. The lower leg is normally in a hanging position to allow guide wire insertion or reaming of the tibia. This position however, complicates image intensifier use and also retention of the fracture reduction. The purpose of this study was to introduce a lateral para-patellar incision with horizontal positioned lower leg, facilitating reduction and image intensifier use and comparing this approach to the medial para-patellar and trans-patellar incision.
Methods: 73 patients with OA type 42 A-C tibial fractures using one of the aforementioned approaches were analyzed regarding operation procedure, i.e. operation and fluoroscopy time.
Results: Of all 73 patients, a transpatellar approach was used in 29, a medial in 18 and a lateral in 29 patients. Patients' characteristics were similar regarding gender and body mass index. Operation time was significantly shorter using the lateral approach (96 min ±29) compared to the transpatellar (126 min ± 30) or the medial (105 min ± 29) approach. Likewise, shorter image intensifier time was documented in the lateral approach (211sec ±189) compared to the transpatellar (347sec ± 204) or the medial (241sec ± 222).
Conclusion: The extra-articular semi extended tibial nailing technique using a lateral parapatellar approach was associated with a significant decrease in time of surgery, while fluoroscopy time was shorter but not significantly different between the three groups.

Free communications VI

FM61

The Anatomical course of the lateral femoral cutaneous nerve with special attention to the anterior approach to hip joint

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Introduction: Commonly used in orthopaedic surgery, the anterior approach to the hip joint places the lateral femoral cutaneous nerve (LFCN) at risk for iatrogenic injury. Several anatomic studies have focused on variations in the nerve as it exits the pelvis in relation to the anterior superior iliac spine (ASIS). Surgeons using the anterior approach must also be aware of variations in the course of the LFCN in the upper thigh. The aim of this cadaveric study was to demonstrate the spreading pattern of the nerve with attention to the incision for the anterior approach to the hip joint.
Methods: Dissection of the inguinal region and upper thigh were performed on twenty-eight lower extremities. The LFCN was dissected proximal to the inguinal ligament and the distal course of the nerve branches was examined in relation to the borders and sections of the tensor fasciae latae and sartorius muscles.
Results: The course of the nerve branches of the LFCN can be categorized into three different types. Sartorius-Type (n = 9): The main branch of the LFCN follows the lateral border of the sartorius and gives off smaller braches to the lateral thigh. Lateral-Type (n = 10): The main branch of the LFCN turns laterally only a few Millimetres distal to the ASIS. Broom-Typ (n = 9): By giving up multiple smaller branches the LFCN spread laterally over the whole section of the tensor muscle.
Discussion: The incision used for the anterior approach to the hip joint always lead to a certain degree of damage of the LFCN. However, iatrogenic nerve damage in the Sartorius and Lateral types (2/3 of the cases) can be reduced by keeping the incision 1) 2 cm or more distal to the ASIS and 2) as much lateral as possible. Nerve damage in the broom type is frequently not avoidable and is determined by the nerve distribution.

FM62

Effect of Labrum on Hip Range of Motion in 3D Hip Simulation

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Introduction: Since more than one decade three dimensional (3D) computer simulation of hip range of motion (ROM) is performed for better understanding the impact of different hip morphologies on ROM, localization of impingement zones and to plan treatment options. Until now labrum and cartilage was not included in such simulations. In a first pilot study, we wanted to test the hypothesis that, when compared to bone only simulation, segmentation of labrum and cartilage would decrease ROM and change contact zone locations.
Material and Methods: A 3D hip model was created out of an arthro-contrast computed tomography of one female cadaver. Labrum and cartilage were segmented manually, bone semi-automatically using MeVisLab (MeVis Medical Solutions AG and Fraunhofer MEVIS, Bremen, Germany) and Mimics Software (Materialise, Leuven, Belgium). ROM simulation and contact zone detection was done in a custom made computer program [1]. The results of ROM and contact zones were compared between bone only and labrum-cartilage model.
Results: For planar movements, differences between the two models ranged between 0° (for internal rotation in neutral position) to 39° (for hip extension). In average, labrum-cartilage segmentation reduced ROM by 14°. Similar differences were also seen for combined movements. Where contact zones occurred due to a non-spherical head-neck junction, differences between the two models were smallest. The location of contact zones changed from the Ischium to the posteroinferior acetabular rim for adduction movements; from the anterosuperor to the posterosuperior rim for abduction; and from ther posterosuperior to the posteroinferior rim for extension movements.
Discussion: Our hypothesis that labrum and cartilage segmentation would decrease ROM and change contact zone location was verified. Depending on the research question, inclusion of labrum-cartilage model simulation can make a relevant difference.

1 Developed and Programmed in collaboration with the Computer Vision Laboratory, ETH Zurich, Switzerland and the Computer Asssisted Research and Development Group, Uniklinik Balgrist, Univeristy of Zurich, Switzerland.

FM63

Size and Shape of the Lunate Surface in Different Types of Pincer Impingement: Implications for Surgical Therapy

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Acetabular rim trimming is indicated in pincer hips with an oversized lunate surface but could potentially result in a critically decreased size of the lunate surface in pincer hips with malorientation of the acetabulum. There is a lack of detailed 3-dimensional information on the anatomy of lunate surface in pincer hips. Therefore, we questioned how does (1) size and (2) shape of the lunate surface differ among hips with different types of pincer impingement?
We retrospectively compared size and shape of the lunate surface between acetabular retroversion (48 hips), deep acetabulum (34 hips), protrusio acetabuli (seven hips), normal hips (30 hips), and hip dysplasia (45 hips). Using MRI arthrography with radial slices we measured size in percentage of the femoral head coverage and shape using the outer (inner) center-edge angles and width of lunate surface. Hips with retroversion had a decreased size and deep hips had normal size of the lunate surface. Both had a normal shape of the outer acetabular rim. Protrusio hips had an increased size and a prominent outer acetabular rim. In all three types of pincer hips the acetabular fossa was increased.
Size and shape of the lunate surface differs substantially among different types of pincer impingement. Most importantly, we did not find an increased size of the lunate surface in retroversion or deep hips. These results have direct implications on the choice of surgical treatment and the amount of surgical correction.

FM64

The prevalence of abdominal hernias in patients with symptomatic femoroacetabular impingement

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Introduction: Various pathologies can induce groin pain, so the diagnosis of symptomatic femoroacetabular impingement (FAI) can be challenging. One differential diagnosis is abdominal hernia. The aim of the present study was to evaluate the prevalence of abdominal hernias in a consecutive cohort of FAI patients.
Methods: The cohort comprised a consecutive series of 79 patients (87 hips) with clinical symptoms and radiographic evidence of FAI. There were 37 females and 42 males. The mean age was 29.5 years (range, 12–64 years). All patients underwent an ultrasound evaluation of the involved groin. Diagnostic injections of the symptomatic hip joints were also performed. Basic demographics were collected and radiographic parameters were analyzed.
Results: Sonographic evidence of abdominal hernias was found in 34 (39%) of the hips. There were seven femoral and 24 inguinal hernias, in three cases they occurred concurrently. Six of the patients with hernias reported either no or only minimal improvement upon diagnostic intra-articular injection. Two of these patients had signs of insertional tendinopathy at the os pubis, and four underwent surgical repair of their hernia. There were no statistically significant differences regarding age, center-edge angle, acetabular version, femoral neck-shaft angle.
Conclusion: With a prevalence of almost 40%, abdominal hernias seem to appear frequently concurrently with FAI. Diagnostic intra-articular injections could differentiate between the source of pain, highlighting that in most cases the observed hernias were not responsible for patients' symptoms. In patients who do not respond to an intra-articular injection, ultrasound of the groin may therefore be an important diagnostic tool to identify abdominal hernias as source of groin pain similar to FAI symptoms. These patients may require referral to a general surgeon for further treatment.

FM65

Relative Neck Lengthening In Complex Proximal Femoral Deformities: Technique, Complications, And 5-year Results

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Surgical hip dislocation and extended soft-tissue retinacular flap are techniques that allow a tailored treatment of complex proximal femoral deformities. Specifically, relative femoral neck lengthening (RFNL) is a new technique to address intra- and extraarticular femoroacetabular impingement. We evaluated clinical and radiographic outcome, complications, and conversion rate to total hip arthroplasty after RFNL with combined head-neck offset osteochondroplasty and advancement of the greater trochanter in hips with complex proximal femoral deformities.
We retrospectively reviewed 42 patients (43 hips, mean age 23 years) that underwent RFNL. Underlying conditions included sequelae of Legg-Calvé-Perthes disease (40 hips, 93%), slipped capital femoral epiphysis (2 hips, 5%), and septic hip arthritis (1 hip, 2%). We obtained abductor muscle strength, Merle d'Aubigné-Postel score, limp, range of motion, and anterior and posterior impingement test. Radiographic parameters included osteoarthritis (OA), alpha angle, sagging rope sign and trochanteric height. Complications were assessed using the Clavien Dindo classification modified by Sink et al. Mean follow-up was 7.8 (range, 5.1–11.1) years.
Abductor muscle strength, Merle d'Aubigné-Postel score, range of motion (internal and external rotation, and abduction) improved. Limp and the anterior and posterior impingement test were less prevalent. The alpha angle improved. Trochanteric height was normalized. The center collum diaphyseal angle was unchanged. Progression to OA was not prevented. There were 7 complications (16%) requiring surgical intervention without long-term morbidity. Four hips (9%) converted to THA.
RFNL allows correction of combined intra- and extraarticular impingement in hips with complex proximal femoral deformities. Specifically, clinical symptoms in this young patient population suffering daily pain and restricted joint function compromising daily life and physical activity improved after surgery. The rate of complications was low. The benefits of this procedure in delaying severe progression of OA still have to be shown.

FM66

Surgical Hip Dislocation for Treatment of Femoroacetabular Impingement: Factors Predicting 10-year Survivorship

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Patients with femoroacetabular impingement (FAI) often develop pain, impaired function, and progression of osteoarthritis (OA). The surgical hip dislocation with femoral neck osteochondroplasty and acetabular rim trimming can be used to treat hips with FAI. We asked whether (1) hip function and pain improves and if (2) OA progression can be prevented at 10-year follow-up. Additionally, we determined (3) survival of the native joint and (4) factors predicting conversion to total hip arthroplasty (THA), OA progression, or insufficient clinical outcome. Between July 2001 and March 2003, we performed 97 surgical hip dislocations to treat FAI in 75 patients. Mean follow-up was 10.6 years (range, 10–12 years). One patient died 8.5 years postoperatively from a cause unrelated to surgery and with an uneventful follow-up. Three patients (5 hips, 5%) were lost to follow-up after 5.2–6.9 years with a good clinical and radiographic result. We used the anterior impingement test to assess pain, the Merle d'Aubigné-Postel score to assess function, and the Tönnis grade to assess OA. The end-points were defined as the need for conversion to THA, progression of OA by at least one Tönnis grade, and/or a Merle d'Aubigné-Postel score less than 15. Survival and predictive factors were calculated using the method of Kaplan and Meier and Cox regression, respectively.
The proportion of patients with anterior impingement decreased from 95% to 42% ($p < 0.001$). The Merle d'Aubigné-Postel score improved from a mean of 15 to 17 ($p < 0.001$). Eleven hips (11%) converted to THA and another 8 hips (8%) showed progression of OA. Three patients (3 hips, 3%) showed an insufficient clinical result. Survival free from any end-point at 10 years were 80% of the hips. Predictive factors for conversion to THA, progression of OA, and/or a Merle d'Aubigné-Postel score less than 15 were an excessive acetabular rim trimming, preoperatively OA (Merle d'Aubigné-Postel score >1), increased age at operation, and increased weight.
At 10-year followup, 80% of patients with FAI treated with surgical hip dislocation, femoral neck osteoplasty, and acetabular rim trimming showed no THA, no progression of OA, and no insufficient clinical result. Excessive acetabular trimming, OA, increased age, and weight were associated with early failure. To prevent early deterioration of the joint, excessive rim trimming or trimming of borderline dysplastic hips has to be avoided.

FM67

A Core Outcome Measures Index (COMI) for patients with femoroacetabular impingement

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Introduction: Patient-related outcome measures are required when evaluating the success of elective surgery. For a comprehensive evaluation, both generic and disease-specific instruments should be used; however, the use of several questionnaires increases the respondent burden and the administrative load, which impedes the systematic evaluation of outcome in clinical practice. We sought to evaluatea short, hip-oriented measure, based on the Core Outcome Measures Index (COMI), a validated instrument that requires just minutes to complete and has been used successfully in other areas of orthopedics/registries, including total hip replacement. The COMI-hip comprised just six items (pain, function, symptom-specific well-being, quality of life, and disability), extracted from established full-length questionnaires.
Methods: 159 consecutive patients undergoing surgery for femoroacetabular impingement (FAI) completed the following full-length questionnaires preoperatively and at 6 and 12 months' follow-up (FU): Oxford Hip Score (OHS), WOMAC, Hip Outcome Score (HOS), SF12, WHOQOL-BREF, EQ5D.The performance of the COMI-hip items (and sum-score) was compared with that of the full-length instruments.
Results: Scores for the single items of the COMI-hip correlated well with those of the full-length instruments from which they were extracted ($r = -0.62$ to -0.89). The COMI-hip sum-score also correlated well with the pain and function scores of the OHS and WOMAC ($r = -0.70$ to -0.85) and the HOS ($r = -0.60$ to -0.72), which was specifically developed for FAI patients. The internal responsiveness (Cohen's d for effect size) of the COMI-hip sum-score was similar to that of the HOS Activity of Daily Living (ADL) score (–0.76 and –0.68, respectively, at 12 months' FU). Significant

correlations were also found between the change scores of the COMI-hip sum-score and the change scores of the HOS ADL and HOS Sport at 6 months' FU (r = –0.62 and –0.60, respectively) and 12 months' FU (r = –0.69 and –0.61, respectively), illustrating the external responsiveness of the COMI-hip.
Conclusions: The results of the current investigation showed that the COMI-hip is a simple but valid and responsive outcome instrument for the efficient assessment of patients undergoing surgery for FAI. It performs at least as well as the current reference instrument for FAI (the HOS). It can therefore be considered a potentially valuable instrument for routine use in both research and clinical practice.

FM68

Is labral hypoplasia correlated with increased acetabular depth?

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Introduction: Labral hypertrophy and degeneration have been recognized as a distinct feature in DDH patients, assumed to be a result of elevated shear forces due to a lacking bony acetabular coverage. In the literature there is a lack of information concerning the size of the labrum for different shapes oft he acetabulum. Occasionally, very small, atrophic labra are observed. However, there is no literature concerning this pathology
Methods: We determined labral volumes on rotational-arthro-MRI of 20 hips with hypoplastic labra (gr. 1), 20 hips with normal labral appearance (gr. 2) and 10 hips with hypertrophic labra (gr. 3). We then measured the Neck-Shaft-Angle (NSA), the Lateral Center-Edge Angle (LCE), the Acetabular Index (AI) and the Femoral Extrusion Index (FEI) on plain ap pelvic radiographs to identify any significant differences between the 3 groups.
Results: Labral volumes in gr. 1 ranged from 6.2 to 16.1 mm^2 (mean 12.1 mm^2), from 17.5 to 43.2 mm^2 (mean 25.2 mm^2) in gr. 2 and from 24.3 to 61.6 mm^2 (mean 41.1 mm^2) in gr. 3 ($p < 0.001$). NSA were significantly higher in gr. 3 compared to gr. 2 ($p < 0.009$) on the side of the affected hip, no difference was found between gr. 1 and 2 or 1 and 3. LCE, AI and FEI were significantly different in gr. 3 (LCE: mean value of 11° compared to 30.2° in gr. 1 and 27.6° in gr. 2; $p < 0.001$; AI: mean value 16.4° vs gr. 1: 3.3°, gr. 2: 4.7°; $p < 0.001$; FEI: mean value 33.9% vs mean values gr. 1: 17%, gr. 2: 19%; $p < 0.001$). No significant difference was found betweeen groups 1 and 2 for all measured parameters, though a tendency towards higher LCE-angles, a lower AI and FEI in gr. 1 was observed. All subsets regression analyses showed a significant correlation between all radiographic parameters and labral volume with a corrected R^2 value of 0.278. Stepwise linear regression analyses showed a significant correlation between LCE angle and labral volume ($p < 0.001$) with a R^2-value of 0.301
Conclusion: Labral volume seems to correlate with the degree of acetabular containment, although no statistically significant difference between hips with normal labra and hypoplastic labra could be identified. Nevertheless, the group with the hypoplastic labra had the highest mean containment of all groups, the dysplastic group the lowest, resulting in the corresponding labral volumes. Probably a higher number of patients is necessary to yield a significant difference betweeen groups 1 and 2.

FM69

Distraction test of the posterior superior iliac spine (PSIS) in the diagnosis of sacroiliac joint arthropathy

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Background: The sacroiliac joint (SIJ) is a frequently underestimated cause of lower back (LBP). A simple clinical test of sufficient validity would be desirable. The aim of this study was to evaluate the diagnostic value of a new PSIS distraction test for the clinical detection of SIJ arthropathy and to compare it to several commonly used clinical tests
Methods: Consecutive patients, where a SIJ pathology had been confirmed by an SIJ infiltration were enrolled (case group, 61 SIJs in 46 patients). Before infiltration, patients were tested for pain with PSIS distraction by a punctual force on the PSIS in medial-to-lateral direction (PSIS distraction test), pain with pelvic compression, pelvic distraction, Gaenslen test, Thigh Thrust, and Faber (or Patrick's) test. In addition, these clinical tests were applied to both SIJs of a population of individuals without history of LBP (control group, 64 SIJs in 32 patients).
Results: Within the investigated cohort, the PSIS distraction test showed a sensitivity of 100 % and a specificity of 89 % for SIJ pathology. The accuracy of the test was 94%, the positive predictive value (PPV) was 90 % and the negative predictive value (NPV) was 100%. Pelvic compression, pelvic distraction, Gaenslen test, Thigh Thrust, and Faber test were associated with a good specificity (>90%) but a poor sensitivity (<35%).
Conclusions: Within our population of patients with confirmed SIJ arthropathy the PSIS distraction test was found to be of high sensitivity, specificity and accuracy. In contrast, common clinical tests showed a poor sensitivity. The PSIS distraction test seems to be an easy-to-perform and clinically valuable test for SIJ arthropathy.
Key words: sacroiliac joint pain; provocation test; joint infiltration; diagnostic value

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FM70

Periacetabular Osteotomy Does not Result in Restricted Range of Motion

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A periacetabular osteotomy (PAO) allows correcting the deficient acetabular coverage in dysplastic hips. However, increasing the acetabular coverage also can result in an iatrogenic femoroacetabular impingement (FAI). We asked the following questions: (1) does a PAO result in restricted ROM compared to normal hips?; (2) does a cam-morphology of the femur negatively affect ROM following PAO; and (3) how does a concomitant intertrochanteric osteotomy affect ROM?
We performed a retrospective comparative study. The study group consisted of 20 patients (27 hips) with developmental dysplasia of the hip (DDH). All patients underwent PAO with a mean age at operation of 27 ± 10 (range, 13–44) years. Nine hips (33%) had a valgus hip with high femoral antetorsion which underwent concomitant intertrochanteric varus and derotation osteotomy. All patients had pre- and postoperative CT scans. The normal group consisted of 19 patients (19 normal hips). ROM was computed using previously developed and validated software. The anterior pelvic plane was used as the pelvic reference system and for the femur the distal femoral condyles and shaft axis were used as reference system. Two ROM-patterns were analyzed: anterior impingement (combined flexion and internal rotation) and posterior impingement test (combined extension and external rotation).
For the anterior impingement test the dysplastic hips showed increased internal rotation (IR) compared to the normal hips (mean IR of 38° vs. 28° in 100° of flexion; $p = 0.008$). After PAO IR decreased and did not differ compared to the normal group (mean IR of 29° vs. 28° in 100° of flexion; $p = 0.806$). Hips with a cam-morphology showed a decreased IR following PAO compared to hips with a spherical head-neck offset and PAO (mean IR of 21.1° vs. 34.1° in 100° of flexion; $p = 0.116$). For the posterior impingement test hips following PAO and concomitant intertrochanteric osteotomy (IO) showed increased external rotation (ER) compared to hips with PAO without IO (mean ER of 34° vs. 15° in 5° of extension; $p < 0.001$).
An uncorrected cam-type morphology of the femur can result in restrict IR following PAO. Therefore, IR should be assessed intraoperatively after acetabular reorientation and if restricted IR is present an arthrotomy with offset creation is indicated. A valgus hip with high femoral antetorsion can lead to restricted ER following PAO. A concomitant derotational and varus IO could normalize ER.

FM71

Loss in the level of mobility following stabilization of trochanteric fracture in geriatric patients: The key role of the neglected greater trochanter fragment.

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Background: Patients suffering from trochanteric fractures are most likely to experience a drop in the level of mobility and home independence irrespective of the surgical technique used for stabilization. The importance of the greater trochanter to the ability to walk is well accepted, but the influence of a dislocated or malunited greater trochanter fragment in a trochanteric fracture on patient's mobility is not known. The aim of this study is to determine if there is an association between the greater trochanter position and the level of mobility following internal fixation of trochanteric fractures.
Methods: Between January 2011 and March 2012, all patients treated for a fragility trochanteric fracture were prospectively assessed for their mobility before and one year after the fracture treatment using the Parker mobility score. In a multivariate analysis, the influence of a dislocated or malunited greater trochanter on patient's mobility at one-year follow-up was assessed, adjusted for age, gender, body mass index, Charlson comorbidity index, AO fracture classification, and Parker mobility score before fracture.

Results: In the study period, 133 patients with a median (interquartile range [IQR]) age of 85 years (79–91) were operated, out of which 105 (79%) were female. During follow up, 66 (50%) patients had a displaced or malunited greater trochanter fragment. One year mortality rate was twenty-four per cent (n = 32). The median (IQR) Parker mobility score before fracture and at one-year follow-up was 9 (4–9) and 7 (3–9) in patients without, and 8 (4–9) and 3 (2–5) in patients withdisplacement or malunion of the greater trochanter. In multivariable analysis, a malunited or displaced greater trochanter was significantly associated with a lower Parker mobility score (–2.09, 95% confidence interval –2.75, –1.44, p <0.01).
Conclusion: Greater trochanter position following internal fixation of trochanteric fractures has a major impact on the drop of mobility and home independency. Therefore, surgeons have to focus on the adequate reduction and stabilization of this fragment during internal fixation. Moreover, future implant developments are needed in conjunction with existing nails to allow minimally invasive reduction and stable fixation of this key fragment.

FM72

Extracortical plate fixation with new plate inserts and cerclage wires for the treatment of periprosthetic hip fractures

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Introduction: Fixation of periprosthetic hip fractures with intracortical anchorage might be unfeasible in cases with bulky implants and/or poor bone stock.
Methods: Rotational stability of new plate inserts with extracortical anchorage for cerclage fixation was measured and compared to the stability found using a standard technique in a biomechanical setup using a torsion testing machine. In a synthetic PUR bone model, transverse fractures were fixed distally using screws and proximally by wire cerclages attached to the plates using "new" (extracortical anchorage) or "standard" (intracortical anchorage) plate inserts. In a consecutive series of 18 patients (18F; mean age 81yrs, range 55–92) with periprosthetic hip fractures (10 Type B1, 8 Type C-Vancouver) treated with the new device between 07/2003 and 07/2010 the time to fracture consolidation and occurrence of complications were assessed.
Results: The "new" device showed a higher rotational stability than the "standard" technique (p <0.001). Fractures showed radiologic consolidation after 14 ± 5 weeks (mean ± SD) postoperatively in patients. Revision surgery was necessary in four patients, unrelated to the new technique.
Conclusion: In periprosthetic hip fractures in which fixation with intracortical anchorage using conventional means might be difficult due to bulky revision stems and/or poor bone stock, the new device might be an addition to already existing implants.

FM73

Efficiency of a new clinical pathway for proximal femoral fractures

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CHUV

Background: The number of hip fractures is still increasing in relation to the increase of the average age of the population. Such patients have a high risk of postoperative complications and the length of stay can be in this case even longer with a high risk of death or institutionalization. In 2011, we established a clinical pathway (CP) to improve the qualitative and quantitative efficiency of the management of proximal femoral fractures in elderly patients. The goal of this study was to evaluate the CP using clinical, process and financial indicators.
Methods: All patients aged 65 and over, arriving at the emergency department with a fracture of the proximal femur after a fall and having surgical treatment were included. Outcomes measurements included performance indicators: the clinical indicators were nosocomial pneumonia, acute confusional state on the third postoperative day, and percentage of patients covering at least 75% of their nutritional needs; the process indicator was the time between arrival at the emergency department and surgery; the financial indicators were the imaging costs and the number of days spent in the hospital.
Results: From 2011 to 2013,669 patients were included in the CP. We observed that the average length of stay in hospital decreased from 16 days to 11 days as soon as the CP was used and it stabilized afterwards. In terms of time between arrival in the emergency department and the start of surgery, the goal of the CP was to operate at least 90% of patients within 48 hours. In 2013, this goal was achieved for 93.1% of the patients. We observed also an improvement of the clinical indicators and the imaging costs.
We also observed that the deployment of a CP demanded a concerted action and effective cooperation between different health professionals. Finally the communication between various clinicians has increased and is now perpetuated through regular review meetings of the CP.
Conclusion: CP of proximal femoral fractures in elderly patients allowed to improve qualitative and quantitative efficiency of the management regarding clinical, process and financial factors. We intend to extend CP to others frequent musculosqueletal pathologies.

FM74

Long-term follow-up after Surgical Hip Dislocation for the Treatment of Acetabular Fractures

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Introduction: Surgical hip dislocation allows safe visual inspection of the acetabulum and the femoral head. In acetabular fracture surgery (in contrast to the classic Kocher-Langenbeck approach), this enables the open reduction and internal fixation (ORIF) of the acetabular fragments under direct vision, exclusion of intraarticular screw placement and assessment of the quality of reduction, concomitant fixation of femoral head fractures. The aims of this study were (1) to calculate the cumulative 10-year survivorship of the hip and (2) to calculate predictive factors predicting an unfavorable outcome.
Methods: We performed a clinical follow-up study of 61 consecutive patients undergoing ORIF for displaced acetabular fractures (24 posterior wall, 18 transverse & posterior wall, 9 transverse, 3 T-shaped, 7 others) with a mean follow-up 12.4 years. Clinical grading was assessed using the Merle d'Aubigné scores modified for acetabular fractures. Radiographic grading of osteoarthritis was assessed according to Matta. Kaplan-Meier survivorship and a multivariate Cox-regression analysis was performed using the following endpoints: total hip arthroplasty and a Merle d'Aubigné score of less than 13.
Results: (1) The 10-year cumulative survivorship of the hip was 91% (95% confidence interval 84–99%). XX patients reached an endpoint. Of those, six patients underwent conversion to THA and six patients had a Merle d'Aubigné (MdA) of less than 13. (2) Independent predictors for the defined endpoints were (a) age at surgery and (b) T-shaped fractures.
Conclusion: Comparing our results of these often challenging acetabular fractures with the literature, surgical hip dislocation can provide predictable and even superior long term results.

FM75

Reconstruction of AAOS Type III and IV Acetabular Defects with the Ganz Reinforcement Ring

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Introduction: Large acetabular defects and pelvic discontinuity are complex problems in revision total hip arthroplasty (THA). Acetabular reconstructions are associated with an increased risk of aseptic loosening, infection, disarticulation, and nerve injury. Treatment options include reinforcement rings, plating of the anterior and/or posterior column, bone grafting, triflange acetabular components, porous metal implants, and combinations of the above.
Methods: 47 reconstructions of large acetabular defects and pelvic discontinuity (AAOS type III and IV defects) using the Ganz reinforcement ring were retrospectively reviewed after a mean follow up of 64 months (13–161 months). Patient age at the time of surgery was 69 ± 9 years. All hips underwent THA revision surgery with implantation of a Ganz reinforcement ring and bone grafting. In pelvic discontinuities, plating of the anterior and/or posterior column was performed. Follow-up investigations included conventional x-rays and clinical evaluation including Harris Hip Score (HHS) and Merle d'Aubigné Score.
Results: In type III defects, 24 out of 27 defect reconstructions survived; three hips failed due to aseptic loosening. In pelvic discontinuities, eight out of 20 reconstructions failed due to aseptic loosening (n = 4), non-union (n = 2), and deep infection (n = 2) [Kaplan-Meyer Survival type III vs. type IV: p = 0.002]. Nine additional reoperations had to be performed in 6 hips following type III defect reconstructions. In type IV defects, eleven additional reoperations in 6 hips were carried out. Average HHS and Merle d'Aubigné scores of the surviving reconstructions at follow-up were similar in both groups [type III: HHS: 80 (45 – 99), Merle d'Aubigné: 14 (9 – 18); type IV: HHS: 75 (36 – 97), Merle d'Aubigné: 14 (9 – 16)]. Of those reconstructions that survived, 23 out of 24 after type III defects and 9 out of 12 cups after pelvic discontinuity did not show radiographic signs of loosening.
Conclusion: THA revision surgery in patients with pelvic discontinuity involves a significant risk of failure and severe complications. The failure rates found in the present study are similar to that reported in the literature when reinforcement rings are used for type III as well as type IV defects. However, the functional results of successful reconstructions are satisfactory in this elderly population. Yet, porous metal implants may be a favorable alternative especially for the treatment of type IV defects.

FM76

Potential risk to the superior gluteal nerve during the anterior approach to the hip joint

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Introduction: The superior gluteal nerve (SGN) has been well described in the literature. Recent reports on the SGN have been focused on the lateral approach to hip arthroplasty, its potential dangers and safe zones. The aim of this cadaveric study was to demonstrate the innervation of the SGN in the tensor fascia latea muscle (T) in relation to the anterior approach for hip arthroplasty.
Methods: Nineteen cadaveric lower limbs were used for the study. With special attention to the innervation of the tensor fascia latae muscle (T) macro-dissection of the SGN was performed. The terminal nerve branches to T in relation to the anterior approach were studied and its distance to the ascending branch of the lateral femoral circumflex artery (LFCA) and the anterior superior iliac spine were measured.
Results: Terminal branches of the inferior branch of the SGN innervate the tensor fascia latae muscle in the deep surface in the middle of the muscle. There is little variation in the mode of entrance of its nerve of supply. In 95% one or two terminal nerve branches entered the muscle with its artery supply, the ascending branch of LFCA.
Discussion: The anterior approach to the hip joint requires the ligation or coagulation of the ascending branch of the LFCA very close to the point where the nerve branches enter T. This study highlights the risks of damaging the nerve to T during 1. Process of reaming while preparing the femur for insertion of the prosthesis, 2. Placement of retractors during surgery and 3. Coagulation of the ascending branch of the LFCA. The results will provide surgeons with an accurate description on the proximity of the nerve during surgery.

Free communications VII

FM77

Implant failure after biodegradable screw fixation in osteochondritis dissecans in skeletally immature patients

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Purpose: The purpose of this study was to prospectively assess the incidence of bioabsorbable screw failure in skeletally immature patients treated for OCD of the knee. The second purpose was to assess implant degradation, focusing on differential break-down of the intraosseus and the extraosseus parts of the screw.
Methods: 24 patients (30 knees) with MRI-confirmed OCD were fixed with biodegradable screws, mean follow up was 26 months. MRI scans were performed at 6 and 12 months to assess screw intensity at head and body and the presence of edema. The angle between the surface of the head and the body of the screw was measured, with >90° interpretated as "impending fracture". The incidence of screw fracture and revision survery was calculated based on patient-years (PY).
Results: 18 (14 with diameter 2.7 mm) of 61 screws (29.5%) showed a signs of impending screw failure on MRI. 7 screws (all 2.7 mm) in five patients were stated as "impending fracture". The implant failed completely in four patients with brakeage of 4 out of 6 screws, 3 cases were late failures after >6 month. The incidence of screw failure was 0.09/PY with 9 patients (37.5%) leading to an incidence of surgical revision of 0.08/PY with 4 patients out of 24 (16.7%).
Conclusion: Screw breakage is a surprisingly frequent failure in resorbable OCD fixation in skeletally immature patients. MRI data revealed differential decomposition of the screw within and outside of bone as a major cause. Importantly, late failure due to chemical decomposition was three times more likely than early failure due to mechanical stress, and independent from defect size and classification. Thus it should be ruled out in all patients returning because of mechanical symptoms, even if the OCD is perfectly healed.

FM78

Correction of multiplanar limb deformities with an intramedullary distraction nail and a plate – a new technique

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Introduction: Intramedullary leg lengthening is an accepted alternative to external fixators. The use of rigid nails, however, is limited by anatomical preconditions. Therefore, to date, the use of external fixation is sometimes inevitable. We report on a series of patients with a combined limb length discrepancy and complex axis deformity, who were treated exclusively with internal devices.
Methods: Between October 2008 and November 2011 six patients with a median leg length discrepancy of 37 mm (range 2.5–5.1 mm) and a complex deformity (3 femora, 3 tibiae) were treated with a fully implantable motorized nail and a locking plate. All patients were evaluated regarding the postoperative leg length, axis alignment, functional outcome, lengthening indices and complications.
Results: In all cases a successful leg lengthening (within 5 mm of desired length) was performed. Additionally, axis alignment with physiological anatomical and mechanical axis angles or symmetrical in relation to the contralateral leg was achieved. The median distraction index was 1.0, the maturation index 22.8 and the consolidation index 32.1. The functional outcome was excellent. In total two complications were observed, one non-union and one loss of leg length after an early locking screw removal in an external hospital. After revision surgery an uncomplicated healing was achieved in both patients.
Conclusion: The fully implantable motorized lengthening nail in combination with a locking plate is an efficient method for treating limb length discrepancies and even complex deformities of the lower leg. However, the reported technique puts high demands on preoperative planning, precise operative technique and surgeon's skills.

FM79

Trigonometric analysis of deviation in the mechanical axis induced by temporary hemiepiphysiodesis for lower extremity angular deformities.

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Introduction: Angular correction with growth modulation around the knee also modifies the alignment between the tibial tubercle and the trochlear groove (TT-TG). This study's aim was to predict the modification of the TT-TG distance that occurs during femoral or tibial hemiepiphysiodesis.
Methods: In this study, we developed a trigonometric formula to calculate the predicted change of the TT-TG distance that occurs during hemiepiphysiodesis around the knee. We used the planned angular correction, as well as the length between the physis (both distal femoral and proximal tibial) and the insertion of the patellar tendon of the tibial tubercle. The distances between the physes and cranial insertion of the patellar tendon on the tibial tubercle were extracted from MRI carried out in our institution from January 2008 to December 2013.
Results: We retrospectively reviewed 541 knee MRI scans performed on children and teenagers. Statistical analysis demonstrated that the distance of the femoral phyis on the tibial tubercle (FP-TT) increased with age in both genders (for females, rho 0.122, $p = 0.044$; for males, rho 0.281, $p < 0.001$). Conversely, there was a statistically significant decrease in the distance between the tibial physis on the tibial tubercle (TP-TT) with age in male subjects (rho –0.193, $p = 0.002$), whereas there was a statistically non-significant decrease in female subjects (rho –0.100, $p = 0.098$). However, the differences in FP-TT and TP-TT distances between all groups had very few effects on the translation of the tibial tubercle, and may be neglected when predicting the modification of TT-TG distance.
Conclusions: This study demonstrated that TT-FP and TT-TP distances vary very little with sex and age during growth. We were thus able to predict that, during distal femoral hemiepiphysiodesis, for every one degree of angular correction there was a 1 mm simultaneous lateral or medial transfer of the tibial tubercle. Furthermore, during proximal tibial hemiepiphysiodesis, an angular correction of 8° will roughly translate into a simultaneous 1 mm transfer of the tibial tubercle.

FM80

Moderate femoral varisation osteotomy in combination with pelvic osteotomy for the treatment of hip subluxation and dislocation in cerebral palsy

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Introduction: Restoration of hip stability in cerebral palsy patients with severe acetabular dysplasia necessitates femoral varus derotational osteotomy (VDRO) or pelvic osteotomy, or the combination of both. At our institution a moderate varisation with a planned post-operative CCD of at least 130° or higher is the standard procedure of VDRO in order to maintain good hip abduction and therefore reduce the amount of additional soft tissue surgery, especially tenotomy of the adductors. Furthermore to prevent common complications of VDRO such as avascular necrosis of the femoral head or varus malunion. The purpose of this study is to review the results of this moderate correction in VDRO in combination with pelvic osteotomy in patients with cerebral palsy.
Material & Methods: Patients with cerebral palsy who had been treated at our institution between 2005 and 2010 for hip dysplasia, subluxation or dislocation with a VDRO in combination with a pelvic osteotomy were reviewed. All patients had a minimum follow up of 2 years.
Results: 41 patients with a mean follow up of 4.5 years were included, 21 males and 20 females. Mean age at time of operation was 9.2 years. 27% (n = 11) patients were walkers (GMFCS I, II or III), 73% (n = 30) non-walkers (GMFCS IV or V). All together 59 hips were treated with both, femoral and pelvic osteotomy, both hips in 18 patients, one hip in 23 patients, whereof in 13 patients the contralateral hip was treated with a VDRO alone. Results enclose only hips treated with VDRO in combination with pelvic osteotomy: The mean pre-operative CCD angle of 152° was reduced to an average post-operative value of 135°. An additional soft-tissue release was performed in 11 hips: 7 adductor tenotomies if intra-operative hip adduction was <20° and in 4 hips a release of the abductors. Reimers`Migration Index (RMI) could be improved from a mean of 63% pre-operatively to 3.4% post-operatively. At latest follow up all patients were painfree. The mean RMI was 10.6%. Results were good in 97% (n = 57) with centered, stable hips (RMI <30%), fair in one with a subluxated hip (RMI 42%) and poor in one requiring revision pelvic osteotomy in case of ventral instability.
Conclusion: Our results show that even moderate varisation in VDRO in combination with pelvic osteotomy leads to good midterm results with stable, painfree hips with low complication rates, even in the severely involved spastic quadriplegic patients.

FM81

Primary subacute haematogenous osteomyelitis in children; towards a new bacteriological reality?

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Introduction: Primary subacute hematogenous osteomyelitis (PSAHO) is a distinct form of osteomyelitis which is characterized by insidious onset, mild symptoms, lack of systemic reaction, and absence of anomalies of laboratory data. The aim of this study was to describe the spectrum of PSAHO seen in children, to investigate their bacterial etiology, and to modify the previously classification system based on the radiographic appearence of the lesions.
Methods: Fifty-five consecutive cases of PSAHO admitted at our institution over a 14-year period were retrospectively reviewed to assess their clinical, radiographic, and MR imaging features as well as their bacteriological etiology.
Results: WBC was normal in 45 cases (81.2%), CRP in 30 cases (54.5%), whereas ESR was superior to 20 mm/hr in 75.5% of cases. The pathogen failed to be identified from hemocultures in all patients except one, whereas it was isolated from bone samples on classical cultures in 4 cases (11.4%). Use of PCR assays further allowed the causative microorganism to be isolated in additive 16 additive cases on bone aspirates, and in other 2 cases on blood. Considering the results of classical cultures and results of PCR assays together, the pathogen was detected in 22 cases (61.1% of children bacteriollogically investigated) and K. kingae was the most frequent reported microorganism. The intraoberver/interobserver agreements for the PSAHO's classification were found as excellent when plain radiographs were studied (kappa = 0.931 & 0.864) and even more accurate when lesions were investigated by MRI or CT scanner (kappa = 0.920).
Conclusions: Two distinct forms should be distinguished on the basis of age of patients and bacteriological etiology. The infantile form affects children aged between 6 months to 4 years and most of the time it is due to K. kingae. The juvenile form involves children older than 4 years and S. aureus appears as the main bacteriological etiology. If hemocultures and classical cultures of bone aspirates usually fail to isolate the causative pathogen, appropriate nucleic amplification assays improve drastically the detection rate of microorganisms responsible for PSAHO. Finally, MR investigation may improve in a significant way the recognition of PSAHO's lesions before a bony lytic lesion occurs.

FM82

Effect of high tibial osteotomy on joint loading in symptomatic patients with varus aligned knees – a study using SPECT/CT

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Purpose: The purpose was to prospectively evaluate the outcome, in particular the SPECT/CT bone tracer uptake (BTU) after high tibial osteotomy (HTO) due to symptomatic varus malalignment. It was the hypothesis that the BTU after HTO decreases in the medial compartment, clinical outcome and the degree of correction correlates with BTU and asymptomatic patients after HTO reveal a significantly decreased BTU in the medial subchondral areas.
Methods: Twenty-two consecutive patients with 23 knees undergoing medial opening-wedge HTO for medial compartment overloading were assessed pre- and postoperatively (12 and/or 24 months) using Tc-99m-HDP-SPECT/CT including our 4D-SPECT/CT protocol. BTU was quantified and localised to specific biomechanically relevant joint areas. Maximum absolute and relative values (mean ± standard deviation, median and range) for each area were recorded. Pre- and postoperative mechanical alignment was measured. At 24 months after HTO the WOMAC score was used.
Results: A significant decrease of BTU in the medial subchondral zones after HTO was found (preoperatively to 12 and 24 months postoperatively, $p < 0.01$). BTU normalized in all asymptomatic patients within 24 months. This decrease was partly seen in the lateral compartments, but significantly higher in the medial compartments ($p > 0.0001$). A significant increase of the BTU was noted in zones directly adjacent to the plate or within the osteotomy zone ($p < 0.01$). Decreased BTU was observed in osteotomy zones at 24 months postoperatively following higher uptake values at 12 months postoperatively. The average valgus correction of the tibiofemoral angle was 5.9 ± 2.77°. Less stiffness correlated significantly with a higher decrease in BTU ($p < 0.05$). Higher postoperative BTU significantly correlated with more pain ($p < 0.05$). No statistical significant associations between BTU and alignment correction were found.
Conclusion: In patients with medial compartment overloading due to varus malalignment HTO led to a significant decrease in BTU in the medial joint compartments. SPECT/CT BTU patterns and intensity in these patients pre- to 12 and 24 months postoperatively were seen. These correlated significantly with pain and stiffness. Hence, SPECT/CT could be used for assessment of adequate correction and healing after HTO.

FM83

Finite Element Analysis of Postero-medial Opening Wedge Osteotomy of the Proximal Tibia undercutting the Tibial Tubercle distally

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Introduction: Knee preserving osteotomies of the proximal tibia are underused. Correcting a deformity in one plane, may induce an inadvertent alteration in another plane. Relative length of the patellar ligament may be influenced by the type of osteotomy placed at the level or above the tibial tubercle.
Material and Methods: We used the method of finite element analysis assigning 180'000 tetrahedral elememts to the proximal tibia. We simulated three variations of medial opening wedge osteotomies of the proximal tibia undercutting the tibial tubercle distally. We designed three models of oblique ascending medial wedge osteotomies Models A, B, C and we applied three load steps: postero-medial gap opening, extension and external torsion.
Results: of finite element analyses of an oblique ascending, postero-medial opening wedge osteotomy revealed correct coronal plane realignment in all models. By undercutting the tibial tubercle distally, a decrease in patellar height was avoided in all models. In model A and B an increase of the posterior tibial slope occurred. By applying a posterior directed force, -to the anterior aspect of the proximal tibia in

the sagittal plane–, an increase of the posterior tibial slope was avoided but an increase in internal tibial torsion occurred. By controlling tibial torsion in the transverse plane, such as in model C, inadvertent tibial torsion was avoided. The simulation of two pairs of parallel running K wires, –monitoring the correction in all planes–, facilitated the understanding of opening a postero-medial gap during the oblique ascending medial opening wedge osteotomy.
Conclusions: Modeling the effects on stress strain behavior at the pivot point, in the cancellous bone of the lateral tibial condyle and adjacent to the tibial tubercle, allowed us to simulate and design a safe knee preserving realignment procedure. Finite element modeling allowed us to increase precision by simulating a multiplanar knee preserving osteotomy of the proximal tibia, respecting patellar height and controlling the posterior tibial slope in the sagittal plane whilst avoiding inadvertent internal torsion in the transverse plane.

FM84

Trochleaplasty – functional and subjective results

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Introduction: Dislocation of the patella represents a common injury of the knee (incidence 5.8/100'000). Recurrent events are a reason for pain, significant loss of physical function, activity and quality of life. Patellofemoral instability is a multifactorial clinical problem. Besides passive (patellofemoral ligaments) and active (quadriceps femoris) stabilizers the congruence of patella and trochlear groove (static stabilizer) is a central factor. Dejour estimates the presence of trochlear dysplasia in up to 85% of patients with recurrent dislocations. Aim of our study was to assess the functionality, satisfaction and patellar stability after trochleaplasty by retrospective survey.
Methods: Between 10/2004 and 11/2012 we performed trochleaplasty on 77 knees (66 patients). Indication was recurrent patellar dislocation and existence of trochlear dysplasia at least Dejour type B. Preoperatively we classified the degenerative changes of patellar cartilage as well as trochlear dysplasia and Caton-Deschamp index on strictly lateral radiographs. Every patient was examined clinically and radiologically 1 year after surgery. With a minimum follow-up of 1 year (12–109 months) we started a retrospective subjective evaluation by questionnaire for quality of life (SF-36), activity (Tegner-Score) and functional impairment (Lysholm-Score).
Results: 42 knees (39 patients) were included into the analysis. 31% (13/42) had undergone previous surgery. The average of Tegner's activity score was 4.95 points (3-9). Lysholm score reached 81.3 points (39–100) with 40.5% (17/42) excellent and 57.1% (24/42) good and excellent results. The average value for physical health component summary score (PCS) and mental health component summary score (MCS) in SF-36 showed only little variation compared to German norm population (PCS: male 48.9, female 49.6, MCS: male 51.1, female 52.5). We had no recurrence of dislocation while 1 patient reported about slight tendency for subluxation. Complications: 1x removal of hematoma (3rd day after surgery), no problem with wound healing, no infection.
Conclusions: Trochleaplasty represents a demanding surgical procedure for reconstruction of the trochlea's morphology and the stability of the patellofemoral joint. Recurrent patellar dislocations can be reliably avoided while activity and quality of life can be preserved with only little or moderate functional impairment in most of the patients.

FM85

The Tibial-Tubercle Trochlear Groove Distance in Patients with Trochlear Dysplasia – are we getting it right?

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Introduction: The tibial tubercle-trochlear groove (TT-TG) measures the distance between the deepest point of the trochlea and the tibial tubercle and is one of the main contributing factors of lateral patellar instability. A majority of patients with lateral patellar dislocation, however, have some sort of trochlear dysplasia, hence a proximally flat trochlea. This fact might bias the TT-TG distance, since the trochlear groove is not perpendicular but running laterally as it merges. We therefore hypothesize that the TT-TG might be underestimated in patients with trochlear dysplasia, which might be a source of technical error in tibial tubercle corrective osteotomy.
Methods: 50 patients with trochlear dysplasia (TD, 23.3 years ± 8.9) and 52 aged and gender matched patients serving as control group (CG, 21.9 years ±7.4) without history of lateral patellar dislocation or radiographic signs of trochlear dysplasia were assigned for MRI measurements.
The TT-TG was measured on axial MRI slices in all patients, measuring the distance between the most proximal trochlear deepening of minimal 2 mm depth, where full cartilage coverage was seen, and the center of the tibial tubercle. The perpendicular height of the most proximal trochlear deepening in relation to the femorotibial joint-line was also recorded. Additionally, the TT-TG was measured in the CG at 15, 20 and 25 mm above joint line.
Results: Patients with TD showed a mean TT-TG of 15.3 mm ± 5.3, compared to the CG 10.5 mm ± 3.8 ($p < 0.001$) with a mean height of the most proximal trochlear deepening to the femoro-tibial joint line of 20.6 mm (range: 10.3 to 30.9, median: 20.5) and 33.8 mm (range: 25.4 to 41.1, median 33.6; $p < 0.001$), respectively.
TT-TG measured at 20 mm and 15 mm above joint line for CG was 1.8 mm (95%CI 1.34 to 2.28, $p < 0.001$) and 2.43 mm (95%CI 1.87 to 3.00, $p < 0.001$) higher compared to the most proximal measurement. Inter-rater reliability was excellent using intra-class correlation for single measures ($p > 0.99$).
Conclusion: TT-TG is underestimated in patients with trochlear dysplasia. This should be taken into consideration when planning tibial tubercle corrective osteotomy.

FM86

Significant reduction of isokinetic muscle strength and hamstring-quadriceps-ratio 4 years after autologous chondrocyte implantation: the influence of defect lo

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Introduction: Matrix associated autologous chondrocyte implantation (ACI) is a well-established treatment method for full thickness articular cartilage defects. However, detailed biomechanical analysis including isokinetic muscle strength measurements after this procedure are still rare, but might be of crucial importance for long-term outcomes. This is the first study to specifically evaluate the impact of defect location on clinical and biomechanical outcomes after autologous chondrocyte implantation. Our aim was to provide results, which may contribute to develop specific rehabilitation protocols optimized for different implantation locations.
Methods: 44 patients with full-thickness cartilage defects ICRS grade IIIB and C underwent ACI and were assigned to two groups, the femoral condyle (fc) group or the patellofemoral joint (pj) group. Clinical scores were gathered preoperatively and 6, 12 and 48 months after implantation using the International Knee Documentation Committee (IKDC) score and the International Cartilage Repair Society (ICRS) form. Isokinetic strength measurements were performed 48 months postoperatively comparing healthy and operated knee joint of each patient. Additionally, Hamstring-Quadriceps-Ratios were calculated.
Results: Clinical scores (ICRS, IKDC) showed continuous significant ($p < 0.05$) improvement over the whole study period for both groups. However, isokinetic muscle strength measurements showed significantly reduced maximum strength capacities for the operated knee joint compared to the healthy knee in both groups ($p < 0.05$). The patellofemoral group in particular revealed a significant change in physiological muscle balancing (H-Q-ratio) based on significantly impaired extensor muscle strength.
Conclusion: Despite good clinical outcomes, all patients showed significant strength deficits on the operated extremity even 4 years after ACI. Furthermore, the patellofemoral compartment showed significantly worse hamstring-quadriceps-ratios compared to condylar defects. Consequently, more efforts should be made to restore muscular strength especially of the quadriceps and the rehabilitation protocol must be adapted according to the particular demands of each defect location to improve clinical and functional outcomes.

FM87

Effect of microfracture on the immediate postoperative properties of the subchondral bone plate. A biomechanical study.

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Introduction: While Steadman's microfracture is still considered gold standard in the treatment of small unifocal cartilage defects, several study groups report a considerable early to long-term failure rate. The presented study discusses iatrogenic disruption of subchondral bone plate stability as potential early mode of failure. The biomechanical effect of microfracture on the subchondral layer was simulated. Special regard was given to the question, if increasing microfracture hole angulation will lead to further weakening of bony support.
Methods: Microfracture of femoral condylar bone cubes was performed according Steadman's technical protocol procured from fresh-frozen human cadaveric knees. Holes were angulated perpedicularily to the surface (group 1), as well as with 15°/30° deviation angles (group 2/3), with 8 specimens in every group. Repetitive non-destructive and consecutive destructive compressive testing was performed in a Mach-1 Micromechanical Testing System (Biomomentum Inc., Laval, Canada) in order to simulate protected postoperative gait, as well as load to failure. Radiographic changes were analyzed by Micro-CT (GE Medical Systems, London, Canada) before and after every biomechanical test run.
Results: Microfracture lowered subchondral stiffness for all specimens in non-destructive testing (pre µFX E0.3% 743.4 ± 347.4 N/mm; post µFX E0.3% 528.0 ± 334.8 N/mm; p <0.001). Variation of hole angles, however, produced similar biomechanical properties in all groups (p = 0.774). Micro-CT showed only two failures by crack propagation through a microfracture hole in destructive testing (25% end strain), while all other specimens had failed by lateral expansion.
Conclusion: As expected, biomechanical analysis after microfracture supports early weakening of the subchondral bone layer. Increasing hole angulation, however, did not lead to further compromise of subchondral integrity.

FM88

Risk Factors for Patellar Instability in Patients with Patellar Tendon Partial Tear (Jumper's Knee) – an MRI-based study

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Introduction: Patellar tendon partial tears (PTPT) at the proximal patellar tendon insertion are an overuse condition and a potentially sports-career ending injury to the knee. Therapeutic strategies are most often highly challenging since origin and especially biomechanical predisposing factors are not yet known. We therefore conducted an MRI-based study of patients with PTPT to compare risk factors for patellofemoral instability with controls.
Methods: The MRI of 47 patients with PTPT (30.8 ± 11.4 years) were analysed for trochlear geometry (trochlear facet ratio (TFR), lateral inclination (LI), trochlear angle, and lateral condylar index (LCI)), patellar position (Patellatrochlear Index (PTI), Insall-Salvati (IS), Caton-Deschamp (CD), and Tilt), and tibial tubercle trochlear groove distance (TT-TG). 100 age and gender matched patients (29.3 ± 9.3 years) served as controls (CG).
Results: Measurements for trochlear geometry differ significantly between the PTPT and CG for LI (19.0° vs. 16.2°; p <0.05) and TFR (0.39 vs. 0.48; p <0.001), however not for the LCI (p = 0.61) and trochlear angle (p = 0.92). TFR was pathologic in 55.3% of the patients with PTPT, and in 23% of the controls (p <0.001). The patella in PTPT is significantly higher than in controls (PTI: 0.32.6 vs. 0.37, p <0.001; and IS 1.19 vs. 1.10 p <0.02). In PTPT, PTI was pathologic in 31.9% (controls 11%, p <0.01) and for IS in 42.6% (controls 26%, p <0.05). The TT-TG distance is also increased (12.0 mm vs. 10.1 mm, p <0.01), however pathologic in only one patient.
Overall inter-rater reliability was excellent using intra class correlation for single measures (p >0.9).
Conclusion: PTPT is associated with patella alta, decreased medial trochlear facet and increased TT-TG. Further studies are requested to determine whether a clinical relevant patellar instability is more likely to be present in patients with PTPT.

FM89

Biomechanical Comparison of All-inside Meniscal Repair Devices with their Matched Inside-Out Suture Repair: Introducing 10.000 and 100.000 Loading Cycles

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Introduction: To date, inside-out suture repair techniques are still considered the gold standard for treatment of meniscal tears. However, all-inside repair devices experience an increase in popularity because of their lower complication rate, decreased morbidity and the easier surgical handling compared to inside-out techniques. Until now, biomechanical tests have only be been performed up to 1000 cycles, corresponding to only a single day of walking. In the present study, for the first time, we introduced cyclic loading up to 100.000 cycles, comparable to a rehabilitation phase of 6–8 weeks. We hypothesized that suture-controls would show superior response to cyclic loading and load-to-failure compared to their matched all-inside devices.
Methods: Bucket-handle tears in 72 porcine menisci were repaired using the all-inside repair devices Omnispan and Fast-Fix 360 as well as the corresponding inside-out suture repairs Orthocord 2-0 and Ultrabraid 2-0 in a single vertically-oriented manner. Initial displacement, displacement after cyclic loading (100, 500, 1000, 2000, 5000, 10 000 and 100 000 cycles), ultimate load-to-failure, mode of failure and construct stiffness were recorded.
Results: There were no significant differences between the groups concerning initial displacement and displacement after cyclic loading. The Omnispan repair demonstrated the highest load-to-failure force (151.3 ± 21.5 N) and was significantly stronger than all the other constructs (Orthocord 2-0, 105.5 ± 20.4 N; Ultrabraid 2-0, 93.4 ± 22.5 N; Fast-Fix 360, 76.6 ± 14.2 N; p <0.0001 for all). The Orthocord vertical inside-out mattress repair was significantly stronger than the Fast-Fix 360 repair (p = 0.003). The Omnispan (30.8 ± 3.5 N/mm) showed a significantly higher stiffness compared to the Ultrabraid 2-0 (22.9 ± 6.9 N/mm, p <0.0001) and Fast-Fix 360 (23.7 ± 3.9 N/mm, p = 0.001). The predominant mode of failure was suture failure.
Conclusion: Even after 100.000 cycles of cyclic loading (representing about 8 weeks of rehabilitation), all-inside repair devices achieved comparable biomechanical results to the corresponding inside-out suture techniques. These findings in addition with the apparent advantages of the all-inside repair techniques, such as lower complication rate and easier surgical handling, show the non-inferiority to vertical inside-out repairs.
Accepted American Journal of Sports Medicine, January 2014

FM90

Management of concomitant MCL lesion in athletes with ACL rupture. Introduction and results of a new treatment concept.

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Introduction: Anteromedial knee injury (AMKI) with rupture of anterior cruciate ligament (ACL) and concomitant lesion of medial collateral ligament (MCL) is common in athletes. Anteromedial rotatory instability (AMRI) is a frequent complication. While surgical treatment of ACL-rupture is mandatory in athletes different therapy-strategies for concomitant MCL-lesions are described. Standardized treatment algorithm does not exist in literature. Therefore, in this study we treated athletes with ACL rupture and different MCL lesions according to a new treatment concept to develop classification and treatment algorithm in this kind of knee injury.
Methods: In this study 30 recreational athletes with ACL-Injury and concomitant MCL lesion were treated according to a distinct treatment concept. Patients were classified in six different types of concomitant MCL lesion depending on grade of MCL lesion and presence of AMRI. According to degree of MCL lesion patients were primarily divided in injury type's I-III. Depending on presence of AMRI these types were subclassified in a-type injury or b-type injury. Final classification and surgical indication were determined six weeks posttraumatic. All patients received ACL reconstruction. In patients with injury type Ia, Ib and IIa MCL lesion was treated conservative, in injury type IIb, IIIa and IIIb MCL lesion was treated by surgical treatment We evaluated standardized knee examination according to international knee documentation committee (IKDC), excessive medial knee opening (EMKO), presence of AMRI and Lysholm score both preoperative and after 6, 16 weeks and 9 months postoperative.

Results: All patients could be uniquely classified and treated according to introduced treatment concept. All patients showed good to excellent clinical results at the follow-up examinations. The incidence of AMRI was significantly reduced to 6.6% compared with 43.3% preoperatively. EMKO was in none of the patients verifiable postoperative. In all 30 patients the findings were graded as normal or nearly normal according to IKDC knee examination form. The overall Lysholm score averaged 93.3 after treatment.
Conclusion: Introduced treatment concept for concomitant MCL lesion showed excellent results on short tern outcome and provided evidence for sufficient management of concomitant MCL lesion in athletes with ACL rupture. Further data will follow soon.

FM91

Knee dislocation and associated popliteal artery injury

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Introduction: Although knee dislocations (KD) are rare, associated vascular lesions are common. They can lead to limb loss or even be life-threatening if not discovered and treated. During a dislocation of the knee, the popliteal artery but also the collaterals can be injured and this lesion can lead to an acute and drastic limb ischemia. Therefore, quick diagnosis and prompt treatment are necessary but not always easy to perform to ensure good results in terms of limb-salvage. The aim of this study is to review the patients treated for a KD and the management of a potential arterial injury at our institution.
Methods: This is a retrospective review of the data of all the patients treated at our institution between 2005 and 2012 for a KD. During this period, 18 patients with 19 knee lesions have been identified. Dislocations have been characterized using the Wachser classification. All patients underwent clinical examination followed by angiological and radiological work-up if necessary.
Results: Among the 18 patients, there were 61% of men and the mean age was 38 years. There were 1 dislocation KD-1 (6%), 1 KD-2 (6%), 6 KD-3 (33%), 1 KD-4 (6%) and 10 KD-5 (50%). In the 19 knee dislocations, 5 (26%) vascular lesions could be identified. All of them except one had diminished or absent pulses at the initial evaluation. Two other patients presented with no pulses but no vascular lesion was identified. The radiological work-up performed consisted of 14 angio-CT scans and 3 angiographies. The 5 arterial injuries required an intervention. There were 4 venous bypasses and 1 arterial suture. In 1 case, fasciotomies had to be performed in the early post-operative period. All vascular reconstructions remained patent except one that required a successful overbypass. The limb salvage rate was 100%.
Conclusion: Arterial injury following knee dislocation is common. However, the diagnosis can be difficult, especially in obese patients and a high index of suspicion is necessary to perform adequate radiological work-up. Today, angio-CT scan is the exam of choice to confirm or rule out the vascular injury. It leads to a quick and accurate diagnosis, allowing surgery to be performed in a reasonable delay in order, to ensure a limb salvage rate of up to 100%.

Free communications VIII

FM92

Survival rate after repeat surgery of chordomas of the cervical spine including the cranio-vertebral junction

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Introduction: Chordomas rarely metastasize but due to the high local recurrence rate, despite surgical resection and/or radiation therapy, prognosis is poor. There is a paucity of literature regarding the outcome of treatment of recurrent chordomas. The purpose of this study was to report on survival rate and complications in patients treated with chordoma remnants with/without tumor recurrence at the cranio-cervical junction or in the cervical spine.
Methods: 24 patients, referred to our department with chordoma remnants (Rc-group; 7 cases) or recurrent chordomas (RRc-group; 17 cases) were reviewed retrospectively between 1999 and 2012 (12 men and 12 women, aged 5 to 86 (mean 44.3) years). The chordomas were located at the cranio-cervical junction (N = 13), mid-cervical level (N = 9) and the low-cervical spine (N = 2). All patients underwent single- or multi-staged piece-meal tumor removal and instrumentation if necessary. Postoperatively, 4 patients received adjuvant proton beam radiation therapy (mean dose, 69.2 CGE) and 12 patients, combined photon- and proton beam radiation therapy (mean dose, 74.19 CGE). Medical and radiological follow-up took place on average 37.5(4 to 102) mo after surgery. Survival rates were evaluated with Kaplan-Meier-plots.
Results: Gross total tumor removal was achieved in 17 cases, subtotal resection in 3, and uncertain degree of resection in 3 cases; in 1 case, for palliative reasons, partial excision was carried out. Early complications were CSF leak in 7 patients, meningitis in 1, haematoma evacuation in 3 (due to neurological deficit). Dehiscence of the pharyngeal wall at the site of incision was the most common long-term complication (7 cases). No instances of instability were observed. The 5-year progression-free survival rate was 72.6 %.
Conclusion: In patients who have undergone previous chordoma resection surgery, gross total tumor removal is feasible, even at the cranio-cervical junction. With the combination of adjuvant single proton- or single proton plus photon beam radiation therapy, a survival rate can be achieved that is similar to that reported in the literature following first time chordoma removal.

FM93

Clinical Outcome of Decompressive Surgery for Lumbar Epidural Lipomatosis

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Introduction: The treatment of spinal epidural lipomatosis (SEL) is controversial. The limited evidence for the success of surgical decompression in this rare pathology is mostly derived from case reports. Moreover, no patient-rated outcome studies are available. The objective of this study was to evaluate clinicaloutcome after lumbar decompressive surgery for SEL in the largest series of patients examined to date.
Methods: Consecutive patients with symptomatic SEL documented on MRI undergoing surgical treatment in a single centre (2004–2012) were analysed. Data were obtained from the International Spine Tango Register. Patients with spinal stenosis caused by other pathologies were excluded. Outcome was evaluated using Core Outcome Measure Index (COMI; scored 0–10) including the pain scale for leg and back. Three months was defined as the minimal follow-up time; for most patients a two-year follow-up period was available (mean 20.2 months).
Results: In 170 patients undergoing lumbar decompressive surgery SEL was documented. 141 patients were excluded due to accompanying discogenic or arthrogenic stenosis. In 6 patients MRI scans was unavailable and 1 patient did not complete the forms. Finally, 22 patients (19 male, 3 female, mean age: 68.2, 50.4–88.7 years) were included. At 3 months the outcome scores showed a significant improvement: COMI from 7.5 ± 1.7 (mean ± SD) to 4.9 ± 2.5 ($p < 0.0001$), leg pain from 5.9 ± 2.6 to 3.5 ± 2.8 ($p = 0.0042$) and back pain from 5.4 ± 3.2 to 4 ± 2.8 ($p = 0.004$). The effect was retained for 2 years (COMI: 5.1 ± 3.1, $p = 0.003$ vs. preoperative).
Conclusion: Based on patient-reported outcome, we could demonstrate a beneficial effect of decompressive surgery for spinal stenosis due to epidural lipomatosis. The improvement of leg pain was more pronounced than the improvement in back pain, as expected, and the effects lasted for at least 2 years.

FM94

COMPARISON OF BENDING RADIOGRAPHS BETWEEN UPRIGHT POSITION IN EOS AND CONVENTIONAL SUPINE POSITION IN PATIENTS WITH ADOLESCENT IDIOPATHIC SCOLIOSIS

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Introduction: Biplanar low-dose X-ray systems called EOS imaging have been regularly in use in adolescent patients with idiopathic scoliosis (AIS). The aim of the present study was to compare the standing EOS bending radiographs to conventional supine bending radiographs.
Methods: This is a retrospective study of 29 consecutive adolescent patients with idiopathic scoliosis (mean age of 17.3 years) who had preoperative radiological work-up. Preoperative imaging included standing whole spine in EOS, upright bending radiographs in EOS and supine bending conventional radiographs. Thoracic (T) and thoracolumbar/lumbar (TL/L) curves were measured. The upright EOS bending radiographs were compared to conventional supine radiographs and statistical analysis was performed. Inter- and intraclass reliability for two observers with measurements at two time points was evaluated.
Results: Mean T-Cobb angle in neutral standing position was 54.6°. Mean TL/L-Cobb angle was 44.4°. Mean bending T-Cobb angle (n = 23) was 35.9° in upright position in EOS and 31.6° (p = 0.005) in supine conventional radiographs. Mean bending TL/L-Cobb angle (n = 14) in upright position in EOS was 31.7° and 26.2° in conventional supine bending (p = 0.034). Inter- and intra-observer reliability was excellent (ICC = 0.96 and 0.97). The level of the first opening disc distally on the concave side on bending was the same in both techniques.
Conclusion: A significant difference between upright bending radiographs in and conventional supine bending radiographs with less correction of more than 4° in upright EOS was observed in the thoracic as well as in thoracolumbar and lumbar curves. This might influence the determination of fusion levels in AIS.

FM95

Negative beliefs and psychological disturbance in spine surgery patients: a cause or consequence of a poor treatment outcome?

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Introduction: Chronic musculoskeletal pain is often associated with psychological distress/maladaptive beliefs and these may have a negative impact on surgical outcome. The influence of a surgical intervention, and its outcome, on the course of change in psychological status has been poorly documented. We prospectively examined the dynamic interplay between psychological factors and outcome in patients undergoing decompression for spinal stenosis/ herniated disc.
Methods: Before and 12 mo after surgery, 159 patients (100 M, 59 F; 65 ± 11 y) completed questionnaires enquiring about socio-demographics, medical history, pain characteristics, psychological disturbance, catastrophising, disability (Roland & Morris), general health and Fear Avoidance Beliefs about physical activity (FABQ-PA). The global outcome of surgery at 12 mo was rated using a 5-point Likert scale and dichotomised as "good" (operation helped/helped a lot) or "poor" (operation helped only little/didn't help/made things worse).
Results: Questionnaire data were available for 148 patients at 12 mo follow-up: 113 (76.4%) reported a good outcome and 35 (23.6%) a poor outcome. In univariate analyses the following each significantly ($p < 0.05$) predicted a good 12 mo global outcome: no disability claim, and lower values for LBP frequency, average pain score, FABQ-PA, and catastrophising. In multiple logistic regression, only lower FABQ-PA scores (OR 0.877 (95%CI 0.809-0.949), p = 0.001) and lower LBP-frequency (OR 0.340 (1.249–1.783), $p < 0.0001$) significantly predicted a good outcome at 12 mo. A second "explanatory" logistic regression model revealed that a good outcome at 12 mo was significantly associated with improvements (pre-op to 12mo) in: average pain score (OR 1.6879 (1.187–2.398), general health (OR 1.246 (1.004–1.545), psychological disturbance (OR 1.073 (1.006–1.144), and Roland Morris (OR 1.243 (1.074–1.439).
Conclusion: In a multivariable predictive model, FABQ-PA was the only psychological factor that significantly predicted outcome. Future studies should assess whether preoperative cognitive-behavioural therapy in patients with maladaptive beliefs improves treatment outcome. Psychological disturbance did not predict outcome, but it improved in patients with a good outcome and worsened in those with a poor outcome. Rather than being a risk factor for poor outcome, it appeared to be a consequence of long-standing, unremitting pain that improved when symptoms were resolved after successful surgery.

FM96

Is an annular tear a predictor for accelerated disc degeneration?

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Introduction: It is questionable whether an annular tear (AT) is a predictor for accelerated degeneration of the intertervertebral discs. The aim of this study was to answer this question via a matched case control study design that reliably eliminates potential confounders.
Methods: Presence or absence of AT, defined as a hyperintense lesion within the annular fibrosus on T2-weighted non-contrast MRI images, was documented in 450 intervertebral lumbar discs of 90 patients who could be followed up for at least 4 years with MRI. Discs with an AT (n = 36) were matched 1:1 to control discs according to the level, degree of intial disc degeneration on MRI (both Pfirrmann grade median 4, range 3–4), age (59.5 ± 15.0 years vs 59.3 ± 14.6 years), BMI (26.7 ± 4.4 kg/m^2 vs 26.9 ± 4.4 kg/m^2) and interval to the follow up-MRI (4.8 ± 0.8 years vs 5.1 ± 0.8 years). The degree of disc degeneration after a minimum of 4 years was graded on the follow up MRI in both groups according to the Pfirrmann classification.
Results: One-forth (25%) of the 36 discs with an AT on the inital MRI exam progressed in degeneration. This was similar to the rate of the matched control discs with no AT, in which also around one-forth (22%) showed a progression of degeneration (p = 1.00), also without any difference in the degree of degeneration.
Conclusion: Discs with a Pfirmann grade >2 with an AT, defined by a hyperintense signal intensity on MRI, are not prone to accelerated degeneration if compared to discs without an AT. Therefore, the presence of an AT per se does not predict accelerated disc degeneration.

FM97

INFLUENCE OF PREVIOUS CONSERVATVE TREATMENT INTERVAL ON OUTCOMES FOLLOWING DECOMPRESSIVE SURGERY FOR LUMBAR DISC HERNIATION

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Introduction: Symptomatic lumbar disc herniation is a well-accepted surgical indication for decompression, yet the optimal timing for such surgery remains unclear, given the likelihood for spontaneous symptomatic improvement. We hypothesized that there is a difference in the outcomes observed following decompression surgery dependent on the duration of previous conservative treatment (none, <3 months, 3–6 months, 6–12 months, >12 months).
Material/Methods: Spine Tango, the nonprofit International Spine Registry of EuroSpine currently contains more than 50,000 spinal surgical procedures; at point of time 10,000 cases are fully documented with pre- and postoperative patient- and physician based assessment. This study examined 2,176 cases of single level lumbar disc herniation that underwent surgical intervention.
Pre- and post-operative patient-based assessment of leg and back pain indicated on a Visual Analogue Scale (VAS) from 0 to 10 and the back specific Core Outcome Measures Index (COMI) were recorded. Additional physician-based documentation including surgical treatment (specification of main pathology, detailed procedure description, surgical time, intra- and post-operative complications, blood loss, and length of hospital stay) and a physician-based follow-up assessment were recorded.
Descriptive statistics and multivariate logistic regression were used to analyze pre to post-operative patient-based VAS values for leg, VAS for back pain and COMI scores for the whole group and for four cohorts with differing periods of conservative care.
Results: The duration of previous conservative treatment, stratified as outlined, did not have any influence on the ultimate outcomes. There were no statistically or clinically significant differences in leg pain relief, back pain relief or COMI score for the four different time periods of conservative care. The individual results for the groups are for back pain relief: 2.4, 1.9, 1.8, 2.1, 2.4 ($p > 0.05$); for leg pain relief: 4.0, 3.9, 3.8, 4.1, 4.1 ($p > 0.05$); for COMI: 3.3, 3.2, 3.1, 3.4, 3.4, ($p > 0.05$).
Discussion: Due to spontaneous symptomatic recovery in patients with lumbar disc herniation, surgical decision making is still a challenge. This study demonstrated significant improvements in standardized outcomes following surgical discectomy that were independent of the duration of conservative care. These findings have to be confirmed in more controlled study environment.

FM98

Microscopic versus open discectomy for lumbar disc herniation: a retrospective single center analysis of 500 consecutive patients

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Introduction: Surgery for lumbar disc herniation is a common and well established procedure. Different techniques were performed and still remain controversial under discussion in the literature.
Methods: 500 consecutive patients from 2003–2011 were retrospectively analyzed after either microscopic or open discectomy for lumbar disc herniation. 225 patients were treated with an open, 275 with a microscopic procedure. Primary endpoints were defined as: clinical outcome, duration of surgery time and hospital stay. As secondary endpoint we analyzed the cost-effectiveness of both procedures.
Results: Regarding the clinical outcome both procedures were equal in focusing on neurological outcome and recurrent disc herniation. In the open group the average operation time was 46 min (20–90 min), compared to 87 min (45–195 min) found in the microscopic discectomy group. Average hospitalization was shorter in the microscopic discectomy group (6.3 days) compared to the open discectomy group (7.2 days). Regarding the cost-effectiveness there was no significant difference in both groups. The overall cost of open discectomy was 8'903 CHF compared to 9'167 CHF with microscopic discectomy.
Conclusion: This retrospective single center analyses open vs. microscopic discectomy showed equal results focusing on clinical outcome and cost effectiveness. Further prospective randomized trials were necessary in this regard.

FM99

What level of pain are patients happy to live with after surgery for lumbar herniated disc?

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Introduction: A new approach to the reporting of health outcomes – and one which differs from the notion of "improvement" or "change" after treatment — involves assessing the proportion of patients achieving a level of symptoms that they consider acceptable and feel they could live with. We evaluated the acceptable level of pain in patients after surgery for lumbar disc herniation (LDH).
Methods: This was a retrospective analysis of prospectively collected data from consecutive patients in our Spine Center Outcomes Registry who had undergone first-time surgery for LDH between 2005 and 2011. 12 months postoperatively, patients completed 0–10 scales for back pain and leg pain and a question: "if you had to spend the rest of your life with the symptoms you have now, how would you feel about it?", answered on a 5-point Likert scale from "very satisfied" to "very dissatisfied". This was dichotomised and used as the external criterion in receiver operating characteristics (ROC) analysis to derive the cut-off score for pain that best indicated being at least "somewhat satisfied" with the symptom state.
Results: 1'209 patients (57% men, aged 51 ± 15 y) returned a questionnaire (90% follow-up rate), of which 611 (51%) reported being at least somewhat satisfied with their symptom state. The area under the curve for the ROC analysis was 0.91 (95% CI, 0.89–0.92), indicating a good ability of the pain score to discriminate between being in a satisfactory state or not. The cut-off indicating a satisfactory symptom state (with 76% sensitivity and 89% specificity) was ≤2 points on the 0–10 pain scale.
Conclusion: Most spine interventions are aimed at decreasing pain but only rarely do they totally eliminate it. Determination of the % patients achieving an acceptable symptom state for pain may represent a useful and more stringent target for denoting surgical success in the treatment of painful spinal disorders. For LDH, the acceptable level of pain appears to be ≤2 points on a 0–10 scale.

FM100

Biologically Augmented Lumbar Spine Fusion – Fusion Rates vs Heterotopic Ossification

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Introduction: Biological stimulants such as Bone Morphogenetic Proteins (BMP-2 and 7) or platelet concentrates have been propsed to augement lumbar fusion and improve union rates. This meta-analysis focuses on the current best evidence for fusion rates, i.e. intented stimultation, and heterotopic ossification (HO), i.e. overstimulation, with the use of such stimulants.
Methods: We conducted an online search for relevant controlled trials and extracted data on complications and revision rates. These data were synthesized in a meta-analysis using DerSimonian-Laird random effects modelling. Fusion rates were calculated per level fused, using cluster modeling if multiple levels were fused.
Results: Our search produced 571 results, 12 of which were eligible for inclusion. These studies report on a total of 1,226 fused levels patients (650 experimental, 576 controls) with a mean age of 53.8 ± 9.0 years. Mean follow-up was 1.8 ± 0.6 years.
The cumulative fusion rates were 0.76 (95%CI 0.73 to 0.80) for ICBG, 0.69 (95%CI 0.58 to 0.81) for BMP-7/OP-1, 0.95% (95%CI 0.93 to 0.97) for BMP-2, and 0.54 (95%CI 0.47 to 0.61).
However, in the formal meta-analysis there was no difference betweem ICBG, BMP-7, and PRP (all p >0.05), with the only statistically signficant difference seen for BMP-2 at a risk ratio of 1.1 (95%CI 1.04 to 1.14, p <0.001), consistend with a 10% increase in fusion rates.
We found only insufficient data on BMP-7 and platelets for a formal analysis of HO. We did see a significantly increased rate of heterotopic ossfication with BMP-2 (0.19, 95%CI 0.15 to 0.24) compared to ICBG (0.09, 95%CI 0.04 to 0.14), consistent with a 10% increase in the risk of HO (p = 0.012)
Conclusion: Biologically augmented spinal fusion produces similar fusion rates as conventional iliac bone crest grafting. The current best evidence shows that BMP-2 increases the risk of fusion by 10%, but at the cost of a virtually identical increase in heterotopic ossification. ICBG should still be considered the gold standard.

FM101

Complication, Revision, and Cancer Rates in Biologically Augmented Spine Fusion

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Introduction: Biological stimulants such as Bone Morphogenetic Proteins (BMP-2 and 7) or platelet concentrates have been propsed to augement lumbar fusion and improve union rates. However, recent data has shed light on increased rates of complications with the use of these agents. This meta-analysis assesses the available evidence for complications, revisions and cancer rates with the use ofBiological stimulants in spine fusion.
Methods: We conducted an online search for relevant controlled trials and extracted data on complications and revision rates. These data were synthesized in a meta-analysis using DerSimonian-Laird random effects modelling.
Results: Our search produced 571 results, 22 of which were eligible for inclusion. These studies report on a total of 2,095 patients (1181 experimental, 914 controls) with a mean age of 55.2 ± 8.8 years. Mean follow-up was 1.6 ± 0.5 years.
There was a signficantly higher risk of complications with biological augmentation compared to ICBG with a risk ratio (RR) of 1.5 (95%CI 1.04 to 2.04, p = 0.029). However, there was no difference in revision rates (RR 1.3, 95%CI 0.7 to 2.4, p = 0.456). While there was no overall increase in new cancer incicidence for all biologic augmentation (p = 0.155), BMP-2 had a signficantly higher rate (3.1%) of new onset cancer than ICBG (0.6%, p = 0.02)
Conclusion: While helpful in achieving postoperative fusion in spine surgery, biologic augmentation is associated with a higher rate of complications. These complications do not always require further surgery, but, including increases cancer rates, are severe in nature nevertheless.

FM102

Minimum Ten-Year Follow-up of Decompression and Dynamic Stabilization for Spinal Stenosis with Degenerative Spondylolisthesis

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Introduction: Decompression and fusion surgery is widely recommended for spinal stenosis with degenerative spondylolisthesis. However, posterior nonfusion pedicle-screw-based stabilization ("dynamic stabilization") is still a controversial area in spine surgery even though various studies with good to excellent short- and mid-term results have been reported in the current literature.
With this study, we are able to present the first long term (minimum 10 years) follow up for decompression and dynamic stabilization in situ with the Dynesys System (Zimmer Spine, Minneapolis, MN, USA) without bone grafting in patients with spinal stenosis and degenerative spondylolisthesis.
Methods: 36 patients (mean age 66.8 years at time of operation) with symptomatic lumbar spinal stenosis and degenerative spondylolisthesis underwent interlaminar decompression and monosegmental stabilization with Dynesys instrumentation according to our inclusion criteria. Patients were evaluated clinically and radiologically after a minimum follow-up of 10 years (range 10–13 years).

Results: At final follow-up, the mean VAS for back and leg pain significantly improved to 28 mm and 20 mm respectively (p <0.001). The walking distance improved for 89% of the patients. 92% of patients would undergo surgery again.
Radiologically, the spondylolisthesis did not progress and the motion segments remained stable. We did not see any significant screw loosening or breakage of the implanted materials at the final follow-up. 95% of the study population showed some radiological signs of adjacent segment degeneration (osteochondrosis and/or olisthesis). 16% of the patient population required further surgery because of symptomatic adjacent segment degeneration.
Conclusions: Decompression and single level dynamic in situ stabilization with the Dynesys System demonstrates excellent clinical and radiological long-term results in elderly patients. It maintains enough stability to prevent progression of spondylolisthesis without the need for fusion surgery and its associated risks and morbidity. It does not, however, prevent adjacent segment disease. The rate of secondary surgeries is comparable to other posterior instrumentation devices.

FM103

Determinants of evolution of endplate and disc degeneration in the lumbar spine – A multifactorial perspective

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Introduction: Evolution and progression of disc and endplate degeneration of the lumbar spine is thought to be multifactorial, yet, the strengths of the influences of potential factors and their interactions are not understood. The aim of this study was to find the strength of influence and interaction of the potential factors associated with evolution of degeneration of the lumbar spine
Methods: Patients (n = 90) who underwent two lumbar MRI exams with an interval of at least four years and without any spinal surgery where included into the longitudinal cohort study with nested case control analysis. Disc degeneration was scored according to the Pfirrmann classification and endplate changes according to Modic in 450 levels on both MRIs. Potential variables for degeneration such as age, gender, BMI, scoliosis and sagittal parameters were compared between patients with and without evolution or progression of degenerative changes in their lumbar spine. A multivariate analysis aimed to separate the most important variables for progression of disc and endplate degeneration, respectively.
Results: While neither age, gender, BMI, sacral slope or presence of scoliosis could be identified as progression factor for disc degeneration, a higher lordosis was observed in subjects with no progression (49.2° ± 11.0° vs 43.2° ± 11.7°, p = 0.017). Progression or evolution of endplate degeneration was only associated with higher degree of scoliosis (9.5°±10.4° versus 5.9° ± 9.0°; p = 0.0078) and not to any of the other variables.
Conclusion: While a coronal deformity of the lumbar spine is associated with evolution or progression of endplate degeneration, a higher lumbar lordosis is protective for radiographic progression of disc degeneration. This implies that patients with a scoliotic deformity and lesser lumbar lordosis are prone to faster overall degeneration of their lumbar spine.

FM104

Obesity Measured By Outer Abdominal Fat May Cause Facet Joint Arthritis At The Lumbar Spine

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Background: Obesity is a common health problem, which may cause mechanical stress on the spine and lead to degenerative diseases of the back. There is a lack of studies on the relationship of obesity and spino-pelvic parameters, such as lumbar lordosis (LL) and pelvic incidence (PI). Previous studies have only focused on BMI and facet joint (FJ) arthritis with varying results. Outer abdominal fat (OAF) describes subcutaneous adipose tissue thickness of the abdomen. It accurately predicts the amount of total body fat and remains a rarely studied parameter.
Objective: Our goal was to clarify the remaining issues about OAF and (1) its physiologic values on CT scans, (2) age, (3) gender, (4) FJ arthritis, FJ orientation (5) LL and (6) PI.
Methods: We retrospectively analyzed CT scans of 620 individuals, with a mean age of 42.5 (range, 14–94) years, who presented to our traumatology department and underwent a whole body CT scan, between 2008 and 2010. OAF was measured on axial planes of CT scans at the level of umbilicus and the thickest anterior abdominal wall distance was determined in millimeters. FJs of the lumbar spine were evaluated for arthritis and orientation between L2 and S1. LL was evaluated between L1 and S1. The PI was measured by the angle between the hip axis to an orthogonal line originating at the center of the superior end plate axis of the first sacral vertebra.
Results: (1) The mean value for OAF on CT scans was 19.7 mm (SD 10.1°, range 2.2-68 .0 mm). (2) OAF significantly increased with age until 70 years and then decreased again (p = <0.0001). (3) There was no significant gender difference for OAF. (4) OAF was significantly increased in individuals with FJ arthritis (p = 0.01, OR = 1.019 [1.004, 1.034]), but not with FJ orientation. (5) We did not find a significant association between OAF and LL (p = 0.18), nor PI (p = 0.34 for logarithmic values).
Conclusion: The mean value for OAF on CT scans is 19.7 mm. OAF is significantly associated with age. It increases with age until 70 years and then decreases again. It is not gender-related. As a novelty finding, OAF significantly increases with higher degrees of FJ arthritis, but is not related to FJ orientation, LL or PI. Therefore, obese patients may benefit from weight loss by decreasing their FJ arthritis and potentially associated back pain.

FM105

The assessment of patient-rated outcome in spinal stenosis: could less be more?

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Introduction: The Core Outcome Measures Index (COMI) is a short, validated questionnaire for assessing the key outcomes of importance to back patients. With just one question per domain, it enables the efficient assessment of large groups, with minimal respondent burden. However, for specific pathologies, intuitively it may be expected to be less responsive than a disease specific instrument. In patients with lumbar spinal stenosis (LSS), we compared the performance of the COMI and the widely accepted Swiss Spinal Stenosis Measure (SSM).
Methods: The following questionnaires were completed before surgery by 91 LSS patients (73 ± 8 y; 50 m, 45 f) and after surgery by 47 patients who had reached 12 months' post-op: SSM, COMI, Roland Morris disability (RM), EuroQoL-VAS (EQ-VAS), complaints "feeling thermometer" (FT), pain numeric rating scale (pain NRS). At 12 months' post-op, SSM "satisfaction with treatment result" and the Global Treatment Outcome (rated 1–5) were assessed.
Results: The COMI correlated with the SSM and the comparator questionnaires to the expected (r ≥0.4 ≤0.8) extent, indicating good construct validity. The external criterion of Global Treatment Outcome correlated better with the change score (baseline to 12 mo FU) for COMI (r = –0.62) than for SSM symptoms (r = –0.43) or SSM function (r = –0.42) (each p <0.05). Similarly, "SSM satisfaction" correlated better with the change score for COMI (r = –0.63) than for SSM symptoms (r = –0.59) or SSM function (r = –0.45).
Conclusion: COMI scores correlated to the expected extent with the scores on the SSM and its subscales, and with the scores for pain, disability and QoL, suggesting construct validity. With either SSM "satisfaction with treatment results" or Global Treatment Outcome serving as the external criterion, COMI showed better external responsiveness than did the SSM subscales. The COMI is well able to detect important change in LSS and has the added benefits of facilitating outcome comparisons with other spinal pathologies and reducing the response burden for the patient.

FM106

Decompression surgery for lumbar spinal canal stenosis in octogenarians; single center experience of 121 consecutive cases

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Introduction: With increasing age, ubiquitous degeneration processes lead to a narrowing of the spinal canal. Degenerative lumbar spinal stenosis (DLSS) causes functional disability with back and lower extremity pain at older ages. Goal of this study was to determine the outcome and if quality of live might improve after decompression surgery in an octogenarian population.
Methods: In this retrospective study, we examined files of 121patients with the age >80 years, which underwent posterior decompression surgery for DLSS from January 2006 to August 2013. Patients were evaluated for surgical outcome using the Zurich Claudication questionnaire (ZCQ), walking distance were compared pre, – and postoperatively. And further the visual analogue scale (VAS) was determined before and after surgery and in the follow-up process.

Results: Our preliminary results show similar peri- and postoperative complication rates compared with younger patients and overall improvement in all ZCQ-subgroups (overall symptom severity, physical function domain). Patients were overall satisfied with surgery. The pre and post-operative VAS-comparison showed a mean improvement by 2,9 points.
Conclusion: Our study suggests that posterior decompression is a beneficial treatment procedure and seems to improve quality of life even in patients over 80 years of age. To date, this is the largest European single-center octogenarian patient population with DLSS that were evaluated for decompression surgery.

FM107

Does the duration of preoperative conservative therapy in degenerative lumbar spinal stenosis have an influence on the outcome in microsurgical decompression?

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Introduction: Decompression without fusion is one of the most common interventions in patients with lumbar spinal stenosis (LSS) where no radiological signs or intraoperative instability exist. Until now only few predictors (age, operation time, and comorbidities) were found to be influencing the outcome. The success of conservative therapy is still discussed controversially. No evidence exists when the time has come to switch from conservative to surgical therapy, unless there is a neurologic deficit (rare condition). This study aims at the influence of the duration of conservative therapy (none, <3 mo, 3–6 mo, 6–12 mo, >12 mo.) on the outcome of decompression in LSS. We hypothesized outcome of surgery is dependent on the duration of previous conservative treatment.
Methods: This prospective multicenter study currently contains more than 50,000 spinal operations; We examined 2,479 complete LSS cases with deco. Pre- and 1-year-post-operative assessment of leg- and back pain on Visual Analogue Scale (VAS: 0-10) and spine specific Core Outcome Measures Index (COMI) were recorded. Physician-based documentaion defining the surgical treatment (pathology, procedure, complications, blood loss, hospital stay) and surgeon follow-up were recorded. Descriptive statistics and multivariate logistic regression were used to analyze pre to post-operative patient-based VAS for leg- and back pain and COMI scores for the whole group and for four cohorts with differing periods of conservative care.
Results: The duration of previous conservative treatment, stratified as outlined, did not have any influence on the ultimate outcomes. There were no statistically or clinically significant differences in leg pain relief, back pain relief or COMI score at the 1-year-FU for the four different time periods of conservative care. The individual significant results for back pain relief in all groups were between 2.1 and 2.5 ($p > 0.05$); Relief for leg pain was higher with: 2.4 to 3.3 ($p > 0.05$) and for COMI: btw 2.6 and 3.1 ($p > 0.05$).
Conclusions: Due to the relative long time frame of a clinical stable situation in LSS and temporary relief due to conservative therapy, the decision making for a surgical intervention is still a challenge. This study demonstrated significant improvements in standardized outcomes following lumbar decompression at the 1y FU that were independent of the duration of cons. care. These findings have to be confirmed in a more controlled study environment.

FM108

Long-Term Results of Bankart Repair and Latarjet Procedure for Treatment of Recurrent Shoulder Instability

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Introduction: For recurrent anterior instability several different operative techniques have been proposed. The aim of the present study was to compare the mid- to long-term results of the two currently most commonly performed procedures: the arthroscopic soft tissue repair (Bankart) and bone reconstruction (Latarjet) procedure.
Methods: A comparative case analysis was performed for 256 patients (261 shoulders) with first time surgery for recurrent anterior glenohumeral joint instability between 1998 and 2007. Minimum follow up time was six years. Re-operations, recurrent instability, subjective shoulder value, ability for sports participation and overall satisfaction were recorded. The study has a conscious selection bias because high risk shoulders with an anterior glenoid rim fracture involving a supero-inferior glenoid rim distance of more than half of the maximal glenoid diameter were not considered candidates for arthroscopic Bankart repairs.
Results: shoulders had undergone a Latarjet and 181 shoulders an arthroscopic Bankart procedure. Mean age was 31 years for patients treated with a Latarjet procedure and 29 years for the Bankart group respectively. Recurrence of joint instability occurred in 72 cases (38.5%) following a Bankart procedure and in 8 cases (10.8%) in the Latarjet group after a mean of 37.7 months. Kaplan-Meyer analysis for time to sensation of instability ($p = 0.0001$), time to subluxation ($p = 0.001$) and time to redislocation ($p = 0.001$) demonstrated significant differences between both procedures with decreasing effectiveness of the Bankart procedure over the postoperative course of time. Failures following a bone reconstruction procedure occurred early postoperatively with nearly no long-term failures. In both groups the subjective shoulder value significantly improved postoperatively ($p = 0.0001$).
Conclusion: The open Latarjet procedure demonstrated superior results with significantly fewer failures compared to an arthroscopic Bankart repair. The difference increased significantly over the course of our follow up period with decreasing effectiveness of Bankart repair over time. In accordance to these findings, we suggest a minimum follow up period of 3 years following a Latarjet procedure and 7 years for patients having received an arthroscopic Bankart procedure respectively.

FM109

Arthroscopic rotator cuff repair in wheelchair patient

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Introduction: It was the purpose of this study to investigate the specific rotator cuff (RC) tear patterns as well as the outcome after arthroscopic RC repair in a cohort of wheel-chair users.
Methods: 61 shoulders in 56 patients, which have been operated between 2006 and 2011, and meet the study specific inclusion criteria (pre- and postoperative wheel-chair use, arthroscopic repair of a full thickness RC lesion) were invited to a study specific clinical (Constant score (SC) and ASES score) and ultrasound follow-up analysis.
Results: Of the 61 operated shoulders, 8 showed a sole subscapularis (SSC), 7 a sole supraspinatus (SSP), 22 a combined SSC and SSP, 11 a combined SSP and Infraspinatus (ISP) and the remaining 13 a combined SSC, SSP and ISP lesion.
15 patients did not show up for study. 6 of them had a documented re-tear with revision surgery after a mean of 12 months (range 2–26). Of the other 9 patients, 6 are living abroad, 2 in a nursing home (advanced dementia) and one refused follow-up visit. Of the remaining 46 shoulders, which could be analyzed after a mean follow-up of 46 months (range 24–82), 5 had a documented revision and 6 additional shoulders showed a full thickness lesion of the repaired RC tendon in our ultrasonographic control, leading to an overall failure rate of 33%(17 out of 52). Traumatic cause for the re-tear appeared in 7 Patients (13,5%).
The 35 shoulders with an uncomplicated postoperative course had a preoperative CS of 51 points (range 22-86) and ASES score of 55 points (range 20–92), which increased to a CS of 82 points (range: 40–98) and ASES of 94 points (range 53–100), with a subjective shoulder value (SSV) of 86 (25–100). Patients who showed a re-tear at final follow-up (n = 6) increased their CS from 46 (range 35–63) to 74 (51–89) and the ASES score from 58 (range 47–75) to 87 (range 70–98), with a SSV of 73% (range 50–90), which was barely different from patients, which had to be revised and evidence of healed re-tear (n = 5; CS from 45 (range 25–63) to 71 (48–91) ASES from 55 (range 42–78) to 81 (70–98) SSV: 82% (range 50–100).
Conclusion: Despite an overall failure rate of 33% arthroscopic RC repair in weight-bearing shoulders leads to satisfying clinical results with high patients satisfaction. However, the postoperative rehabilitation is demanding, requires high patient compliance and a specialized unit with experience in handling those additionally impaired patients.

FM110

Prospective Clinical and Radiological Evaluation of Factors Predicting Outcomes After Arthroscopic Rotator Cuff Repair

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Introduction: This study aimed to report the clinical and sonographic outcome of patients who underwent arthroscopic repair of a full-thickness rotator cuff tear, and to determine the factors associated with poor clinical outcome at six and nine months after surgery. The hypothesis was that different factors are related to unsatisfactory postoperative evolution.
Materials: All patients who had a ARCR performed by one author were considered potentially eligible for inclusion in this longitudinal continuous prospective study. The cohort was divided into two groups based clinical results at six months. Group A consisted of patient that were considered as cured, satisfied, with a Constant score above 80, and that return to their professional activity. Group B consisted of patients that had a medical file that could be closed, that were unsatisfied, with a Constant score below 80, and that were unable to return to work.
Results: Three hundred and sixty-five patients met the entry criteria and were enrolled in the study. The group A consisted finally of 293 patients and the group B of 58 patients. In the multivariate analysis, the only preoperative factors that showed a significant relationship with group B were workers' compensation patients and preoperative Constant score below 50 points. Postoperatively, the number of tendons repaired (large and massive tears) and bursitis dertermined by ultrasound at six months were the only factors that increased the risk of being in the group B. A tendon non-healing was consequently not a bad progosis factor. However, if a patient with a non-healing had pain at 6 months, the pain would persists at 9 months.
Conclusion: ARCR is an effective procedure that leads in most cases to significant improvement in satisfaction and function, and to tendon healing. However, in one of five cases, patients were not considered as cured at six months and could not return to work. This information is crucial in our current practice as it permit to justify an inability to return to work of more than 6 months postoperatively vis-à-vis of insurances. Persistent limitation at six months was associated with workers' compensation status, a preoperative Constant score below 50 points, size of the tear and the presence of postoperative persistent bursitis. Functional result is limited at nine month in case of tendon non-healing.

FM111

Pseudoparalysis can be reversed following arthroscopic rotator cuff repair: A prospective analysis

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Introduction: Some authors have suggested that patients with pseudoparalysis and an "irreparable rotator cuff tear" require a reverse shoulder arthroplasty (RSA) to regain active motion above shoulder level. However, RSA has been associated with high complication rates. The purpose of this study was to determine the preoperative factors associated with recovery of pseudoparalysis following an arthroscopic rotator cuff repair (ARCR).
Methods: This was a prospective multi-centered study of ARCR performed in the setting of preoperative pseudoparalysis with a minimum follow-up of 1 year.
Results: A total of 53 cases of pseudoparalysis that met the study criteria were identified during the study period. The mean age of the cohort was 62.6 + 8.9 years at the time of surgery. Pseudoparalysis had a traumatic origin in in 79% of cases and had been present for a mean of 4.2 + 6.1 months prior to surgery. The mean follow-up was 13 months. 51 (92.7%) of the patients recovered from pseudoparalysis. The mean scores at last follow-up were 1.2, 87, 10.1, 83.6 for pain, ASES, SST and SSV, respectively. 98% of the patients were satisfied and could return to work/activities. One patient required additional surgery. Complication rate was 11%, consisting mainly of non-healing of chronic tears and frozen shoulders.
Conclusion: Acute development of pseudoparalysis can be adequately treated arthroscopically and is, with RSA, an option of treatment for this condition. Non-healing of chronic tear is frequently observed.

FM112

Midterm clinical outcome after combined direct tendon repair and tendon transfer procedure to treat acute on chronic anterosuperior rotator cuff tears (RCT)

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Introduction: Chronic isolated subscapularis tears are usually well tolerated. An acute superior RCT on a chronic subscapularis tear on the other hand generally leads to persistent painful decrease of function. Therefore surgical treatment is frequently required and remains challenging when joint preserving restoration of function is required.
The aim was the assessment of midterm clinical outcome after a direct repair of the reparable superior portion and a pectoralis major and teres major (PM/TM) transfer procedure for the irreparable anterior part of acute on chronic anterosuperior RCT.
Methods: 6 consecutive patients (7 shoulders) were included and treated by the same surgeon between 2006 and 2011. The mean age was 57 years (range 46–74). The procedure was performed through a combined superolateral and deltopectoral approach. The torn superior part of the tear (supraspinatus in 4 shoulders, supraspinatus and cranial infraspinatus in 3 shoulders) was repaired directly. A split PM tendon transfer of the sternal muscle head was performed to reconstruct the cranial part of the subscapularis muscle (7 shoulders). In patient with complete loss of the subscapularis muscle a TM transfer was added to reconstruct the lowest part of the muscle (6 shoulders). The Constant score (CSS) was used to assess shoulder function. In addition patients were asked to rate the level of satisfaction and the subjective shoulder value (SSV).
Results: At a mean follow-up period of 5.1 years (2–7 years), the reconstructed rotator cuff was intact in 6 from 7 shoulders. The average CSS increased from 34 (SD ± 14) before surgery to 67 points (SD ± 15) at follow-up ($p < 0.003$). Whereas pain and mobility scores increased from 7 (SD ± 2) to 13.1 (SD ± 3.8) ($p < 0.02$) and 16 (SD ± 9) to 30 (SD ± 6.6) points ($p < 0.017$) respectively, strength remained low in all patients. All patients with a healed cuff were very satisfied and rated the SSV >95%. One patient with a re-rupture of the superior cuff remained painful and was somewhat satisfied.
Conclusion: Reconstruction of acute on chronic anterosuperior RCT with combined direct tendon repair and tendon transfer leads to sustainable pain reduction, increase of function and high patient satisfaction provided healing of the fixed and transfered tendons occurs. The relevance of the tendon transfer on clinical outcome remains matter of debate.

FM113

Is there an Association between Rotator Cuff Degeneration and Shoulder Subluxation in OA Shoulders?

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Introduction: Rotator cuff muscles are critical for the stability of the glenohumeral joint. OA shoulders may be associated with degeneration of these muscles and/or shoulder subluxation.
Aim: Therefore, the objective of this study was to test the hypothesis that the degeneration of the rotator cuff muscles is related to the subluxation of the humeral head. In OA shoulders
Methods: Muscle degeneration was quantified by atrophy and fatty infiltration. Atrophy was Ra = (S-Sa)/S, with S and Sa respectively normal and current cross-section area. Fatty infiltration was Ri = (Sa-Si)/Sa, with Si muscle area excluding fat. Ra and Ri were measured on a CT slice perpendicular to the scapular plane and coincident with the spinoglenoid notch. Ra and Ri were measured for supraspinatus, subscapularis, and infraspinatus. Glenohumeral and scapulohumeral subluxation were measured in 3D, providing subluxation level and orientation. Subluxation was normalized to humeral head (0% for a centered head). The method was applied on 112 OA shoulders.
Results: Glenohumeral and scapulohumeral subluxations were only associated with atrophy of supraspinatus (normalized Ra was lower ($P < 0.001$) than normalized subluxation). Ra of SS varied from 2.9 to 80.0%. Glenohumeral subluxation varied from 1 to 20%. It occurred nearly equally in the posterior, anterior, superior and inferior directions. The scapulo-humeral subluxation varied from from 0 to 44%. It occurred mainly in the posterior and postero-superior directions.
Conclusion: Supraspinatus is an important stabilizer of the glenohumeral joint. A quantitative evaluation of its degradation seems critical when planning total shoulder arthroplasty for OA.

FM114

Extra-articular Step Osteotomy of the Olecranon: A Biomechanical Assessment

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Background: Due to its maximized exposure, trans-olecranon chevron-shaped osteotomies (COs) remain the gold standard approach to type C fractures of the distal humerus. In consideration of the high complication rate inherent to this technique, an extra-articular osteotomy of the olecranon may be advantageous. The purpose of the present study was to compare primary biomechanical stability of COs with extra-articular oblique osteotomies (OOs) as well as modified, extra-articular step osteotomies (SOs).
Methods: According to pilot studies, the three osteotomies were tested in 42 composite analog ulnae models at 20° and 70° of flexion. Triceps loading was simulated with a servo hydraulic testing machine. All specimens were isometrically loaded until failure. Kinematic and force data, as well as interfragment motion were recorded.
Results: At 70°, CO failed at a mean load of 963 N (SD 104 N), the OO at 1512 N (SD 208 N) and the SO at 1484 N (SD 153 N), ($p < 0.001$). At 20°, CO failed at a mean load of 707 N (SD 104 N) and OO at 1009 N (SD 85 N) ($p = 0.006$). The highest load until failure was observed for the SO, which was with 1277 N (SD 172 N) significantly stronger as the CO as well as the OO.
Conclusion: Extra-articular osteotomies showed a significant higher resistance against tensile forces than traditional COs. At close to full extension, these biomechanical advantages were further improved by a step-cut modification of the oblique osteotomy.

FM115

The Deltoid Tuberosity Index (DTI) – A Simple Radiographic Tool to assess Local Bone Quality for Proximal Humerus Fractures (PHF)

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Introduction: Osteoporosis complicates the treatment of PHFs and should be respected for the preoperative planning. Peripheral quantitative CT (pQCT) and the Tingart measurement (TI) are validated methods, but both have limitations in the clinical use. It was the aim to define and validate the DTI to radiographically predict local bone quality for PHFs.
Methods: The DTI was defined directly proximal to the deltoid tuberosity, where the inner and outer cortical borders become parallel. It was calculated by dividing the outer by the inner cortical diameter at this level.
The DTI and the TI were measured on internal rotation AP shoulder radiographs (IRx) and BMD (mg/cm^3) on pQCTs of 26 unfractured shoulders (11 female, 13 male, mean: 62 years). Inter-/intrarater correlations (2 readers) of the DTI and TI were calculated using IRx of 40 randomly selected patients (31 female, 9 male, mean: 65 years) with PHFs.
Results: The mean (range) values were: DTI 1.46 (1.1-2.05), TI 5.32 mm (1.92–7.95) and BMD 94 mg/cm^3 (40-178). Both, the DTI and the TI showed a strong correlation to each other ($r = 0.87$) and to the BMD ($r = 0.85/0.84$). The intra-/interrater correlations were strong for both: DTI ($r = 0.92/0.96$), TI ($r = 0.89/0.85$). The DTI was measurable in significantly more PHFs (76/80 vs. 63/80; $p < 0,01$). The optimal threshold values (ROC-analysis) to predict osteoporosis (<85 mg/cm^3) were <1.4 (DTI) and <5 mm (TI).
Conclusions: The DTI correlated well to local BMD with a threshold value of <1.4 to predict osteoporosis. It's clinical feasibility and reproducibility for PHFs were superior compared to the TI. The DTI turned out to be a simple and valuable alternative to the TI without need for correction of magnification.

FM116

Lengthening of the Subscapularis Tendon as a Sign of Partial Tearing

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Introduction: Partial subscapulairs (SSC) tendon tears usually involve the superior aspect first, with later inferior extension. The tendon thereby may be continuously elongated and replaced with newly formed scar tissue leading to retraction and loss of function of the corresponding muscle. For better understanding and identification of such a tendon rupture in continuity, the purpose of this study was to quantify SSC tendon length in MRIs of patients with pathological or normal (control group) SSC tendons.
Methods: 91 shoulder MR arthrographies, which were performed within 3 months prior to shoulder arthroscopy (between 2010 and 2012) were retrospectively identified for the purpose of this study. On T2 weighted transverse sections through the center of the SSC's myotendinous unit we identified (1) the most medial part of the SSC muscle origin (medial border of the scapula), (2) the myotendinous junction and (3) the tendon insertion at the lesser tuberosity and calculated thereof the SSC muscle and tendon length and the tendon to muscle ratio, respectively. All MR radiographies were reviewed by 2 readers independently. Findings in later performed arthroscopy were used as the diagnostic gold standard and all surgical reports and intraoperative photo documentations were reviewed for the exact description of the SSC tendon integrity.
Results: In 55 patients arthroscopy showed an intact subscapularis tendon (group A), while in 36 patients a partial SSC tear (group B) was diagnosed and treated with debridement (5 patients) or tendon to bone repair (31 patients). The interobserver variability (Pearson) was 0.83 for SSC tendon length and 0.84 for tendon/muscle ratio respectively. While intact SSC musculotendinous units (group A) showed a tendon length of 40.5 mm (SD 0.93) and a tendon-muscle ratio of 0.40 (SD 0.013), in case of tendon lesion (group B) the SSC tendon length was significantly ($p < 0.0001$) increased (52.7 mm; SD 1.4) leading to a higher tendon-muscle ratio of 0.57 (SD 0.019).
Conclusion: Partial tears of the upper part of the subscapularis tendon are associated with a – on MR-arthrographies detectable – lengthening of the tendon, leading to a retraction of its corresponding muscle and medialization of the myotendinous junction.

FM117

The Joint Reaction Force is Dependent on the Size of The Critical Shoulder Angle. A Biomechanical Analysis

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Introduction: Osteoarthritis (OA) of the glenohumeral joint is a common pathology and the most frequent reason for nontraumatic shoulder joint replacement. Recently a correlation between a small critical shoulder angle (CSA) of 28.1° (± 3.3) and OA was found (control group: CSA = 33.1°(± 2.3). We hypothesized that a small CSA leads to a higher joint reaction force (JRF) causing OA.
Methods: A shoulder simulator with simulated deltoid (DLT), supraspinatus (SSP), infraspinatus/ teres minor (ISP/TM), and subscapularis (SSC) musculotendinous units was constructed. The principal abductors DLT and SSP were configured to apply increasing tension at a constant ratio. The ratio of SSP to DLT was varied between 1:2 and 1:1. The cord of the DLT was looped around a pulley which could be horizontally adjusted to achieve a CSA of 28° or 33°. The inclination of the glenoid was varied between neutral position 5° downward tilt and 5° upward tilt. The SSC and the ISP/TM at the proximal humerus were symmetrically loaded with a constant force of 45 N. The scapula itself was mounted to a rotary stepper motor and contributed one third of the overall arm abduction. For each of the 4 settings the joint forces orthogonally and laterally to the glenoid were measured by a 6-axis load cell and the joint reaction force was reduced from the data for a range of motion between 10° and 82° of thoracohumeral abduction.
Results: The JRF showed a constant increase during thoracohumeral abduction lying within the range of in vivo recorded values by means of a telemetric implant for a thoracohumeral abduction between 13° and 55°. For the CSA (28°) associated with OA the magnitude of the JRF force was found to be higher compared to the control CSA (33°) for both DLT/SSP ratios and all three inclination angles of the glenoid during the whole movement. The finding was more pronounced for the DLT/SSP ratio of 2 compared to an equal force distribution between DLT and SSP with a maximum difference of 26.4 N (8.5%) at angle of 55° of thoracohumeral abduction compared to 16.1 N (5.9%). A general correlation between the inclination and the difference in JRF could not be proven.
Conclusion: Our results show that the CSA found in OA leads to a higher reaction force. This supports the theory that a small CSA leads to a higher load at the joint surface causing degenerative changes that leads to OA.

FM118

3-D preoperative planning and patient specific instrumentation for Reverse Shoulder Arthroplasty

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Introduction: Optimal glenoid component positioning in total shoulder arthroplasty is crucial to avoid early loosening, scapular notching, and impaired shoulder function. To date, preoperative planning is based on 2-D assessment of the native glenoid version and only rough estimation of the inclination. Furthermore, intraoperative orientation and implantation to the desired positioning are guided only by simple instruments.
Patient specific instrumentation (PSI) facilitates anatomically guided component positioning based on precise 3-D preoperative planning. The purpose of the study was, whether PSI-instrumentations are intraoperatively feasible and allow accurate glenoid implantation.
Methods: A preoperative CT-Scan was performed at least 3 weeks prior to surgery. Preoperative planning was done with a specific 3-D software, allowing optimal positioning of the glenoid component within the glenoid vault. Patient-specific Instruments for the Trabecular Metal Anatomical™ Glenoid were provided by Zimmer, Warsaw, USA. It included anatomically preformed drill guides for the central pin and screw guides. The study was approved by the institutional review board. Five patients with rotator cuff arthropathy (n = 4) and recurrent instability (n = 1) were included. Constant score, ASES, Subjective shoulder value, and EQ-5D were pre- and postoperatively assessed. A postoperative CT-Scan was performed at 3 months. Mean follow-up was 9 months (range 4–13 months).
Results: In all cases, patient-specific instruments were easily applied and did not impede operative procedure. There was no perforation of the central peg and screw length corresponded with the preoperative plan. Postoperative clinical parameters revealed anticipated improvement in shoulder function and quality of live. On postoperative CT-scans, there was no perforation of the glenoid vault. Glenoid version as well as inclination corresponded to the preoperative plan (deviation ≤10°).
Conclusion: Preoperative 3-D planning and utilization of patient-specific instruments is easily feasible and allows for precise and reproducible implantation of the glenoid component. Particularly in small glenoid vaults or severe deformities, PSI-instrumentation is a valuable aid for accurate glenoid implantation.

FM119

Effects Humeral Configurations in a Virtual Reverse Shoulder Arthroplasty Model

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Introduction: Many complications, such as scapular notching and arm lengthening could be attributed to 155° humeral neck-shaft inclination. To address these problems, several authors have proposed a change in the design of the Grammont prosthesis, promoting a decrease of the humeral neck-shaft angle. However, the implication of these different design changes on shoulder kinematics is still poorly understood. Change in the neck-shaft angle theoretically increases the risk of humeral lateralization. The latter has been only partially analyzed yet and may have a dramatic influence on outcomes after surgical reconstruction. The aim of this study was thus to analyze the effect of humeral lateralization with a numerical model after different configurations of RSA on ROM, and scapular impingement.
Methods: A 3-dimensional computer model was developed from computer tomography (CT) images of a cadaveric shoulder. The RSA Aequalis Reverse and Aequalis Ascend FLEX were inserted into the virtual shoulder. The standard 36 mm glenosphere was used. Six humeral components were tested: Aequalis Reversed 155° (H1), Aequalis Ascend Flex 155° (H2), 145° (H3), 145° medialized (H4), 145° lateralized (H5), and 135° (H6).
Results: Different stem design (Aequalis vs. Ascend Flex) lead to change of almost 10 mm of global and humeral offset. Contrarily, the different neck-shaft angle of the Ascend Flex (H2-H6) has almost no influence on global and humeral offset. There was a 24% decrease in abduction and a 78% increase in adduction in H6 constructs compared with a H1. When going from a H1 to a H6, the flexion decreases slightly of 4%, whereas an improvement in extension of 79% was observed. The H6 stem offer an advantage for external rotation elbow at the side but is limiting external rotation at 90° of abduction. Regarding rotations at 90° of abduction, external rotation decreased of more than 100% with H6 configuration compare to H1. Two types of impingement interactions were noted: the humeral socket could engage the glenoid circumferentially, included with superior glenoid fossa (friction-type impingement), or the proximal humerus could impinge with the acromion in abduction and in external rotation at 90° of abduction (abutment-type impingement).
Conclusions: An understanding of changes in prosthetic design, such as humeral lateralization and different neck-shaft angles, is important to maximize ROM and limiting the different types of impingements.

FM120

REVERSE TOTAL SHOULDER ARTHROPLASTY AFTER FAILED DELTOID FLAP RECONSTRUCTION

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Hypothesis: Reverse shoulder arthroplasty (RSA) yields unsatisfactory results after deltoid flap reconstruction due to defect of the deltoid muscle.
Methods: We retrospectively reviewed the outcome of 19 patients after failed deltoid flap reconstruction treated with RSA. Follow-up was after a mean of 4.5 years.
Results: Seven patients (37%) had 9 postoperative complications requiring totally 16 revision surgeries. Nonetheless, at latest follow-up, 17 patients had no or mild, 2 had moderate, and none had severe pain. Before RSA; 13 patients had a pseudoparesis. At latest follow-up, none of the patients had a pseudoparesis. Mean flexion was 121° (90°–160°). Abduction strength averaged 2.3 kg (range, 0 to 5.4 kg). The mean Constant score was 70% (range, 28–98%). Of the 19 patients, 15 were very satisfied with the outcome, 4 were satisfied, and none was dissatisfied. The mean overall subjective shoulder value was 73% (30–95%) of the value of a normal shoulder.
Conclusions: Despite of a localized defect of the deltoid muscle after deltoid flap repair, RSA can reliably be associated with a satisfactory outcome.

FM121

Bilateral reverse shoulder arthroplasty: Deficits of internal rotation and limitations in activities of daily living at one year follow-up

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Introduction: Bilateral reverse shoulder arthroplasty (RSA) is controversial because postoperative deficits in humeral rotation on both arms might lead to distinct limitations of activities of daily living (ADL). The aim of this study was to assess the postoperative outcome of staged bilateral RSA especially with respect to reaching a sufficient internal rotation.
Methods: 39 patients with staged bilateral RSA and a minimum follow-up of one year after the second arthroplasty were identified in our local shoulder arthroplasty register. Indications for surgery included rotator cuff deficiencies (n = 33), rheumatoid arthritis (n = 3) and secondary osteoarthritis (n = 3). The mean age of the patients (30 women, 9 men) was 75 years (range 61 to 92 years) at the time of second RSA. The mean time between the first and second arthroplasty was 18 months (range 4 to 76 months). Preoperatively as well as 6, 12 and 24 months postoperatively the functional outcome was assessed using the Constant score, SPADI and quick DASH. Reaching the lumbosacral junction in the apley's scratch test was determined as sufficient internal rotation in daily life.
Results: The rate of patients who experienced a loss of internal rotation from preoperative to 2 years postoperative was similar between the first and the second RSA (18% versus 15%, p = 0.75). One year after the second RSA 84% (31/37) reached the lumbosacral junction with at least one hand, after two years even 96% (23/24). Overall, the Constant score of the second shoulder was significantly lower at the one year follow-up (mean 62.3 SD 20.2) than it was one year after the first RSA (mean 68.4 SD 12.6)(p = 0.045). Similarly, the SPADI showed lower values after the second operation compared to the first [mean 61.4 (SD 26.7) vs. 70.2 (20.9), p = 0.015]. These differences were reduced at the two year follow-up (p >0.05). All patients reported an improvement of their shoulder value one year after the first surgery, whereas 89% did so after the second surgery.
Conclusion: As known from the literature the limited internal rotation after RSA often remains a problem. However, most patients with bilateral RSA achieve a sufficient internal rotation of at least one side. The functional outcome of the later operated side is inferior to the first shoulder within the first 2 years after implantation. Despite persisting limitations in terms of function and ADL patients appreciate the benefit of bilateral RSA.

FM122

Influence of the glenosphere size on the functional outcome after reverse shoulder arthroplasty

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Introduction: Biomechanical studies could show that the glenosphere size of reverse shoulder arthroplasty (RSA) has impact on the stability and the range of motion. However, published evidence from clinical data supporting this observation is scare. The goal of this study was to compare the clinical outcome of two different glenosphere sizes of a single RSA type.
Material & Methods: Ninety-two patients treated by RSA after severe rotator cuff deficiency were documented in a prospective clinical register between 05/2006 and 03/2008. The glenosphere component was chosen with a diameter of 36 mm or 44 mm according to the preference of the surgeon. In addition to pre- and perioperative evaluation, patients attended follow-up examinations 6, 12, 24, and 60 months postoperatively including Constant Score (CS), Quick-DASH and SPADI. Both patient groups were compared according to baseline demographics and shoulder status. The effect of glenosphere size on functional scores was investigated using mixed models adjusted for gender, glenoid caudal-cranial distance (GCC) measured on xrays and baseline scores.
Results: Male patients were twice as likely to receive a 44 mm glenosphere as female patients and most patients with GCC >45 mm or humerus head diameter >60 mm received a 44 mm glenosphere; study groups were similar with regard to other baseline parameters. Patients with a 44 mm glenosphere diameter (n = 43) showed a significantly higher CS in all follow-ups (5y-FU: mean = 67; 95%CI = 62–72) than patients with a 36 mm diameter (n = 49, mean = 59; 95%CI = 54–64) (p = 0.042). This is reflected in particular by the subscores related to strength and pain. These patients had also a significantly higher external rotation in adduction (5y-FU: mean = 29°, 95%CI 25-33) than patients with a 36 mm diameter (mean = 21°, 95%CI=17-24) (p <0.001) – even after exclusion of patients with positive lag sign (p = 0.044). No dislocations were experienced in both groups and no prosthesis had to be revised. The patient group with a higher glenosphere diameter tended to a slightly better Quick-DASH [5y-FU: mean (95%CI) = 65 (59-72) versus 60 (54-66)] and SPADI [71 (64-77) versus 67 (60-73)] (p >0.05).
Conclusion: Independent to gender and other baseline parameters such as baseline scores, RSA models with a higher glenosphere diameter seem to facilitate a clinically better shoulder function with higher rotational amplitude and a gradually higher patient satisfaction in the midterm.

FM123

Operative versus conservative treatment of displaced greater tuberosity fractures: a radiological and biomechanical assessment

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Introduction: Displaced greater tuberosity fractures may result in a painful subacromial impingement and a reduction of normal shoulder motion. The displacement that can be tolerated for a conservative treatment of such fractures and the method to measure the displacement are not well defined. In order to improve our treatment algorithm we developed a new method, which allows to quantify the displacement of greater tuberosity fractures on true anteroposterior radiographs and to predict a possible subacromial conflict.
Method: Three concentric circles were drawn on true anteroposterior radiographs and the corresponding radii were measured. The first circle (radius Rh) perfectly matched the humeral head surface. Its centre corresponded to the geometric centre of the humeral head. The second circle (radius Rt) was tangent to the greater tuberosity and the third circle (radius Ra) touched the undersurface of the acromion. The relationship (Rt-Rh)/(Ra-Rh), which is a measure for the space occupied by the greater tuberosity under the acromion, was called impingement index. It was calculated in 50 normal shoulders and four cadaver specimens with iatrogenic greater tuberosity fractures of different sizes and different displacements.
Results: The inter-rater reliability of the measurements was excellent. In normal shoulders the impingement index averaged 0.49 (range 0.23–0.73). In the cadaver shoulders with greater tuberosity fractures an impingement index of 0.70 or greater was associated with subacromial impingement.
Conclusion: A patient with a displaced greater tuberosity fracture and an impingement index >0.70 may benefit from surgical treatment.

FM124

Risk Assessment of Sexual Activity after Total Hip Arthroplasty (THA)

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Introduction: Many patients wonder about the risks related to sexual activity after THA, but this issue remains rarely discussed between patients and surgeons. To date, the relative risk of impingement and joint instability during sexual activities after THA has never been objectively evaluated. Hip range of motion (ROM) necessary to perform sexual positions is also unknown. Our goal was to fill this lack using motion capture and computer simulations of prosthetic models.
Methods: Motion capture and MRI was performed on 2 healthy volunteers (1 female, 1 male). Motion of the subjects was acquired during 12 common sexual positions. The hip joint kinematics and ROM were computed from the markers trajectories using a validated fitting algorithm (accuracy: translational error ≈0.5 mm, rotational error <3°) taking into account the patient's anatomy reconstructed from their MRI data.
3D models of prosthetic hips (pelvis, femur, implants) were developed based on variations of acetabular cup's inclination (40°, 45°, 60°) and anteversion (0°, 15°, 30°) parameters, resulting in 9 different implant configurations. Femoral anteversion remained fixed and determined as neutral with the stem being parallel to the posterior cortex of the femoral neck. Motion capture data of sexual activity were applied to all configurations.
During simulation, a collision detection algorithm was used to locate impingements between both bony and prosthetic components. Femoral head translations (subluxation) were also computed to evaluate the joint congruence.
Results: Sexual positions for women required intensive flexion (4 positions with >95°) and abduction (4 positions with >32°). For men, external rotation was dominant for all motions. Prosthetic impingements occurred during one or more of the sexual positions for women at 6 cup positions (no collision at cups 45°/30°, 60°/15°, 60°/30°). Impingements were observed in the 4 positions requiring the highest hip flexion. For men, impingements remained scarce except for 1 position where bony impingements were observed at all cup positions. Subluxation was posterior for women, while it was anterior for men.
Conclusion: Sexual activity could expose the patients after THA to impingement associated with joint instability. This study objectively indicates that 4 positions for women and 1 position for men could be potentially at risk after THA. This information could be useful for surgeons in order to provide specific instructions to patient's inquiries.

FM125

Osteolytic changes associated with bio-absorbable cement restrictors in hip surgery

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Introduction: The use of bio-absorbable cement restrictors in hip surgery, constructed from PolyActive, eliminates the need for restrictor removal at possible future revision surgery. The safety and biocompatibility of these implants have been studied extensively, with no reports of adverse reactions. However, recent studies report an increased incidence of osteolysis around bio-absorbable cement restrictors in the femoral shaft. Even an associated periprosthetic fracture has been reported.
Methods: We identified all patients from our database who underwent cemented hip arthroplasty between 2007 and 2012 and where the bio-absorbable cement restrictor "Synplug®, Integra", has been used. Mean age was 77 years at time of surgery. We reviewed all available radiographs of 972 patients, and compared the ratio of the cortical thickness around the cement restrictor from the initial radiographs with radiographs 2 months, 1 year and 5 years postoperative, both in the ap and in the lateral view.
Results: One year after implantation the femoral cortex surrounding the cement restrictor showed a significant thinning of 12 percent as calculated in the ap view and 8% in the axial view. This process of thinning seemed to remain stable in most cases over time as in the later periods; a thinning of 12% in both ap and axial view could be stated. However, in some patients an alarming amount of cortical thinning with potential risk of femur fracture and in two cases an early aseptic loosening with atypical loosening pattern could be observed.
Conclusion: This study confirms osteolysis associated with the use of bio-absorbable cement restrictors in a biomechanically delicate zone distal to the prosthetic stem. This might increase the risk for periprostheic fractures and could be the reason for early aseptic loosening. Thus we abandoned the use of bio-absorbable cement restrictors.

FM126

Objective and subjective measurement of the influence of femoral head size on early postoperative outcome in total hip arthroplasty

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Introduction: Much is known about the influence of femoral head size on wear rate, the probability of dislocation and range of motion in total hip arthroplasty. Data about the influence of femoral head size on gait parameters and subjective perception of the patients in total hip arthroplasty is rare.
Objectives: The aim of the present study was to evaluate the influence of femoral head size on objective gait parameters and on subjective perception of patients within the first postoperative year.
Methods: Double blinded, prospective, monocentric, cohort study of 57 hips (27 large femoral heads vs. 30 small femoral heads) in 55 patients undergoing THA for primary and secondary osteoarthritis at LUKS Wo with either a large (41–53 mm, Ø47 mm) or a small (28 mm) femoral head. Mean age of the cohort was 60 ± 10 years and mean BMI was 28.9 ± 6.3 kg/m^2. After preoperative baseline measurement, follow-up assessments were done at 12 weeks, 6 months and 1 year postoperatively. Data included subjective evaluations (Oxford Hip Score, Hip Outcome Score-ADL, EQ-5D and Harris Hip Score) and objective gait parameters from 2 walking trials of at least 30 meters walking distance, performed at different speeds, using an ambulatory gait analysis system (Physilog®, BioAGM CH).
Result: The two groups were comparable in terms of age, body mass index, gender, pain and functional levels at baseline evaluation. At follow-up examinations patients' subjective scores as well as ambulatory gait analysis including several temporal and spatial gait parameters at different walking speeds (slow, normal and fast), showed no significant differences between the two groups of femoral head size.
Conclusions: The present study demonstrates that femoral head size in total hip arthroplasty had neither influence on patient's perception nor on objective gait parameters in early postoperative phase. In view of price difference and the possible disadvantages associated with the femoral head size, this study may provide additional decision support. Further studies with longer follow-up time are required to measure long-term effects and potential superiority of large femoral head diameters.

FM127

Systemic metal ion levels in patients with modular neck total hip arthroplasties: A prospective cohort study

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There is increasing evidence that modular neck stems are prone to corrosion-related complications. Recent studies showed elevated metal ions levels and occasional pseudotumor formation in patients with such implants.
The purpose of this study was to compare systemic metal-ion levels in patients after primary THA with modular neck stems to those of patients after non-modular implants. To our knowledge, this is the first cohort study including a control group, THA without CoCr heads and dry-assembled neck-stem connections.
Methods: 50 patients after THA at a minimum follow-up of 1 year have been selected for the study. Patients with multiple prosthesis or other implants have been deselected. All received a cementless SPS stem from Symbios (Ti6Al4V). 40 patients have the modular neck (CoCr) version and 10 a monobloc version. All bearings were either ceramic-ceramic or ceramic-polyethylene to minimize other sources of CoCr ion release. In the modular group, the neck was chosen pre-operatively based on a 3D planning, allowing for a dry assembly of the stem and neck on the back table before implantation. A plasma system coupled to mass spectrometry was used for a complete elementary quantification in blood and serum separately. Clinical outcome was measured using the Oxford Hip Score.
Results: Complete data sets of 29 patients (24 in the modular neck-group (10 male, mean age 63y, 35–84 y) and 5 in the monobloc-group (3 male, 69 y, 51–83 y) are available to date.
Mean Co blood levels were .95 µg/L (.14-12.4) in the modular group vs .27 µg/L (.10-.73) in the monobloc group (p = .2). Respective values for Cr were significantly higher in the modular group (.99 µg/L; range .75–1.21) compared to those in the monobloc group (.74 µg/L ;.62–.86; p = .001). No significant difference was found when comparing serum levels. 5/24 patients had Co levels above 1 µg/L (12/24 for Cr), which is by some considered as a relevant elevation. The maximum Co level was measured in an asymptomatic patient. The Oxford Hip Scores were similar in both groups.
Conclusion: Cr levels were significantly elevated in the modular neck group compared to those in the monobloc group. 1/24 patients with a modular prosthesis exhibited Co levels, which are beyond the threshold accepted even for metal-on-metal bearing couples. These results have contributed to our decision to abandon the use of modular neck stems. Routine follow-up including annual measurements of systemic CoCr concentrations should be considered.

FM128

Dual vs. mono-mobility cup for dislocation prevention following revision THA

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Introduction: Revision total hip arthroplasty (THA) is associated with higher dislocation rates than primary THA. The use of a dual-mobility cup in revision THAs surgery has shown in case series a decrease in dislocation rates.
Objective: To compare the risk for dislocation within 6 months (m), the risk for infection within 12 m. and all cause revision after revision THAs with dual-mobility cup compared to revision THAs with mono-mobility cup.
Methods: We conducted a prospective cohort study including all THA revisions totally or only with the cup revised and performed from 01/2004 to 12/2012. The cups used for revision were either a dual-mobility or a mono-mobility; the choice was made according to surgeon's preference.
Results: Overall 250 revision THAs were included, 103 (41%) with dual-mobility cup (group1), the mean follow up (FU) was 33 m.; and 147 (59%) with mono-mobility cup (group 2) and a mean FU of 49 m. At baseline the two groups (group 1 vs. 2) differed in age at revision (75 vs. 69 yrs.), comorbidities (16.5% vs. 10.2% with diabetes) and indication for revision (34 vs. 8.7% dislocation; 35 vs. 59.2% aseptic loosening). A previous revision THA surgery already occurred in 31.1% in group 1 and 16.8% in group 2. The risk of dislocation was lower with the dual-mobility cup, respectively 1.9 and 8.2%. The number needed to treat to prevent one case of dislocation was 16. Risk for infection within 12 m. was slightly lower in the mono-mobility group, unadjusted risk difference was 1.8, The survival at 60 months was similar in both groups, 91.4% respectively 93.1%.
Conclusion: Our study showed good short terms results with dual-mobility cup in revision THA compared to mono-mobility cup. The risk of dislocation was substantially lower in the dual-mobility group. Longer follow up studies are needed to evaluate the long-term results of the dual-mobility compared to the mono-mobility cup.

FM129

Double mobility cup total hip system in high risk patients: Preliminary results

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Introduction: Double mobility cup systems (DMCS) gains increasingly acceptance, especially in patients with high risk for dislocation. In 2008 a DMCS (Versacem® and Versafit® DM Cup, 28 mm CoCr femoral head, UHMWPE Standard,Medacta, Switzerland®) was introduced in our department. Indication for primary and revision total hip arthroplasty (THA) was severe neuromuscular disease, cognitive dysfunction, severe irreversible hip abductor weakness, recurrent instability and multiple prior revisions. The aim of this investigation was to evaluate dislocation and cup revision rate after a minimum of 2 years.
Methods: Retrospective review of a consecutive series of DMCS implanted between 2008 and 2011. Patient's demography, indication and complications were retrieved from patient's charts. A questionnaire together with a WOMAC score at least two years postop was used to document complications and outcome. X-rays were evaluated for signs of loosening according to DeLee.
Results: 89 DMCS were implanted in 86 patients. Indications in 38 primary THAs were severe neuromuscular disease (14), severe irreversible abductor weakness (HAW) (9), cognitive dysfunction (8), physically handicapped (3), multiple hip surgery other than THA (3) and morbid obesity (1).
Indications in 51 revision THAs were recurrent dislocations (28), multiple prior hip surgeries (13), HAW (5), cognitive dysfunction (2), physically impairment (1), psychiatric disorder (1), neuromuscular disease (1). 18 of them were septic revisions.
After a mean follow up of 42.8 months, 16 patients had died unrelated to surgery, 9 were lost to follow up and 61 patients were available for a standardized questionnaire and a WOMAC score.
Dislocation occurred in 2 patients after trauma 2 and 4 months postop, respectively. 8 DMCS needed revision: 1 because of traumatic periprosthetic acetabular fracture 4 months postop, 3 because of persistent infection, 1 because of late hematogenous infection.
In 2 cases new radiolucent lines in zone 1 were recognized.
After a mean of 44.8 months the WOMAC improved significantly from 5.9 preoperative to 1.8 in the primary and from 6.5 to 4.2 in the revision group.
Conclusion: In respect of the difficult patient collective treated, the rate of dislocation was very low and justifies the continuous use of such systems. No disadvantages were recognized in this preliminary results.

FM130

Post-operative Kinematics Assessment in Patients after Total Hip Arthroplasty: A Pilot Study

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Introduction: Following THA, impingements and dislocations may occur during motion, resulting from different factors (eg, implant positioning, biomechanical aspects). These side effects are usually not evaluated post-operatively and require a dynamic assessment of the prosthesis. The goal of this study was to perform a post-operative kinematics evaluation in patients after THA to evaluate the prevalence of impingements during daily activities. We also compared patient's range of motion (ROM) with data obtained from healthy subjects.
Methods: Three male patients undergoing THA were recruited. The planning parameters were to place the acetabular cup parallel to the transverse ligament and the stem in neutral femoral anteversion. Four months after surgery, CT and motion capture were performed. 3D reconstructions of the bones and implants positioning were obtained from the CT data. Motion from the patients were acquired during routine activities (stand-to-sit, lace the shoes while seated, pick an object on the floor while seated or standing) known to create significant stress in the artificial joint.
Based on the markers trajectories and the patient's 3D models, the hip joint kinematics and ROM were computed using a validated fitting algorithm (accuracy: translational error ≈0.5 mm, rotational error <3°). During motion, impingements were detected using a collision detection algorithm. Femoral head translations were also computed. To evaluate the patients' mobility, additional simulations were performed with motion data obtained from a database of healthy subjects during the same activities.
Results: Post-operative cups positioning was respectively 38°–22°, 49°–30° and 48°–26° for the 3 patients. No impingements could be noted for any patient using their own motion. When the motion database was used, impingements occurred for all patients during lace the shoes and pick an object while standing. Patients had lower hip flexion (mean: –13°) and higher abduction (mean: +14°) than healthy subjects. One patient could not perform the full ROM of one motion because of hip and back pain.
Conclusion: Patient's motion was free of collisions, but not when testing with ROM of healthy subjects. Simulations revealed interesting motion adaptations in order to execute the different activities. In particular, patients adopted less hip flexion with more abduction to avoid impingement. This kind of study could be useful to assess patient's mobility, stability and kinematic changes after THA.

FM131

In vitro analysis of wear on artificial hip joints induced by calcium sulphate used for local antibiotic therapy

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Introduction: In case of implant-associated infection, removal or exchange of the implant most often is mandatory for treatment success. Even when sticking to strict selection criteria, implant retention is associated with high failure rates. Local antibiotic delivery is used frequently to optimize drug efficacy. Calcium sulphate is a well-known resorbable carrier for local antibiotic delivery, which has the advantage of being comparatively soft. There is however concern regarding 3rd-body wear caused by small calcium sulphate particles.
Methods: Inlays made of ultra-high-molecular-weight polyethylene (UHMWPE) and cross-linked polyethylene (XLPE) against 28 mm CoCrMo heads and 36 mm alumina pairings were tested in triplicate using a hip simulator (Endolab, Germany) according to ISO 14242-1:2012. All implants were provided by Mathys Ltd. (Bettlach, Switzerland). Calcium sulphate hemihydrate (VWR, 1-100 µm particle size) was added to the standard test liquid at 10 g/L, forming particles made of calcium sulphate dihydrate, i.e. gypsum.
Results: In presence of the gypsum particles, the wear rates of the polymer inlays were 36 ± 5 mg/MC for the UHMWPE and 9 ± 2 mg/MC for the XLPE. Without gypsum, they were 26 ± 2 mg/MC and 5 ± 1 mg/MC respectively. The wear rates of the alumina inlays were 0.3 ± 0.1 mg/MC, both with and without gypsum. When no more gypsum was added to the metal-on-polymer articulations, the wear rates decreased. For the UHWMPE it was in the range of the reference samples, while for the XLPE inlays it remained slightly higher than the references. All heads and inlays showed few scratches, but there was no obvious difference between the articulations with and without gypsum particles.
Conclusions: Neither the alumina articulations nor the CoCrMo heads were affected by the gypsum particles since gypsum is a relatively soft material. Only the much softer polyethylene inlays showed 40–70% higher wear during exposure compared to controls, but they recovered at least partially when no more particles were added. For ceramic-on-polyethylene articulations and mixed ceramics even less effects by the gypsum is expected, since these heads/materials are more scratch resistant. Thus calcium sulphate might be used as antibiotic carrier even in the presence of a hip arthroplasty without fearing excessive 3rd-body wear. This opens new options for joint preservation instead of exchange or removal in case of infection.

FM132

Does stem design influence component positioning in total hip arthroplasty using a minimal invasive posterolateral approach?

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Introduction: MIS total hip arthroplasty (THA) using short bone-preserving femoral components has the potential advantage of reduced soft-tissue trauma. However, there is limited data on the accuracy of component positioning and the reconstructive potential of these implants when a MIS approach is used.The objectives of the present study were (1) to compare the reconstruction of hip geometry and leg length using a short bone-preserving stem with a straight standard-length stem in MIS posterolateral THA and (2) to assess whether a MIS posterolateral approach allows for accurate positioning and orientation of the acetabular component with reference to reported target zones.

Methods: We retrospectively reviewed postoperative AP pelvis radiographs of 272 THAs. Group 1 received a cementless straight standard-length stem and Group 2 received a cementless short bone-preserving stem. Cup anteversion, inclination, femoral offset, acetabular offset and leg-length-discrepancy was measured. Hip offset was defined as the sum of acetabular and femoral offset. The target zones were defined as 10°–30° anteversion and 30°–50° inclination. Reconstruction of joint mechanics and leg length was reported with reference to the contralateral side.
Results: There was no significant difference between mean reconstructed hip offset and mean contralateral hip offset in Group 1 (p = 0.067) and Group 2 (p = 0.793). For the entire cohort, the operated side was relatively lengthened by a mean of 0.8 mm (95%CI: 0.5–1.1). A total of 233 (86%) cups fell within the target zone for both inclination and anteversion.
Conclusion: Accurate reconstruction of hip geometry and leg length was observed for both stem designs and both designs appear to be viable options in MIS posterolateral THA.The used minimally invasive posterolateral approach allows for accurate positioning of the acetabular component with reference to reported target zones for cup version and inclination.

FM133

Acetabular reinforcement ring: only a revision implant? A minimum 20-year follow up

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Introduction: The acetabular reinforcement ring with a hook (ARRH) was originally designed for arthroplasty revision surgery and hips with acetabular deficiency. Due to its excellent results in such difficult cases the so-called Ganz reinforcement ring was also applied for standard primary total hip arthroplasty. This study investigated the long-term results of the ARRH used in primary total hip arthroplasty after a minimum follow-up of 20 years.
Materials and Methods: 210 patients (241 hips) who underwent THA with an ARRH between April 1987 and December 1991 were evaluated after a mean follow-up of 23.7 years (range 21.1–26.1 years). Patient history, clinical status with hip scores (Merle d'Aubigne, Harris Hip Score) and routine x-rays were obtained. Direct cox regression analysis was used to identify independent negative predictors for failure of the primary THA (revision surgery).
Results: Out of the 241 hips, 23 hips (9.5%) were lost to follow-up and 110 patients (124 hips, 51.5%) deceased without having revision surgery after a mean of 12.8 years (range 0.3–24.4 years) after surgery. 83 patients (93 hips, 38.6%) were available for follow-up evaluation. The mean Merle d'Aubigne increased from 8 points to 15 points (P <0.001). The HHS reached a mean of 82.3 at the minimal 20-year follow-up. 18 out of the 241 hips (7.5%) were revised after a mean of 15.7 years (range 7.4–24.9 years) years. Survival probability of the cup at the 20-year follow up was 0.96 (95% confidence interval, 0.93–0.99), survival probability for the whole implant was 0.91 (95% confidence interval, 0.86–0.96). In 14 hips (77.8%) the cause for revision was aseptic loosening whereas two hips (11.1%) required revision due to THA infection and two hips (11.1 %) due to recurrent dislocation. Significant independent negative predictors were patient's age at surgery of less than 50 years, acetabular protrusion and an inclination of the cup of more than 45 degrees.
Conclusion: The 20-year survivorship data, which are comparable to modern cementless acetabular implants support the ARRH's role in primary total hip arthroplasty, especially with difficult acetabular morphology. The ARRH benefits from minimal acetabular reaming and prevention of a high hip center and cup medialization. Our study outlines the importance of preventing a steep inclination of the ARRH for long-term survivorship.

FM134

Effect of stem geometry on radiological changes of two types of the cemented Müller type straight stems

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Cemented hip stems can be fixed either force-closed or shape-closed. Aim of this study was to determine the effect of stem shape on the long-term survival and radiological changes of two comparable shape-closed stems.
We used the Müller straight stem (MSS) and the Virtec straight stem (VSS) which had an identical ap shape and surface finish but different geometrical cross-sections. Both stems are double-tapered, the MSS with a rectangular cross-section with longitudinal grooves running anteriorly and posteriorly and a small proximal collar, the VSS has an oval cross-section with longitudinal fins, thus being thicker in the sagittal plane, filling a bigger part of the proximal femoral canal.
Between July 1996 and July 2003 711 hips were randomized (356 MSS, 355 VSS) and followed prospectively. Groups did not differ in age, gender, diagnosis and used cups. We performed Kaplan-Meier (KM) analysis using aseptic loosening of the stem as endpoint. Radiographs with >10 years were analyzed for osteolysis in the Gruen-Zones (GZ).
182 hips died <10 years follow-up unrelated to surgery (MSS 96; VSS 86 hips) and without revision surgery. 19 hips (2.7%) were lost to follow-up. 24 hips (3.4%) have been revised for aseptic loosening with no differences between the groups (p = 0.151). KM survival with aseptic loosening of the stem as the endpoint was 96.4% (MSS) and 98.1% (VSS, p = 0.204) at 10 years. 17 of 22 stems revised for aseptic loosening showed osteolysis on the final radiograph prior to revision. The MSS showed more osteolysis in GZ2 (p = 0.032), GZ6 (p = 0.041) and GZ7 (p = 0.020) compared to VSS. At 10 years, 68 of 399 available radiographs showed osteolysis (MSS: 40 (20%), VSS: 28 (14%); p = 0.057). Most osteolysis were found in GZ6 (41, 10%) & GZ7 (34, 9%).
Both stems showed excellent and comparable 10 years survival. We found less osteolysis with the VSS than with the MSS. This might be due to a bigger proximal cross-section resulting in better cement penetration and sealing of the medullary canal.

FM135

Effect of Femoral Offset Loss on Muscle Moment Arms in Total Hip Arthroplasty: A 3D biomechanical analysis

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The importance of an accurate femoral reconstruction for a good functional outcome is well documented. However, quantitative data on the effect of offset changes on muscle moment arms are scarce. The purpose of this study was to calculate the impact of a loss of 20% of femoral offset on abductor moment arms in a 3D numerical model of the hip.
Methods: Pre-operative CT scans of 15 patients undergoing total hip arthroplasty were used to build 15 patient-specific finite elements models. Each model included the pelvis, the femur, a total hip prosthesis, and the gluteus medius, minimus and maximus. The femur and pelvis were assumed rigid, as the prosthesis. A hyperelastic deformation law was used for the muscles. In each case, abductor moment arms were calculated during passive flexion-extension and abduction-adduction within a range of motion observed during a gait cycle. These muscle moment arms were calculated in two cases: 1) an ideal anatomical reconstruction of the hip, 2) a reconstruction of the hip with 20% loss of femoral offset. Assuming that 20% loss of femoral offset might result in a maximum loss of abductor moment arm of the same distance in millimeters, the changes of moment arms from case 1 to case 2 were normalized with this effect value for each patient, and reported as a percentage.
Results: Among all patients, the anatomical femoral offset was 37.9 ± 7.4 mm. A loss of 20% of femoral offset corresponded to a loss of 7.6 ± 1.5 mm (from 5.5 to 10.3 mm). In average, a loss of 20% of offset led to a loss of abductor moment arm of 58%. This effect was more pronounced for the gluteus medius than for the gluteus minimus. In average, a loss of 20% of offset led to a loss of flexion moment arm of 25%. Of note, the 20% offset decrease could change some muscle fibers from an agonist to an antagonist action during flexion. In contrast, for abduction, all muscle fibers maintain agonist after a 20% offset loss.
Conclusion: In summary, the loss of muscle moment arm was approximately half the loss of the femoral offset. In addition, some muscle fibers became antagonist. Therefore, a 20% loss of femoral offset might have a negative impact on proprioception.

FM136

Influence of statin use on osteolysis progression after primary THA

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Introduction: Clinical studies recently reported a protective effect of statin use on revision for aseptic loosening and on first occurrence of femoral osteolysis within 5 years after primary total hip arthroplasty (THA).
Objectives: Our objective was to evaluate the influence of statin use on the progression of already established femoral osteolytic lesions.
Methods: Since March 1996 all patients undergoing THA in our University Hospital are routinely enrolled in a prospective hospital-based cohort and followed longitudinally. For this study we included

primary THAs (28 mm head, cemented stem, ceramic-polyethylene or metal-on-metal bearing) with linear or focal femoral osteolytic lesions detected at routine follow-up visits (median time since surgery 60 months) and confirmed independently by two orthopaedic surgeons. The outcome of interest was the progression of osteolysis, which was evaluated qualitatively by two orthopaedic surgeons blinded to the patients' characteristics, on standard a.-p. and axial radiographs. Statin use was systematically assessed at the time of surgery and at each follow-up visit. We compared the risk of osteolysis progression in those who took statins during follow-up with those who did not (ever-users vs. never-users). Adjustment was performed for age, sex, BMI and ASA score, using the propensity score method.
Results: 91 THAs (mean age 63 years, 52% women, 71% primary OA, 80% ceramic-polyethylene bearing) were included. Of those, 8 THAs (8.8%) were in patients who reported statin use. Users compared to never-users were more often women, older, and had higher BMI and ASA scores. Progression occurred over a median follow-up time of 64 months in 67 (74%) THAs. Osteolytic lesions progressed on 3/8 (37.5%) occasions among statin users compared to 64/83 (77.1%) occasions in never-users. The crude odds ratio (OR) was 0.2 (95% CI 0.04–0.8, p = 0.026), and the adjusted OR was 0.2 (95% CI 0.03; 0.8; p = 0.032).
Conclusion: Osteolysis progression around a cemented stem was substantially less frequent in statin users as compared with never-users.

FM137

Strong association between smoking and the risk of revision in patients with metal-on-metal total hip arthroplasty

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Introduction: Thus far the ability to predict who will develop early prosthesis failure following the insertion of a metal-on-metal (MoM) bearing total hip arthroplasty (THA) has been very limited. We assessed the effect of smoking on failure rates in patients with a MoM bearing, compared with patients with a ceramic-on-polyethylene (CoP) bearing.
Methods: From a prospective hospital-based registry we included all primary THAs operated upon between January 1, 2001 and December 31, 2011 with MoM or CoP bearings of the same cup design and head size (28 mm). We compared patient revision rates through October 31, 2013 classified by smoking status at time of arthroplasty and type of bearing.
Results: The Study population included 1,964 patients (median age 71, 57% women), 663 with MoM bearing and 1,301 with CoP bearing. Mean follow-up was 6.9 years (range 1.8-12.8 years). Revisions were required for 56 THAs (2.9%) during the observed follow-up. In patients with MoM bearing the adjusted incidence rate of revision among ever-smokers was four times greater than among never-smokers (95% CI 1.4–10.9). Among those with CoP bearing, the rate ratio was only 1.3 (95% CI 0.6–2.5). The effect of smoking was similar for women and men and for current and former smokers.
Conclusion: We found a strong association between smoking and increased failure of MoM bearing THAs. In contrast, the association was weak for patients with a CoP bearing. Smoking might be a trigger or an effect amplifier for adverse reactions to metal debris from MoM bearings.

FM138

Rehabilitation effect on occurrence of radiolucencies with a cementless bone preserving stem

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Introduction: Cementless straight rectangular stems are routinely used in the THA worldwide with good and reliable results. However, literature reports for this type of prosthesis a high occurrence of radiolucencies which are usually non-progressive over time and occur in the proximal part of the stem. These are not related to clinical symptoms as demonstrated by excellent survival rates. A retrospective radiographic and clinical analysis has been planned for AMIStem-H (Medacta International) to compare its performance to the results found in literature.
Methods: Consecutive case series of 278 patients (290 hips) who underwent primary total hip arthroplasty for any type of etiology using the direct anterior minimally invasive approach between November 2009 and January 2012. Patients are only included in the study if they took part in a 1 year evaluation. A statistical analysis has been performed on these 290 cases in order to investigate if: radiolucency signs on the femur according to gruen classification are combined with discomfort or pain, anatomical shape of the femur (dorr classification), patient characteristics or implant details.
Results: Radiolucencies, if present, were concentrated in the proximal zone: 8.6% of the radiolucencies bigger than 2 mm were in zone 1 and 3.1% in zone 7. No critical radiolucent lines were reported in the distal zone. Most patients (82.8%) were pain free, the others experienced slight (12.1%), mild (2.1%) or moderate pain (0.7%). There is no correlation between radiolucency and anatomical shape of the femur (dorr classification), patient characteristics nor implant details.
An interesting point was highlighted when looking at the date of surgery. 2010 12.9% of patients (23 out of 178) had radiolucencies bigger than 2mm in zone 1, whereas in 2011 the occurrence of radiolucencies decreased to 1.8% (2 out of 112).
Conclusions: The decrease in occurrence of radiolucencies in 2011 is probably due to the changes introduced to practice: removing a minimal amount of bone from the great trochanter and the adoption of a less aggressive rehabilitation protocol by extending the need for using crutches during first six post-operative weeks (allowed full weigth bearing).
In conclusion, although the anterior minimally invasive approach gives patients an almost painfree and faster recovery after surgery, a less aggressive rehabilitation protocol is needed to facilitate the bone-implant osteointegration process.

P1

Twisted long PHILOS plate fixation in a series of humeral fractures

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Aim: The purpose of the article is to highlight a specific fracture pattern encountered by us in the osteoporotic upper humerus. We present our results of management of such metadiaphyseal fractures of the upper humerus with less invasive plating. The additional steps taken to improve final outcome and the reasoning behind each are discussed.
Patients and methods: In our department, a total of 13 fractures (in 12 patients) were managed for a metadiaphyseal fracture of the upper humerus between 2010 and 2013. There were 2 males and 10 females. The average age in the cohort was 74.3 (52–95) years. In 9 fractures, the fracture line was extending above the surgical neck. All patients were managed with a locking compression plate (long PHILOS or LCP) using two approach windows (proximal deltopectoral and a distal anterior or lateral). Patients were evaluated for clinical outcome using the Quick DASH score and assessed for radiological union, complications or re-operations retrospectively.
Results: The mean follow-up was 14.3 months (4–36). All fractures were united, and there was no evidence of avascular necrosis or non-union. Two patients showed varus collapse of the anatomical head of which one patient needed change of screws at 12 weeks from index surgery. In patients, when a distal lateral window was used, 2 patients out of 4 had radial nerve palsy post-operatively. In the rest, when the plate was twisted by 45° to allow anterior placement using the brachialis split, none had radial nerve injury.
Conclusion: The osteoporotic bone failing under a low-energy mechanism seemed to dictate this fracture pattern. The fracture is either a bending wedge or a long spiral with or without a large butterfly and often extends into the humeral head. The fractures are better managed surgically, a primary reduction allowing contact of fragments is essential, and using an anterior window distally with a 45° contoured plate will achieve good plate placement as well as decreases the risk of radial nerve injury considerably compared to total lateral plate positioning.

P2

ASSESSMENT OF GLENOID VERSION AND INCLINATION BY THE SURGEON: VALIDITY OF NEW AUTOMATED SOFTWARE

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Background: Glenoid implant pre-operative planning relies on determination of version and inclination. Manual measurements in the absence of consensus on the method to use may be time consuming.
Objective: 1) To design a fully automated software allowing surgeons to assess glenoid version and inclination on CT three dimensional reconstruction. 2) To assess validity and reliability in comparison to previously described methods.
Material and method: An automated, surgeon operated, image analysis software (Glenosys) was designed. The anatomical scapular reference planes were defined as the mean of the peripheral points of the scapular body and the perpendicular to it passing by the bottom of the supraspinatus fossa. Sixty-three 3D osteoarthritic scapulae reconstructions were obtained from patients CTs. Version and inclination were measured with Glenosys and compared to four previously described methods. Method I (Friedman's version angle) was applied to 2D CTs; method II (IIa inclination, IIb version) to 3D MultiPlanar Reconstructions; method III (according to Ianotti) and method IV (according to Armstrong) to 3D reconstructions. Mean differences ± standard deviation and Concordance of Correlation Coefficients (CCC) were calculated.
Results: Mean difference in measurements with Glenosys for method I was 2.0° ± 4.5° (CCC = 0.9301). It was 2.5° ± 3.2° (CCC = 0.9483) for method IIa; 0.2° ± 4.7° (CCC = 0.7754) for Method IIb; 1.5° ± 4.5° (CCC = 0.9427) for method III and 1.8 ± 3.8 (CCC = 0.9517) for method IV.
Conclusion: Inclination and version measured by surgeons using Glenosys are valid, showing excellent correlation to previously described methods. The software allows for reliable assessment and potential time gain in pre-operative planning.

P3

Assessment of teres minor in massive rotator cuff tears

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Introduction: Assessment of teres minor integrity is integral to the management of massive cuff tears. In patients with a massive cuff tear, involvement of teres minor can adversely affect the results of both tendon transfers and reverse shoulder arthroplasty. However, clinical tests designed to assess this musculotendinous unit have not been validated in the setting of massive cuff tears. We aim to describe the accuracy of the Hornblowers Sign, the External Rotation Lag Sign (ERLS) and Drop Sign for the prediction of teres minor integrity.
Methods: This was a prospective multi-centered study of 100 patients with massive cuff tears that were examined by 2 shoulder surgeons independently. These clinical tests were compared to the results of CT arthrograms and arthroscopy findings for accuracy, PPV, NPV, sensitivity and specificity. Likelihood ratios were calculated for each test.
Results: The most accurate test was an ERLS >40 degrees with a sensitivity of 100% and sensitivity of 93%. A ERLS >10 degrees had an accuracy of 59% (sensitivity 100% and specificity 51%). The Hornblowers sign had an accuracy of 75% (sensitivity 93% and specificity 71%). The Drop sign had an accuracy of 88% (sensitivity 86% and specificity of 88%).
Conclusion: A large ERLS (a lag >40 degrees) is the most clinically useful test for assessing teres minor. It appears superior to previously described tests. This study validates its use in the setting of massive cuff tears.

P4

Interest of anatomical locking plates in the treatment of complex proximal ulnar fractures

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Introduction: Fractures of the proximal end of the ulna are rare. Usually their treatment is surgical. The holding of the material is essential to ensure good radio-clinical results. We report the experience of treatment with anatomical locking plate on complex proximal ulnar fractures with the aim of critical analysis of the results. A hypothesis is this equipment achieves good results but with a sometimes limited clinical tolerance.
Materiel et methods: From September 2009 to December 2011, 28 patients were treated with anatomical locking plates LCP. Six were excluded because the file was incomplete. The series included 22 patients (11M, 11F) with an average age of 55.7 years. Twelve were active. The dominant arm was reached 11 times. There were 15 types II and 7 types III according to the classification of the Mayo Clinic. These fractures were related to 9 fractures of the radial head and 5 fractures of the coronoid process. Functional recovery was evaluated according to the Broberg-Morrey scores and MEPS. The radiographic evaluation measured the quality of the reduction, the healing and the existence of ossification or osteoarthritis.
Results: The average follow up of theses 22 patients was 20 months. The flexion was 131° and the deficit of extension 9.5° for a pronation of 79° and a supination of 80.5°. The average score of Broberg and Morrey was 96.7 and the average score of MEPS was 96.6. All patients consolidated within 10.6 weeks. 6 signs of osteoarthritis, 3 ossifications and 1 synostosis were observed. 1 infection was treated by washing and an antibiotic therapy. The ablation of the material was performed 6 times. No prognostic factor was highlighted.
Discussion-conclusion: Our hypothesis is confirmed. The reported results are encouraging and comparable to the data of the literature. The main critical point is the clinical tolerance of the plate with the existence of a frequent posterior conflict requiring the ablation of the material (27%). A rigorous inserting of these plates is necessary.

P5

The prognostic value of Hamada classification on functional outcome after reverse shoulder arthroplasty

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Introduction: Several radiological classifications exist for the documentation of cuff tear arthropathy (CTA). Their clinical value for predicting the clinical outcome after reverse shoulder arthroplasty (RSA) has been sparsely investigated. The aim of this study was to determine the relationship between the preoperative severity of CTA, as classified by Hamada et al. 1990 (modified by Walch et al. 2005), and functional outcome 2 years after RSA.
Methods: Between 07/2009 and 07/2011 a total of 351 shoulders (332 patients) were treated with primary RSA because of CTA. A set of clinical scores (including Constant score [CS] and SPADI) were prospectively recorded in our local arthroplasty register, preoperatively and 6, 12 and 24 months postoperatively. All preoperative X-rays were retrospectively assessed by an independent examiner using the Hamada classification. The clinical outcome scores were compared between the Hamada groups at each follow-up time point using the Kruskal Wallis test. Multivariable mixed models, taking into account the influence factors age, gender and preoperative functional score, were fitted.
Results: The mean age of patients (69 % female) was 75 years (range 53-92 years) at time of implantation. When classified by Hamada, the distribution of the groups was: 11% grade 1–3 (n = 40), grade 4A 27% (n = 96), grade 4B 36 % (n = 127), grade 5 25 % (n = 88). There were statistically significant relationships between grades of the Hamada classification and both the Constant score and SPADI. Patients with a CTA grade 1 to 4A reached a CS of 70.8 ± 9.4, for grade 4B 63.4 ± 17.6 and for grade 5 63.6 ± 14.7 (p = 0.001). Patients of grade 5 started with lower baseline values in the CS and SPADI, but achieved a similar functional gain for the CS from +35.7 ± 16 as the group grade 1–3 (+34.7 ± 15) and +39.4 ± 25.6 in the SPADI (+41.3 ± 20.2 grade 1-3).
Conclusion: Patients with preoperative Hamada classification of grades 1 to 4A can be expected to achieve a good functional result after implantation of RSA. For patients reaching most severe grades 4B and 5 preoperatively, the expected outcome at 2 years appears more limited. Nevertheless our results suggest that patients receiving a RSA can expect a similar gain in shoulder function irrespective of the severity of their pre-operative CTA. In that respect, the level of detail of the Hamada classification appears of limited value for the prediction of clinical outcome after RSA.

P6

The 3D subluxation in a non-pathological versus a primary glenohumeral osteoarthritis population

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Introduction: According to the Walch classification, based on the static posterior subluxation of the humeral head (SPS), type A shoulders are centred and type B shoulders are posterior subluxated. Currently, SPS is measured on a two-dimensional (2D) computed tomography (CT) scan. Recent studies have shown an inherent error for 2D measurements of the shoulder due to positional errors. Three-dimensional (3D) reconstruction can be used to overcome this problem. The aim of this study was to evaluate the SPS in a normal population and in patients with primary glenohumeral arthritis with the use of a newly developed 3D subluxation index (SI).
Materials & Methods: A non-pathological group of 151 glenohumeral CT scans and a pathological group of 112 glenohumeral CT scans with primary osteoarthritis were analysed. First, the adapted SI according to Gerber was measured on all CT scans. The pathological group was classified into type A (centred) or type B (subluxated) according to the Walch classification. Next, 3D reconstruction of all shoulders was performed and a Cartesian coordinate system was defined with the midpoint of the glenoid circle as its origin. Next, the centre of the 3D reconstructed humeral head (with radius R) was projected to the X-axis and defined as A. Finally, the 3D SI, defined as (A+R)/2R, was calculated in all shoulders. The inter- and intra-rater reliability was measured.
Results: The inter- and intrarater reliability for the 3D SI was excellent. According to the subluxation in 2D, 55 shoulders were classified as type A and 57 as type B. The 3D SI was significant (p ≤ .001) bigger than the 2D SI in the non-pathological group (2D: 48.69%; 3D: 51.54%), in type A (2D: 47.58%; 3D: 55.56%) and in type B (2D: 61.30%; 3D: 67.61%) shoulders. The 3D SI of type A and type B shoulders were significantly bigger (p <0.001) as in the normal population. The 3D SI of type B shoulders was significantly bigger (p <0.001) as in type A shoulders.
Conclusion: This newly developed reproducible 3D SI shows that the conventional 2D SI underestimates the SPS in both non-pathological as pathological shoulders and that the humeral head of type A and type B omarthrosis is significantly more posterior subluxated compared to the normal population.

P7

Outcome of 70 fingertip amputation injuries with the semi occlusive dressing

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Introduction: Treatment of fingertip amputation injuries with the semi occlusive dressing has been known for a long time. The results are usually outstanding. Nevertheless, this treatment is still not included in major textbooks. The therapy is even controversially discussed by some major centers. Particularly controversial is the indication of this therapy in case of exposed bone, where local flaps offer an established alternative.
Methods: During a period of 2 years, we treated 70 consecutive patients with amputations of the the distal phalanx and distal to the insertion of the flexor digitorum profundus tendon by the semi occlusive protocol. After a mean follow-up of 15.6 month, we conducted an examination regarding scar formation, two point discrimination, sensibility with monofilament and subjective acceptance of treatment. The extent of soft tissue regeneration was determined sonographically and by x-ray.
Results: The mean treatment duration of the semi occlusive dressing was 5.4 weeks. All patients were very satisfied with the result. An actual scar formation could only be detected in a few cases. The regenerated fingertips show aesthetic forms, papillary ridges and are resilient. The static two-point discrimination was 4.8 mm (SD 1.9 mm), the dynamic two-point discrimination was 3.7 mm (SD 1.6 mm) and the sensibility tested with the monofilament showed a mean filament size of 2.98, this represents almost normal perception. The soft tissue regeneration showed an extent of 85% compared to the contralateral uninjured side.
Conclusion: In view of the very good results the occlusive dressing therapy is our gold standard for all amputations in the distal phalanx. We will present our treatment technique and protocol, as well as our results and contribute to a greater acceptance of this treatment.

P8

Early Adjacent Segment Add-On Surgery and End of Construct Revision Surgery after Multilevel Lumbar Lateral Interbody Fusion

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Introduction: Lateral lumbar interbody fusion (LLIF) has become a common procedure to treat degeneration of lumbar segments with a reliable fusion rate. However, a solid fusion and therefore a stiff construct can create enhanced stresses at the adjacent segments, particularly in multi-level LLIF. The aim of this study was to find the rates for add-on surgery for adjacent segment degeneration after multi-level LLIF ending at L5 and to compare to the rate of revision surgery for pseudarthrosis at the L5/S1 level in those fused bellow L5.
Methods: Patients with a LLIF of L1 or 2 to L5 (n = 128) were divided into those with (n = 51) and without (n = 77) fusion below L5, and post-operatively followed for an average of 15 months to determine the rate of add-on surgery for distal adjacent segment disease (DASD) or revision surgery at L5/S1 for pseudarthrosis, respectively. Further, the rate for revision for proximal adjacent segment disease (PASD) was documented.
Results: Add-on surgery to treat DASD was performed in 10 of the 77 patients (13%) without prior L5/S1 fusion after a mean of 13 months. In contrast, revision for a pseudarthrosis at L5/S1 was needed in 5 out of the 51 patients (10%) with prior L5/S1 fusion at index surgery (n.s.) after a mean of 15 months. Only one of the 16 patients with ALIF at L5/S1 needed revision surgery for L5/S1 pseudarthrosis. Overall, eight patients (6%) were treated for a PASD. Most of the PASD developed in patients with LLIF starting at L2 (n = 6 of 8).
Conclusion: In the process of planning for multi-level lumbar fusion surgery, the surgeon must weigh the risk of pseudarthrosis versus DASD in whether to include the L5-S1 segment in the construct, since the rate of end of construct pseudarthrosis is nearly as high as rate for add-on surgery for distal ASD. If the L5-S1 segment is included, ALIF seems to be a reliable option.

P9

Is the Iliolumbar Ligament a reliable Identifier of the L5 Vertebra in Lumbosacral Transitional Anomalies?

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Introduction: The origin of the iliolumbar ligament (ILL) has been suggested as a reliable identifier of the L5 vertebra. However, there are no sufficiently sized studies to determine the value of the ILL as an identifier of the L5 vertebra in cases of a lumbosacral transitional vertebra (LSTV).
Methods: After IRB approval of this retrospective study, 71 of 770 patients with LSTV type 2 or higher (case group) and 62 of 611 subjects without LSTV II or higher with confirmed L5-level were included. The level(s) of origin of the ILL was documented by two independent radiologists using coronal MR-images. The interobserver agreement was statistically analyzed using weighted kappa/kappa (wk/k) and a Fischer's exact test was used to assess the value of the ILL as identifier of the L5 vertebra.
Results: The ILL orginated from the L5 vertebra in 100% of the controls but also included other vertebra in 5%. In the case group (LSTV), the ILL originated only from L5 in 25–38%, at least partially in 77–85% (including origins from other vertebra in 39–59%) and had no origin from L5 in 15–23%. The overall interreader agreement was good (wk = 0.69). Both readers completely agreed that an ILL was always present and its origin always involved the last lumbar vertebra.
Conclusion: The level of the origin of the ILL is unreliable for identification of the L5 vertebra in the setting of a LSTV type 2 or higher or segmentation anomalies.

P10

Patient-rated outcomes of lumbar fusion in geriatric patients: does age matter?

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Introduction: Current demographic changes are characterized by population aging, such that the surgical treatment of degenerative spine conditions in the elderly is gaining increasing relevance. However, there is a general reluctance to consider spinal fusion procedures in this patient age group due to the increased likelihood of complications. The aim of this study was to assess the patient-rated outcome and complication rates associated with lumbar fusion procedures in three different age groups.
Methods: This was a retrospective analysis of prospectively collected data from consecutive patients who underwent one to three level instrumented spondylodesis of the lumbar spine between 2004–2011, due to disc degeneration with or without spondylolisthesis. Data from a single center were obtained from the International Spine Tango Register. Before surgery, patients completed the multidimensional Core Outcome Measures Index (COMI), and at 3 and 12 months after surgery they completed the COMI as well as items rating Global Treatment Outcome (GTO) and satisfaction with care. Patients were divided into three groups according to their age: younger (YG, ≥50 y <65 y; n = 317), older (OG, ≥65 y <80 y; n = 350), and geriatric group (GG; ≥80y; n = 40).
Results: 707 consecutive patients were included. The preoperative comorbidity status differed significantly ($p < 0.0001$) between the three age groups with the highest scores in the GG. General medical complications during surgery were lower in the YG (7%) compared to the OG (13.4%; $p = 0.006$) and GG (17.5%; $p = 0.007$). Duration of hospital stay was longer in the GG compared to the YG (10.0 vs 10.8 days; $p = 0.006$). There were no significant group differences ($p > 0.05$) for any of the COMI domains covering pain, function, symptom-specific well-being, general quality of life, and social and work disability, at either 3 months' or 12 months' follow-up. Similarly, there were no differences ($p > 0.05$) between the age groups for GTO and patient-rated satisfaction at follow-up.
Conclusions: Preoperative comorbidity and general medical complications during lumbar fusion for degenerative disorders of the lumbar spine are both greater in geriatric patients than in younger patients. However, patient-rated outcome is as good in the elderly as it is in younger age groups. These data suggest that geriatric age per se is not a contraindication to instrumented fusion for lumbar degenerative disease and/or degenerative spondylolisthesis.

P11

Spinal fusion is associated with increased adjacent segment disc degeneration, without clinical consequence: long-term follow-up of four RCTs

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Introduction: There is ongoing debate as to whether adjacent segment disc degeneration (ASDD) represents the result of increased mechanical stress on discs adjacent to the fusion site (i.e., accelerated degeneration) or is the natural process of pre-existing degenerative disease expressing itself over time. We carried out a combined long term follow-up (LTFU) of patients from four randomized controlled trials of operative versus non-operative treatment for chronic low back pain to examine the influence of spinal fusion on adjacent segment disc space height as an indicator of disc degeneration at LTFU.
Methods: 369/767 (48%) of the patients agreed to undergo radiographic imaging at LTFU (mean 13 ± 4 years post-randomization). Disc space height and posteroanterior displacement (i.e. listhesis in posterior or anterior directions) were measured for each lumbar segment from plain standing lateral radiographs using a validated computer-assisted distortion compensated roentgen analysis (DCRA) technique. Values were reported in units of standard deviations (SDs) above or below age and gender-adjusted normal values. Patient-rated outcomes included the Oswestry Disability Index and pain scales.
Results: Radiographs were usable in 355/369 (96%) patients (259 of whom had received fusion and 96, non-operative treatment by the time of the LTFU). Both treatment groups showed significantly lower values for disc space height of the adjacent segment at LTFU compared with age and gender-adjusted norm values. There was a significant difference between treatment groups for the disc space height of the cranial adjacent segment at LTFU (in both as-treated and intention-to-treat analyses). The mean treatment effect of fusion on adjacent segment disc space height was –0.44 SDs (95% CI, –0.77 to –0.11; $p = 0.01$); there was no significant group difference for posteroanterior displacement (0.18 SDs (95% CI, –0.28 to 0.64, $p = 0.45$)). There was no significant effect of adjacent level disc space height or posteroanterior displacement on adjusted Oswestry or pain scores at LTFU (part correlations in multiple regression, $r = 0.010–0.05$; $p > 0.33$).
Conclusion: Compared with non-operative treatment, fusion was associated with a significantly lower disc space height at the adjacent segment after an average of 13 years follow-up. However, the reduced disc space height had no influence on patient self-rated outcomes at LTFU.

P12

The association between morphological stenosis grade and the outcome of surgery for lumbar spinal stenosis

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Introduction: A new measure of radiological lumbar spinal stenosis (LSS), based on the rootlet/cerebrospinal fluid ratio rather than the dural sac cross-sectional area (DSCA), was recently introduced. Its proponents maintain that grades C & D (severe/extreme LSS) represent surgical indications while grades A & B (no/moderate LSS) should be treated conservatively. However, there has been no external validation of the method or the aforementioned rationale for surgical indications. We sought to validate the new grading system by relating patient outcomes to the stenosis grade, rated blindly by an experienced, external investigator.
Methods: Patients were identified from our outcomes database (nested within Eurospine's Spine Tango Registry) by searching the appropriate documentation fields. Cases were cross-checked (for validity of inclusion) by an independent surgeon, blind to outcomes. T2 axial magnetic resonance images from 80 randomly selected patients were blinded for evaluation: 65 from patients (71.5 ± 7.7y) who had been diagnosed and treated surgically for LSS; 15 from patients (53.7 ± 14.7y) (with e.g. disc degeneration) selected as "controls." Classification was based on dural sac morphology: Grades A & B showed cerebrospinal fluid presence while grades C & D showed none. In examining the correlation between outcomes (Core Outcome Measures Index (COMI)) and stenosis grades, the worst grade of all levels was used.

Results: In the control group, 15/15 (100%) patients were (at worst) grade A. In the LSS group, 14/65 (21.5%) were grade A, 8/65 (12.3%) grade B, 29/65 (44.7%) grade C, and 14/65 (21.5%) grade D. There was a tendency (n.s.) for higher preoperative "worst pain (back or leg)" with increasing stenosis grade, but no significant correlation with any other baseline outcome measures. Multiple regression analysis, accounting for potential confounders, revealed significant ($p < 0.01$) associations between stenosis grade and the improvement (preop to 12 mo postop) in pain and COMI score. In each case, a higher grade resulted in a better outcome. The difference between A and D grades for the improvements in COMI (2.6 points) and worst pain (3.9 points) were clinically relevant.
Conclusion: This initial study suggest that the new grading system, which gives most consideration to the impingement of neural tissue, may represent a more appropriate clinical tool than DSCA and be of prognostic value. It should be evaluated in larger prospective studies.

P13

Concave side opening wedge osteotomy with growing rod for the treatment of congenital scoliosis in young children

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Introduction: Unilateral unsegmented bar has a poor prognosis if left untreated. Surgical treatment is often necessary and an array of techniques are available. These techniques aim to either slow down/arrest growth contralateral to the unsegmented bar area or remove the region causing unbalanced growth (hemivertebra excision, vertebral column resection). As a result, the spinal column is shortened. Further options comprise distraction-based lengthening procedures including the application of growing rods or in rare cases VEPTR. Such lengthening methods include several segments and not only affect the focus of the deformity (main curve) but also the secondary curves.
A more effective treatment method to selectively treat the driving region of the deformity (unsegmented bar) is to cut the bar and perform distraction to compensate for the lost growth. To improve overall correction, it is usually necessary to apply growing rods. The results of such a technique, the opening wedge osteotomy, are analysed and described here.
Materials and methods: 8 consecutive patients with congenital scoliosis due to unsegmented bar were treated with the combination of a concave side opening wedge osteotomy through a posterior approach followed by application of growing rods. Their radiological and clinical data were evaluated prospectively.
Results: There were 8 patients, with an average follow-up of 6.6 (0.5 to 16) years. The mean age at surgery was 4.3 (2.5–5.5) years. Before surgery, the mean scoliotic curve was 56.0° (41°–68°). After surgery, the curve averaged 28.5° (20°–44°), yielding a correction of 27.5° (49%). There were 2 intraoperative monitoring alerts in the first 3 cases, and the final correction was hence delayed for one week in those 2 cases. 1 patient was reoperated due to spinal imbalance. There were 3 cases with implant-related complications during the course of growing rod treatment. No patients showed any neurological abnormalities at the final follow up.
Conclusion: Concave side opening-wedge osteotomy using a posterior approach in combination with growing rod is an effective and safe surgical technique for correction of congenital scoliosis.

P14

Osteosynthesis Of Proximal Periprosthetic Femur Fractures With A Polyaxial Locking Plate System: Results Of A Prospective Multicenter Study

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Introduction: The treatment of periprosthetic fractures around total hip prosthesis is challenging. Recently systems specifically designed for these fracture types have become available.
Objectives: This clinical study analyses 12 month results of a periprosthetic locking plate system These plates have a polyaxial locking mechanism to increase fixation stability by enabling bicortical screw placement around the prosthesis.
Methods: Since December 2011 all periprosthetic fractures were prospectively enrolled in an international multicenter clinical study. Fracture consolidation and implant related revision rate were defined as primary study endpoints. Secondary endpoints were other complications and the Harris Hip Score after 3, 6 and 12 months. All patients with Vancouver B1 und C-fractures were included. Interim results of the first 18 patients are presented.
Results: Eighteen patients (15 women and 3 men) could be enrolled. There were 12 Vancouver type B1 fractures and 6 type C spiral fractures. All but one fractures healed without complications. No fixation failure occurred. One patient had to be revised after 4 months due to a broken plate. No prosthesis loosening was found at 12 months follow up. The mean Harris Hip Score result was 77 (SD = 12) after 6 months and 89 (SD = 5) after 12 months. The score reached the mean preoperative level (87, SD = 14) after 12 month.
Conclusions: Good clinical and radiological results could be achieved with a low complication rate and good patient functional outcome.

P15

Unusual complication after an intramedullary nailing of a pertrochanteric fracture

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Introduction: Pertrochanteric fractures represent almost half of fractures of the proximal femur. The standard treatment is usually a short intramedullary nail.
The main complication is a secondary loss of reduction and cut-out of the cephalic screw. Other complications include femoral neck shortening, lateralisation of the cephalic hip screw or pseudarthrosis development.
We describe a rare case of femoral neck fracture three years after a pertrochanteric fracture treated with an intramedullary nail without breakage of the implant.
Case report: A 89-year-old woman presents to the emergency unit with right hip pain and inability to bear weight after a fall from her height. Her medical history reveals a closed reduction and internal fixation of a Kyle II pertrochanteric fracture with a short intramedullary nail three years ago. The patient was completely asymptomatic before her fall. Standard radiographic images and a computed tomography confirmed a femoral neck fracture and impaction around the cephalic screw without breakage of the implant. The acetabular articular surface was intact during the operation and we performed therefore a partial right hip arthroplasty with a cemented stem.
Conclusion: To our knowledge there is no description in the literature of femoral neck fracture around the cephalic screw of an intramedullary nail with no associated cut-out. Treatment options include a partial hip arthroplasty versus total hip arthroplasty depending on quality of life factors, daily activity demands of the patients and the integrity of acetabular cartilage.

P16

Prospective clinical and radiostereometric (RSA) results of 24 Fitmore Hip Stems after 2 years follow-up

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Background: Uncemented short curved femoral stems in total hip arthroplasty offer the advantage to save proximal bone stock and facilitate stem insertion in minimal invasive surgery. A 2-year follow-up RSA study was designed to evaluate the fixation of the Fitmore™ hip stem in patients.
Patients and methods: We carried out a prospective cohort study of 34 patients receiving a Fitmore™ hip stem. During total hip surgery, tantalum markers were inserted in the femur bone to enable RSA on prosthesis migration. Follow-up was performed at 3, 6, 12 and 24 months post-operatively. Migration was calculated as translations, rotations and maximum total point motion.
Results: 4 patients had to be excluded postoperatively due to RSA failures in 3 patients and periprosthetic fracture after fall in 1 patient. In the further course, 1 patient deceased after 6 months, 2 were non-compliant. Additional 3 patients were excluded and revised due to infection, aseptic loosening and muscular problems leaving 24 patients with complete records. The Harris Hip Score increased from preoperative 59.2 (33–80) to 98.7 (83–100). The RSA analysis showed a decrease of the initial mean subsidence after 3 to 6 months from –0.58 mm to –0.52 mm. After 2 years, the mean subsidence was –0.33 mm and the mean rotation along the longitudinal axis (endo-rotation) was 1.04°.
Interpretation: In conclusion, the Fitmore™ hip stem appears to subside (negative Y-axis translation) and rotate internally (positive Y-axis rotation) within the first 3 months postoperative and seem to stabilize afterwards. Clinically, good results could be achieved with a significant increase of the Harris Hip score.

P17

Validation of a self-reported Beighton score to assess hypermobility in patients with femoroacetabular impingement

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Background: Joint hypermobility (JH) seems to be associated with musculoskeletal pain and injury incidence in an active population. The prevalence of JH in patients with femoroacetabular impingement (FAI) and its association with outcomes is yet widely unknown.
Hypothesis/Purpose: To validate a self-reported version of the Beighton score for FAI patients, and to determine possible associations between JH and clinical and radiographic parameters.
Methods: The study included 55 consecutive patients (18 females, mean age 29 years) with a diagnosis of FAI. All patients completed a self-reported Beighton score before clinical assessment, and two clinicians blinded to the self-reported form filled the examiner-based version. Reliabity of the self-reported version was assessed using kappa statistics. The prevalence of JH and associations between Beighton scores and clinical and radiographic parameters were determined.
Results: The patients scored a mean of 2.6 ± 2.8 points on the self-reported Beighton score. Agreement between self-assessment and examination was good to excellent for all single items and for the total score. Considering a Beighton score of ≥4 as cutoff for JH, the prevalence in the present cohort was 32.7% (50% of females and 24.3% of males). Significant associations were found between Beighton scores and hip flexion (r = 0.61) and internal rotation (r = 0.56). No significant correlations were found between Beighton scores and any of the radiographic parameters.
Conclusion: The patient-oriented Beighton score proved to be feasible and reliable in FAI patients. The prevalence of JH in these patients seems to be high and future investigations about the association of JH with FAI and treatment outcomes are therefore warranted.

P18

Endovascular embolization as treatment for arterial complications after elective hip surgery

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Aim: Arterial complications during elective hip surgery are rare, and require secondary interventions. In this study we analyse endovascular embolization as treatment strategy and link the type of surgical approach to angiographic proven injured vessels. Further we found that endovascular embolization is a save and effective treatment for both acute and chronic postoperative arterial complications.
Methods: In a retrospective study we searched our digital patient database and patient records for elective hip surgery and vascular interventions.
Results: Between 2007 till 2013 for patients that underwent elective hip surgery. Out of 3891 elective hip interventions we were able to identify 16 patients were endovascular embolization was performed postoperatively as treatment for an arterial complication. Ten patients underwent primary hip arthroplasty, four revision arthroplasty, one a hip arthroscopy and one intramedullary nailing. Bleeding were detected by marked swelling, and thereafter confirmed by low haemoglobin count. Seven patients had a known coagulopathy. Eleven out of 16 patients underwent embolization within the first 3 days. 5 patients underwent embolization up until 10 days after primary surgery. In all but one the bleeding could be successfully treated by embolization, one patient did not show any active bleeding. In eleven patients a active bleeding could be found, whereas in four a pseudoaneurysm could be seen. For all embolization coils and or Spongostan™ were used.
Conclusion: Acute and chronic arterial complications in elective hip surgery are rare, and can usually successfully be treated by endovascular management, avoiding the morbidity of open repair. Endovascular embolization is our standard treatment for arterial complications after hip surgery.

P19

Typical and Atypical Atypical Femoral Fractures

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Introduction: Beginning in 2005, reports link long-term use of bisphosphonates (BPs) with atypical fractures of the femur (AFF). The American Society for Bone and Mineral Research (ASBMR) defined major and minor features of AFF and recommends that all major features be present to designate a femoral fracture as atypical. Does rigid application of these features hinder identification of all cases of atypical femoral fractures? We present two cases of femoral fractures with a past medical history and radiomorphologic features suggesting atypical character. However, because failure to meet all major features, these cases would not be accepted to be "atypical".
Case reports: A.A. (1930) suffered from 5 low energy fractures. Dexa scanning revealed osteopenia (DEXA: Femur li T = –1.2, LWS T = –2.3) and antiresorptive therapy was initiated with alendronate. In 2008 the patient suffered from another low-energy periprosthetic femoral fracture. The fracture met all major ASBMR criteria. However, as periprosthetic fractures are excluded from AFF by definition, the fracture shown in fig. 1. would not be accepted to be an atypical one. B.B. (1976) missed to build peak bone mass because of anorexia. Dexa scanning was performed (DEXA: LWS T = –2.9) and antiresorptive therapy was initiated with ibandronate. In 2011 the patient suffered from a pertrochanteric femoral fracture with subtrochanteric extension (fig. 2) when sitting down on a chair. Because of persisting pain in the contralateral femur, MRI scanning was performed. This revealed stress reactions in the other femur, too. Except for the pertrochanteric fracture line and except for an oblique fracture line all major ASBMR features are met. Minor criteria are also met: relevant comorbidity (anorexia), pharmacotherapy (ibandronate) and bilaterality of the lesion.
Discussion: Major and minor features create a case definition of AFF in order to assure that subsequent studies report on the same condition. However, rigid application of criteria might hinder identification of all cases of AFF. An additional group of **atypical atypical femoral fractures** would allow a future AFF register not to drop questionable cases.

P20

Open Reduction and Internal Fixation (ORIF) of Greater Trochanter (GT) Fractures, Non-unions and Mal-unions using a Modular Claw Plate

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Introduction: ORIF of GT fractures, non-unions and mal-unions remain a challenge. Irrespective of the fixation devices used, non-union and implant failure rates are reported as high as 31% and 19%, respectively. Since November 2009, a claw plate with one modular claw (multi optional plate, MOP) was used by 4 different surgeons in two different institutions. The aim of the present study was to retrospectively review these patients in terms of secondary dislocation, union rates and local complications.
Methods: Retrospective review of a consecutive single series of patients using MOP from November 2009 to April 2013. Latest follow-up x-rays were used for evaluation of secondary fracture displacement, device fracture and bony union. Latest follow-up records were used to evaluate clinical outcome. Patient's charts were reviewed in order to record complications, re-operations and patient demographics.
Results: Thirty MOP were used during this time period in two institutions treating 30 patients (age: 68y, range 32-92, women: 22, left: 19). In two patients, GT fracture was diagnosed during implantation of primary THA, while diagnosis was delayed in 7 patients. Two patients were revised for implant failure after primary GT fixation, 9 for non-union. 4 patients were treated by periprosthetic fracture. Prophylactic MOP fixation was used in 4 patients during revision arthroplasty. One patient died unrelated to surgery before follow-up visit. After a mean follow-up of 9 months (range 3–28 months), union occurred in 25 of 29 cases, secondary dislocation in 4. Failure mechanism was loosening of the distal screw fixation in these cases. Hardware removal due to trochanteric pain was performed in 8 patients. At the latest follow-up, 16 patients had no pain and no limitations when walking. Six patients claimed trochanteric pain due to plate prominence and were scheduled for implant removal, 7 patients claimed residual pain or limping due to abductor weakness.
Conclusion: MOP displayed failure rates of 14%. Due the observed failure mode, MOP has been lengthened distally for better distribution of mechanical forces along the distal implant.

P21

Osteolysis around Birmingham Modular Metal-on-Metal Total Hip Arthroplasty: Is CT the better screening test?

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Introduction: Periacetabular osteolysis has been described as a failure mode in modular metal-on-metal (MoM) total hip arthroplasty (THA). The clinical value of metal artifact reduction sequence (MARS) magnetic resonance imaging (MRI) to assess the periprosthetic soft tissue is well documented; however, the appropriate image modalities to detect periacetabular osteolysis remain unclear. The purpose of the present case series was (1) to report on the accuracy of plain radiographs, CTs and MRIs in 10 patients with periacetabular osteolysis around modular MoM THA and (2) to report on periacetabular osteolysis as a possible failure mechanism of the Birmingham MoM total hip arthroplasty (Smith & Nephew, Memphis, TN, USA).
Methods: Ten patients with uncemented modular MoM THA (Birmingham Hip Acetabular Cup, Birmingham Hip Modular Head and Synergy Stem; Smith & Nephew, Memphis, TN, USA) are presented. All 10 patients received corresponding standardized AP pelvis radiographs, high quality MARS MRIs and CT scans with a metal artifact reduction sequence.
Results: While periacetabular osteolysis around MoM THA was not detected on MARS MRI, CT imaging identified osteolysis in all patients. Periacetabular osteolysis appears to be a failure mechanism of the Smith & Nephew Birmingham MoM THA.
Conclusion: MRI is not a sensitive test to identify periacetabular osteolysis. The authors recommend CT for the screening of implants with this failure mode. Our study suggests that patients with a standard BHR metal-on-metal THA are at increased risk to develop acetabular osteolysis and should be carefully monitored for this failure mode.

P22

Iliopsoas Muscle Necrosis Caused by Intrapelvic Extension of an Iliopectineal Bursitis Complicating Femoral Head Necrosis: Case Report and Literature Review

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Iliopectineal bursitis has been reported to occur in various hip diseases such as osteoarthritis, rheumatoid arthritis and osteonecrosis. In severe cases, the iliopectineal mass might produce symptoms due to direct compression of the adjacent anatomical structures. We describe a case with a massive iliopectineal bursitis with intrapelvic retroperitoneal extension and necrosis of the iliopsoas muscle complicating an osteonecrosis of the femoral head.
We report a case of a 78-year old male with an inguinal swelling and a weak and painful hip flexion. Conventional radiography showed sever degenerative changes of the left hip. The MRI revealed a large fluid collection that was referred to as an iliopectineal bursitis. The fluid mass extended into the retroperitoneum along the iliopsoas tendon and formed a collection in the iliac fossa. The presence of a destructive femoral head necrosis was also confirmed in the MRI-studies. Through a Smith-Peterson approach the hip joint was accessed. There was a connection between the joint capsule and the iliopectineal bursa so that a valve-like mechanism was postulated to explain the large extent of the cyst. The exploration of the iliopsoas tendon revealed a partly necrotic tendon and an extensively necrotic and hemorrhagic muscle which was extensively debrided. After an infection was ruled out a Girdlestone resection arthroplasty was performed as the patient did not qualify for a total hip prosthesis. At 2 months follow-up, the patient clinically improved without recurrence of the swelling or groin pain and improved hip flexion force.
Iliopectineal bursitis is a rare pathology that may complicate osteoarthritis, osteonecrosis or rheumatoid arthritis of the hip. Patients might present with an inguinal mass and groin pain, however, in severe cases hip flexion force can be reduced due to femoral nerve palsy or even iliopsoas muscle necrosis caused by extensive compression by the intrapelvic fluid mass. The treatment comprises the evacuation of the mass and debridement of the necrotic tissue on the one hand, and the treatment of the underlying cause on the other hand. This means the resection of the degenerative femoral head with either implementation of a Girdlestone situation or a total joint replacement. In conclusion, awareness of this pathology with its unique symptoms and radiographic findings is important in order to reveal the correct diagnose and initiate the adequate treatment.

P23

Fracture of two tapered modular non-cemented revision stems: case report, technical note for extraction and metallurgic analysis of cause

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Introduction: Fracture of the femoral component after primary total hip arthroplasty (THA) is well known and counts for approximately 1% of revision surgery. Fracture of the femoral component after revision THA is rarely reported but appears to be the cause for 2–3% of subsequent revisions. The failure modes of stem fractures of both primary and revision THA mostly described to date are fatigue fractures caused by cyclic loading. Recent case reports have illustrated fractures of modular femoral stems in primary THA in the head-neck region after major mechanical impact (as fall or jump), which where corrosion induced.
Removal of a broken stem can become challenging as no standard extraction device can be fitted. Various solutions to solve problems of extraction are described, but all require extension of the surgical approach, result in extensive bone loss or need off-label use of devices.
Methods: We present 2 cases of a broken modular tapered, fluted, non-cemented titanium alloy revision stem (Revitan®, Zimmer).
Results: In both cases, an extraction with the standard instruments was no longer possible. Our technical solution of removal via a standard transfemoral approach is simple, reproducible, and does not require extensile measures or special devices other than a carbide drill. After extraction both stems showed the same unexpected location of fracture so that a metallurgical analysis was initiated. The reason for breakage was in both cases crevice corrosion.
Conclusion: To our knowledge there have been no previous reports showing crevice corrosion as a reason for spontaneous fracture of a revision stem. The technique used for extraction is relatively simple. We recommend it should be available to whoever is confronted with revision of broken femoral THA stems.

P24

Voluminous pseudotumor formation due to corrosion at the neck-stem junction in a primary modular total hip arthroplasty

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Modularity at the neck-stem junction has been introduced in total hip arthroplasty(THA) to enlarge the spectrum of options for reconstruction of the joint, without dramatically increasing the stock of implants necessary. However, there is increasing concern in regard to complications related to the neck-stem junction. Sporadic reports of corrosion as well as disappointing results from the registries started to surface.
Case report: We present the case of a 74 yo patient who at one year follow-up after implantation of a primary THA presented with diffuse pain in the right hip. He had received a cementless modular neck implant with a ceramic-on-polyethylene bearing surfaces. Plain x-rays revealed osteolysis at the calcar, adjacent to the neck-stem junction. CT and MR imaging showed a voluminous periprosthetic mass. The infectious work-up was negative and cobalt serum levels were elevated (Co 7.72 ug/L) while chromium levels remained inferior to the 7 ug/L pathologic threshold.
Revision surgery was performed with rapid regression of symptoms and cobalt levels. Electron microscopy as well as a chemical surface analysis of the retrieved implant revealed characteristic features of corrosion. Histopathologic examination of the periprosthetic tissues showed classic features of a metal-induced pseudotumor like abundant necrosis in a thick fibrotic tissue as well as a perivascular lymphocytic “cuffing” which is the main characteristic of aseptic lymphocyte-mediated vasculitis-associated lesion (ALVAL).
Conclusion: Pseudotumor formation due to corrosion at the neck-stem junction in modular neck implants can be the source of failure in total hip arthroplasty. Hip pain in patients with modular neck implants should raise suspicion for pseudotumor formation and other adverse reactions to metal debris, which may lead implant failure necessitating revision surgery.

P25

Are Additional Anteroposterior Hip Radiographs Required for Precise Templating in Total Hip Arthroplasty?

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Introduction: Accurate restoration of the physiological biomechanics in total hip arthroplasty improves abductor strength and range of motion. Traditionally, preoperative templating has been performed on anteroposterior (AP) radiographs of the pelvis. More recently, AP radiographs of the hip have been recommended for an accurate restoration of the femoral offset. However, additional x-ray imaging increases the radiation exposure of the patient as AP pelvis templating is still required to restore the leg length and the center of rotation. We therefore analyzed the femoral offset obtained by AP radiographs of the pelvis and the AP radiographs of the hip. Additionally, we created a geometrical model to calculate the theoretical difference of the femoral offset obtained with AP radiographs of the pelvis as compared to AP radiographs of the hip.
Methods: In 48 patients, both anteroposterior pelvis and anteroposterior hip radiographs were obtained as pre-operative radiographs for templating of unilateral total hip arthroplasty. Patients position and x-ray beam setting followed a standardised protocol to achieve reproducible projections. All images were calibrated with the KingMark® calibration system and the offset measurements were performed with the validated TraumaCAD software programme (Voyant Health, UK). A geometrical model was created to calculate the theoretical difference of the femoral offset between the AP pelvic and AP hip projection.
Results: The mean femoral offset measured on AP pelvis radiographs was 36.8 ± 5.1 mm and 37.9 ± 6.9 mm on AP hip radiographs (mean difference 1.2 ± 1.6 mm). According to our formula, the theoretical projection-derived underestimation of the femoral offset on AP pelvis radiographs as compared to AP hip images and hip was 1.5%.
Discussion: The x-ray measurements and the calculation of the geometrical model demonstrated that the difference of the femoral offset obtained with AP radiographs of the pelvis and the hip is negligible. Additional AP hip radiographs add to the patients' radiation exposure without improving the precision of pre-operative templating of total hip arthroplasty. Consequently, AP hip radiographs do not seem to be required for routine total hip replacement templating.

P26

Tissue engineered nasal cartilage for the regeneration of post traumatic cartilage injuries in the knee – early results of a Phase 1 Clinical Trial

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Introduction: Articular cartilage has a very limited intrinsic repair capacity leading to progressive joint damage. The implantation of autologous articular chondrocytes does not reproducibly support durable regeneration in the long-term. As an alternative, a three-dimensional cartilage tissue graft, engineered in vitro to possess functional properties could result in a more durable repair in the long-term. To reduce the variability in the quality of the engineered tissue grafts, a cell source with more reproducible function such as nasal chondrocytes could be used. The purpose of this phase-1 study is to demonstrate safety and feasibility of the procedure.
Material and methods: Five patients below 55 years with symptomatic post-traumatic full-thickness cartilage lesion (2–8 cm^2) on the femoral condyle and/or trochlea have been up to now treated. The patients underwent a nasal septum cartilage biopsy in an outpatient procedure. Nasal chondrocytes were isolated, expanded and then seeded on a collagen sponge in the context of a quality management system and Good Manufacturing Practice facility. After 4 weeks the tissue engineered nasal cartilage autograft was implanted into the defect and secured sutures and fibrin adhesive. Patients were followed up clinically according to the ICRS evaluation package and radiologically with MRI.
Results: No complication occurred during nasal cartilage biopsy. The engineered cartilaginous tissues were always correctly fixed in the defect. All the operated patients could follow the established rehabilitation program. Three patients reached 6 months follow up so far. At this time, MRI revealed the presence of the nasal cartilage graft in situ without subchondral bone edema. The repair tissue demonstrated in some areas full thickness repair and in certain areas its level was still below the one of the surrounding native cartilage.
Conclusion: The early results show that engineered constructs based on autologous nasal chondrocytes can integrate with the surrounding tissue and participate to the repair of the defects. These data so far indicate safety and feasibility of the procedure, but two year follow up of all included patients is necessary for confirmation of the early observations. This study opens a new approach in biological cartilage regeneration with engineered tissue and nasal chondrocytes as autologous cell source.
Acknowledgments: Deutsche Arthrose-Hilfe for financial support.

P27

Treating patella instability in skeletally immature patients

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Introduction: This systematic review aims at comprehensively and systematically reviewing the current evidence for orthopedic treatment of immature and adolescent patients with acute and chronic patella instability.
Methods: We searched the online databases PubMed, CINAHL, EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL) and Cochrane Database of Systematic Reviews (CDSR) for relevant publications on patella instability. All dates and languages were included.
Results: 20 papers reporting on a total of 456 knees in 425 patients (131 male, 294 female) patients followed for 56.7 ± 42.2 months on average, were included into the analysis. Two studies focused specifically on conservative and surgical treatment in acute dislocations and reported no difference in outcomes after 7 and 14 years, even in the face of slight trochlea dysplasia. For recurrent instability, we found consistent, beneficial effects of surgical stabilization on clinical scores, postoperative stability and radiographic assessment. There is no evidence for growth disturbance with surgical patella stabilization in immature patients.
Conclusion: The current best evidence does not support the superiority of surgical intervention over conservative treatment in an acute patella dislocation. However, anatomic variations and their effect on healing should be considered and included in decision-making. In recurrent patella instability in pediatric and adolescent patients with normal or restored knee anatomy, reconstruction of the MPFL is an effective treatment option but should be carefully weighed against trochleaplasty.

P28

Evidence-based treatment of septic arthritis after ACL reconstruction

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Introduction: This systematic review aims at comprehensively and systematically reviewing the current evidence for the treatment of septic arthritis after ACL reconstruction.
Methods: We searched the online databases PubMed, CINAHL, EMBASE, Cochrane Central Register of Controlled Trials (CENTRAL) and Cochrane Database of Systematic Reviews (CDSR) for relevant publications on septic arthritis after ACL reconstruction. All dates and languages were included.
Results: 190 papers reporting on the diagnosis and treatment of septic arthritis after ACL were reviewed for inclusion. The most critical diagnostic criterion for a joint infection was a cell count >50.000 on an initial aspirate. 60% of all cases are missed at the initial presentation. The highest risk for a septic complication was seen in patients with a soft tissue graft and cannulated fixation. Previous knee surgery increases the risk of infection between 2 and 5-fold. Dropping the graft on the floor does not increase infection rates substantially, if the graft is properly cleaned. Graft retention is a viable solution if an infection is diagnosed early (<2 weeks), although there are no differences in clinical scores and function after 2 years when compared with those treated with graft removal and two stage reconstruction.
Conclusion: Septic arthritis is an infrequent yet much dreaded complication of ACL reconstruction. Unfortunately, detection is difficult, and only 40% are accurately diagnosed right away. In those diagnosed early on, retention is a viable option. Late detection, or additional risk factors such as cannulated fixation, extracortical fixation or soft tissue grafts, graft removal and two stage reconstruction should be considered.

P29

Joint mechanics for descending stairs of different step height in patients with TKA: a biomechanical analysis using principal component analysis

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The mechanical demand placed on total knee prostheses during activities of daily living is important for the outcome of total knee arthroplasty (TKA). While it is known that different stair dimensions affect biomechanical parameters, to date these effects are unknown in patients following TKA. Using principal components analysis (PCA), relevant parameters describing differences in patterns of biomechanical parameters can be identified. We aimed to identify biomechanical parameters for stair descending that are affected by step height in patients following TKA and in age-matched healthy subjects at two different step heights.
Three-dimensional kinematic and kinetic data of 15 patients with good outcome were collected on average 2.1 ± 1.3 years after TKA (6 bilateral, 9 unilateral; LCS® Complete™) for stair descending at step heights of 17 and 21 cm and compared to data of 15 age-matched control subjects (CON). Ground reaction forces were measured for three consecutive steps using an instrumented staircase.
Requirements for good outcome were: postoperative WOMAC score <50; knee and function score (KSS) >70, respectively; EQ-5D >70 as a measure of health outcome; passive knee flexion on the operated side >110°; no other surgeries at the lower extremity; between 60 and 75 years; free of pain and satisfaction after TKA. PCA was used for data reduction. Linear mixed models ($p = .002$) were used for statistical analysis.
Most biomechanical parameters changed significantly with increasing stair height (higher knee flexion angle (PC1, 2), greater knee flexion moment (PC1, 2, 4), and greater knee absorption (PC1, 2, 3, 5)). Differences between TKA and CON were not statistically significant, and there was no significant group by stair height interaction. However, a small interaction effect ($p = .004$) was observed for the knee adduction moment (KAM). The KAM increased with higher stairs in the CON group but did not differ between stair heights in the TKA group. The KAM result of this study suggests that the TKA patients tried to avoid a greater KAM in the knee during the stance phase of stair descending, which could be caused by a protective mechanism that may have been present even before the TKA because of pain during activities. This result should be considered when planning the postoperative treatment program. In conclusion, while the movement patters after TKA were similar to CON, the knee loading is sensitive to stair height in TKA but not in CON.

P30

Long-term survival and radiological results of the Duracon total knee arthroplasty

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Purpose: Aim of this study was to analyze the long-term (>10 years) survival rate and radiological results of the Duracon TKA.
Methods: Between 1992 and 1999 159 Duracon TKA were implanted at our institution. A Kaplan-Meier survival analysis for the endpoints exchange, addition or removal of any component for any reason, revision due to aseptic loosening and mechanical failure was performed. Radiological long-term (>10 years) follow-Up (FU) analysis was performed according to the Knee Society Radiographic Evaluation and Scoring System.
Results: Mean age at surgery was 74.3 years, 28% were male, 89% had primary osteoarthritis as diagnosis. Mean FU for survival analysis was 10.9 years (SD 4.2). 58% of the patients died during follow-up. 3 patients (2.1%) were lost to follow-up. 5 TKA (3.1%) were revised. After 10 years the mean survival was 97.7%, 99.4% and 98.3% for the aforementioned endpoints. Mean radiological FU was 11.8 years (SD 2.3). We found no significant change in alignment of the components or axis over time. Progressive radiolucencies were found in 9 TKA (17%), mainly around the tibial component (95%).
Conclusion: The Duracon TKA showed excellent long-term survival comparable to data from national registers and to other successful designs. Radiological changes found on plain radiographs were scarce after almost 12 years of radiological follow-up indicating good implant stability.

P31

Comparative study of 3.5 mm and 4.5 mm anatomic locked plates in the treatment of tibial plateau fractures

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Introduction: The treatment for tibial plateau fractures will be discussed in the litterature. This report look at a retrospective series of comparative fractures treated with 3.5 mm or 4.5 mm anatomic locked plate. Our hypothesis is that the 3.5 mm plates provide a comparable fixation of tibial plateau fractures, together with a higher clinical tolerance.
Methods: From May 2010 to October 2011, 18 patients (51.9 years) were operated with an LCP 4.5 mm anatomical locking plate (Group A) and 20 patients (51.7 years) with an LCP 3.5 mm anatomical locking plate (Group B).
Group A included 8 Schatzker I, II or III fractures and 10 Schatzker IV, V or VI fractures. Group B included 8 Schatzker I, II or III fractures and 12 Schatzker IV, V or VI fractures. One was an open fracture.
Results: 14 patients in Group A were reviewed after an average of 35.3 months and 16 patients in Group B after an average of 27 months. The mobility was comparable. The HSS score was 86.4 for group A versus 80.6 for group B and Lysholm score was 83.6 for group A versus 77 for group B. The consolidation was 3.25 months versus 3.35 months and the mean axis 183.1° versus 181.6° respectively for groups A and B. The mechanical axes were statistically different from the contralateral axes. The following cases were reported: 1 secondary displacement, 2 arthrosis in Group A; 1 secondary displacement, 1 osteoarthritic change in Group B. Also reported were: 1 phlebitis, 1 complex regional pain syndrome (CRPS), 1 compartment syndrome and 1 regressive paresis of the common peroneal nerve in group A and 1 CRPS, 1 scar separation and 1 infection in Group B. 8 patients in Group A suffered discomfort from the plates, as did 3 patients in Group B ($p < 0.05$).
Conclusion: Our hypothesis is confirmed, that the 3.5mm plates control the tibial plateau fractures effectively. There is no significant differences between the results of the two groups but the clinical tolerance is higher for group B. The follow up is currently low to evaluate on the long term those complex fractures.

P32

Locking plate or intramedullary nailing in the treatment of extra-articular fractures of the proximal tibia?

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Introduction: The treatment of fractures of the proximal tibia is difficult and controversial. Nailing is deemed delicate and osteosynthesis plate construction difficult to carry out. We are reporting on our experience in treating these fractures with a retropective series of nailing and locking plates. The hypothesis is the locked plate osteosynthesis provides better radio-clinical results.
Methods: From January 2004 to December 2011, 22 patients were taken care of (10 female, 12 male), average age 56.9 years. The plate group included 14 cases (8 females/4 male, 60,4 years) and the nail group 8 cases (2 female/6 male, 50.6 years). The equipment used was LCP lateral anatomical locking plate andStryker® remaned nails. Fixation was performed either on an traction table or a standard table. Postoperative partial weight bearing was preferred.
Results: At the follow up 3 deaths were observed and 2 could not be traced (with a minimum follow-up of 2 years. The average follow-up was 47,7 months (27–85 months) for the 22 cases. The nailings were performed on an traction table. The locked plates were performed on an traction table (n = 2) or standard table (n = 12). Functional recovery in professional, domestic and sport settings was complete. Mobility was preserved (mean flexion of 120°). The consolidation ratio was 95.5% in an average of 12.5 weeks. 1 default initial axis 6 (4.5%) was observed in the plate group. At the review 6 secondary displacements of 3° on average were observed in the plate group. We report two superficial infections with skin necrosis.
Discussion: The study shows satisfactory clinical results but emphasize technical difficulties. Nailing is deemed difficult. Some authorss suggest a locked plate fixation with satisfactory results without a real difference appearing for all that. Our clinical results are comparable to those given in the data for both techniques. Radiologically the comparison between groups is less favorable to the plates with cases of secondary displacement. Caution is necessary with plate fixation that needs to be longer and the systematic use of temporary external fixation to help with reduction intraoperatively.
Conclusion: The clinical results are satisfactory but the radiological results should lead to caution with regard to secondary displacements observed in the plate group. The hypothesis is not verified.

P33

A novel standardized algorithm using SPECT/CT evaluating patients after unicondylar knee arthroplasty– a combined analysis of tracer uptake distribution and com

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With the introduction of a standardized SPECT/CT algorithm including a localization scheme, which allows accurate identification of specific patterns and thresholds of SPECT/CT tracer uptake could lead to a better understanding of the bony remodeling of unicondylar knee arthroplasty (UKA) and their specific failure modes. The purpose of the present study was to introduce a novel standardized SPECT/CT algorithm for patients after UKA and evaluate its clinical applicability, usefulness and inter- and intra-observer reliability.
99mTc-HDP-SPECT/CT images of 21 consecutive knees (mean age ± standard deviation 67 ± 10 years) after UKA were prospectively evaluated. The tracer activity on SPECT/CT was localized using a specific standardized UKA localization scheme. For tracer uptake analysis (intensity and anatomical distribution pattern) a 3D volumetric quantification method was used. The maximum intensity values were recorded for each anatomical area. In addition, ratios between the respective value in the measured area and the background tracer activity were calculated. The femoral and tibial component position (varus-valgus, flexion-extension, internal and external rotation) was determined in 3D-CT. Two senior orthopaedic surgeons interpreted the SPECT/CT findings in all patients twice with two week intervals between interpretations in random order. The inter- and intraobserver reliability of the localization scheme, grading of the tracer activity and component measurements were determined by calculating the intraclass correlation coefficients (ICC).
The localization scheme, grading of the tracer activity and component measurements showed high inter- and intra-observer reliabilities for all regions (tibia, femur and patella). For measurement of component position there was strong agreement between the readings of the two observers; the ICC for the orientation of the femoral component was 0.73–1.00 (intra-observer reliability) and 0.91–1.00 (inter-observer reliability). The ICC for the orientation of the tibial component was 0.75–1.00 (intra-observer reliability) and 0.77–1.00 (inter-observer reliability).
The SPECT/CT algorithm presented combining the mechanical information on UKR component position and orientation with the metabolic data is highly reliable and clinically feasible. Using this standardized approach in clinical studies might open a new diagnostic dimension evaluating patients with pain after UKA.

P34

What is the evidence of trochleoplasty in treatment of patellofemoral instability? A systematic review and comparison with MPFL reconstruction outcomes

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Introduction: Trochleoplasty and reconstruction of the medial patellofemoral ligament (MPFL) are the most commonly used surgical treatment in patients with patellofemoral instability. Although there is an increasing number of publications dealing with treatment of patellofemoral instability, the clinical evidence about outcomes and in particular the question when to use which method is still scarce. It was our purpose to perform a systematic review on trochleoplasty in the treatment of patients with patellofemoral instability and compare the outcomes with those seen in patients treated by reconstruction of the MPFL.
Methods: Two independent orthopaedic surgeons performed a standardized search on Pubmed and other literature search engines and reviewed the obtained abstracts. All observational and experimental studies were then obtained in fulltext and again reviewed in a consensus meeting. 15 articles were included and analysed using the CASP appraisal scoring system to assess its methodological quality. As comparison group the same process was done for MPFL reconstruction. 25 studies on MPFL reconstruction were obtained for comparison. The clinical and radiological outcomes of all papers was reviewed and compared. The studies investigated use a great variety of different outcome scoring instruments. Seven outcome variables were found consistently in most of the studies. Descriptive statistics was used for comparison of Kujala score, Lysholm score, patella tilt angle, sulcus angle, apprehension test, redislocation and instability rates.
Results: There was no statistical significant difference in outcomes between both groups investigated. The MPFL reconstruction group showed a trend to better clinical outcomes. Mean postoperative Kujala score and Lysholm score increased significantly in both groups when compared to preoperatively. Postoperatively a positive apprehension test was found in 8% of the MPFL group and in 20% of Trochleoplasty group. No difference in redislocation (2%) and instability (5–6%) rates between both groups. Mean PTA and SA showed a decrease in the trochleoplasty group.
Conclusion: Considering all limitations this systematic review showed that trochleoplasty and MPFL reconstruction are able to deliver good clinical outcomes with stable patellofemoral joints. The minor differences in outcomes seem to be related to different patient populations and surgical techniques.

P35

SPECT/CT for the assessment of the loading history of patients after high tibial osteotomy – a new diagnostic tool and algorithm

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Background: SPECT/CT tracer uptake has been shown to reflect the loading history of the tibiofemoral knee joint and correlate with the mechanical and anatomical alignment. It was our primary purpose to develop a novel standardized SPECT/CT algorithm for patients undergoing high tibial osteotomy, evaluate the inter- and intra-observer reliability (OR) and assess the clinical applicability for follow-up of patients before and after high tibial osteotomy.
Methods: The localization scheme defines 9 femoral, 8 patellar and 13 tibial zones to accurately map the examined tracer uptake volume in each anatomical area of interest. Maximum values for each area (mean ± standard deviation, median and range) of the localization scheme were recorded as well as normalized values for intensity of SPECT/CT tracer uptake calculated. The inter- and intra-OR was assessed for SPECT/CT localization and tracer activity. Pre- and postoperative mechanical alignment was assessed in SPECT/CT using a custom-made specialized software. The median inter- and intra-observer differences of the measured mechanical alignment were calculated along with the inter- and intra-OR.
Results: The localization scheme showed near perfect inter- and intra-OR (ICC >0.9) for the measurement of tracer activity and localization in all anatomical regions. For measurements of mechanical alignment, there was a strong agreement between the two observers (inter-OR of ICC = 0.99 and an intra-OR of ICC = 0.98).
Conclusion: The presented SPECT/CT algorithm is highly reliable and clinically feasible. Combined with mechanical alignment analysis it provides the surgeon with helpful information about realignment effects of high tibial osteotomies (HTO) and might help to identify the optimal personalized degree of correction in HTO surgery.

P36

Do not forget the proximal tibio-fibular joint – a rare cause of unexplained pain after high tibial osteotomy!

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Problems of the proximal tibio-fibular joint (pTFj) as complications after high tibial osteotomy are rare. With this case report we strive to highlight the importance of investigating the pTFj in patients with unexplained knee pain after high tibial osteotomy (HTO).
A 44 years old male patient presented to our knee clinic with referred diffuse pain of his left knee three years after medial opening-wedge HTO due to medial compartment overloading in a varus deformed knee. The patient described persistent anterior tibial and lateral knee pain. Two years after HTO the patient underwent implant removal, he still experienced ongoing knee pain and increasing loss of extension. As the reason for the persistent pain was not identified, further radiological diagnostics was indicated. The differential diagnosis was under-correction of the osteotomy, a non-union or an increasing osteoarthritis. SPECT/CT revealed that there was no increased uptake within the tibio-femoral joint, indicating a biologically well performed correction of the varus deformity. Markedly increased tracer uptake was found at the pTFj. On the inherent axial CT scans it was seen that the proximal screws were too long and placed within the pTFj. SPECT/CT helped to pinpoint to the site of the problem. Along with this a severe osteoarthritis of the pTFj was identified. The cause of the patient`s pain due to an iatrogenic lesion of the pTFj and consequent degenerative osteoarthritis was then confirmed by a CT-guided infiltration with local anaesthesia. An arthrodesis of the pTFj using a

compression screw was performed and at follow-up 12 months after the arthrodesis the patient was pain free.
This case highlights how important it is to investigate the pTFj in patients with unexplained pain after HTO. SPECT/CT was helpful in identifying the patient's problem in this challenging case.

P37

Dynamic intraligamentary stabilization (DIS, Ligamys®) in ACL rupture. Preliminary results in stability and strength in 27 patients 9 months after surgery

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Introduction: Arthroscopically assisted ACL reconstruction is an accepted standard procedure in treating acute ACL tears. Yet, numerous newer studies support the hypothesis of biological self-healing potential of a ruptured ACL.
Recently, a new operation method described as dynamic intraligamentary stabilization (DIS) was introduced. The DIS device combines an internal dynamic screw-spring mechanism with a 1.8-mm braided polyethylene anchoring wire providing continuous stability for the ACL and knee during the self-healing period.
Apart from preserving natural structures, this procedure allows for fast track rehabilitation with near to immediate postoperative onset.
Methods: We present preliminary biomechanical results of 27 patients with a mean follow up of 9 months (277 days). All operations were performed by two experienced knee surgeons. All patients underwent a complex knee testing at a mean of 6 months (187 days) after surgery. Tested features were overall stability, Lachman, strength of extensor and flexor muscles. Flexor to extensor ratio was calculated.
Results: The deficit in overall stability was 3.8% for the injured side. Lachman testing did not show any increased translation in 21 patients and slightly more translation in 5 patients, all of which presented a solid mechanical endpoint.
Isokinetic testing of extensor muscles showed 28.7% less strength in comparison to the healthy, contralateral knee. The difference in muscle strength with regard to the flexors was 6.7%. The calculated relation of flexors to extensors was 79.1% (normal 61–75%).
In 4 patients the tensioning device was removed and the remaining tibial defect filled using bone chips. To date, no additional surgery with regard to the ACL has been required.
Conclusion: DIS is a safe and minimally invasive procedure, which supports the self-healing process in ACL ruptures. It shows promising short-term results in knee stability and flexor/extensor strength and provides adequate and early anterior – posterior stability, which is an important supportive factor in rapid rehabilitation and beneficial for a soft healing response. It leads to a stable knee joint and maintains proprioception. Short- and mid-term results remain to be collected and analyzed and will be reported accordingly.

P38

Smart Implant Loosening Detection: a vibration analysis approach

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Introduction: Total knee arthroplasty loosening results from the weakness of prosthesis-bone interface and is actually the main reason for prosthesis failure and surgical revisions. However pre-operative diagnosis is hard to confirm because of a lack of accurate tests. In the present work, we propose a new method of tibial implant loosening detection.
Method: Our system includes two components. A vibrator, which stimulates the bone and a smart tibial implant, composed of an integrated accelerometer-based sensor cube, which measures the propagated vibration. After implantation of this custom implant in a fresh cadaver knee, harmonic forced vibration was applied to the bone and its transmission to the tibial implant was measured. A progressive cement removal was then performed, creating partial and total implant loosening. Total implant loosening was characterized by implant macromotion. In order to discriminate the two latter conditions from a stable implant, two signal processing approaches were used: power spectrum analysis and input-output coherence analysis.
Results: Our experiments were performed in 6 fresh cadaver lower limbs. Power spectrum analysis could determine total implant loosening in all subjects while input-output coherence analysis could detect it in 5 subjects. After partial implant loosening, power spectrum and input-output coherence analysis could determine this condition in 5 and 4 subjects, respectively.
Conclusion: The proposed method showed encouraging results for tibial implant loosening detection and future experiments are expected to confirm its diagnostic potential.

P39

Septic arthritis with Abiotrophia defectiva after ACL-reconstruction

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Introduction: This is the first published case of septic arthritis with Abiotrophia defectiva after an ACL-reconstruction. A. defectiva is a member of the nutritionally variant Streptococci and part of the normal human flora. Rarely reported as a causing pathogen, the germ has been reported to cause different infections, most of them being endocarditis and only few septic arthritis. Due to intractable problems in diagnosis and therapy and also poor prognosis, more attention should be drawn to its clinical relevance.
Case Report: A 41-year old woman presented in the regular postoperative control 6 weeks after arthroscopic-assisted ACL-reconstruction with Hamstring-graft with progressive pain and swelling in the operated left knee accompanied by a progressive reduction of the ROM. The intra- and postoperative course went without any noticeable problems. 2 weeks after demission the patient underwent a dental procedure. The symptoms started to progress in the fourth postoperative week. The subsequent physical examination and laboratory studies showed modest clinical symptoms and mild increase of laboratory infection markers. Due to these findings, the patient was treated as septic arthritis, although first microbiological investigations did not provide any causing pathogen in the first days and the first arthroscopic debridement did not show clear signs for an infection. The antibiotical therapy with Co-Amoxicillin did not show any success. After the delayed identification of A. defectiva, Gentamicin was added to the intravenous therapy, which showed good effects on the clinical symptoms and on the laboratory markers. With demission the medication was changed to oral Vancomycin and Rifampicin. The laboratory markers showed further decrease, but the flexion being still limited 3 months after ACL-reconstruction.
Discussion: The case shows the challenging diagnosis and therapy of an infection with A. defectiva, caused by its difficult cultivation and therapy. Causing only mild symptoms and being hardly identified, this bacteria is suggested to be responsible for more cases than reported. As to the cause of the infection, most of the known cases describe a temporal relation of a dental procedure and the infection. Since bacteremia after dental procedures is frequently described, this is one possible source of infection for this case. The therapy in this case has shown good progress so far, but is still not terminated as the patient still suffers under limited mobility.

P40

The Risk of Biconvex Patella Resurfacing in Total Knee Replacement

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Introduction: Resurfacing of the patella in total knee replacement (TKR) is still discussed controversially. Leaving the patella alone and replacing it seem to lead to similar long term results concerning residual pain in deep flexion. Non-replacing has the risk of secondary resurfacing with unpredictable results, whereas resurfacing leads to more complications as fractures or button loosening. This study retrospectively analyses the complication rate of non-resurfaced to resurfaced patellae with the subgroups flat triple pegged and biconvex cemented inlay patella buttons respectively.
Methods: Between December 2006 and May 2011 226 Journey BCS I TKR were implanted by a single surgeon in 191 patients. 124 were women, 67 men with a mean age at surgery of 68 years (range 41 to 85 years). 62 patellae were left alone, 164 (72.6%) were resurfaced with inlay buttons. 68 times a biconvex patella was used, in 96 knees a resurfacing button with flat and three pegged base. Preparation was performed with a guided reamer in all cases (inlay technique). All patella complications till February 2013 were recorded.
Results: The average implantation time was 4.0 years (1.8–6.3 years). Two patellae in the non-resurfaced group (2/62: 3.2%) had to be replaced secondary 9 and 14 months after the primary intervention. In the resurfacing group with flat triple pegged implant (n = 96) no complication was registered. In the group with biconvex patella button (n = 68) one case developed a necrosis of the patella without detectable reason one year after the index surgery with loosening of the button. In three further cases (4.4%) the biconvex button dislocated 9, 11 and 36 months postoperatively without trauma and had to be replaced by a classical resurfacing button.
Conclusion: Weakness of the study is the fact that the selection for the three patella groups was not randomized but decided individually. Even then the complication and revision rates for the three groups varied remarkably. Even when excluding the unclear necrosis of the patella with secondary loosening of a biconvex button this button type was responsible for three major revisions. A reason for this complication could be the excentric load of the patella due to bending and/or tilting forces leading to wobbling out the button of the bony bed. This specific biconvex patella button should not be used in primary TKR anymore, which counts even more in revision TKR where the bone bed is less congruent.

P41

The Salvage of Massive Talar Bone Stock Loss with a Custom Designed Talar Component in Revisional Total Ankle Replacement

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Introduction: A failed total ankle replacement is often associated with a significant bone loss, particularly after subsidence of the talar component. As an alternative to a fusion with the use of an allograft, the surgeon may also consider a custom made talar component that is placed on calcaneal bone to compensate for the loss of bone. While only a few cases were reported in the literature mainly with regard to the feasibility, nothing is known about mid- to long-term behaviour of such bulky implants. The purpose of this study was to assess the functional and radiological outcome after the use of a custom made talar component in a consecutive series of 13 patients at mid- to long-term.
Methods: 13 patients (females, 5; males, 8; mean age of 54 [36–77] years) were treated with a custom made component for a large talar defect after failed total ankle replacement (n = 12 [STAR, 7; Hintegra; 4, MOBILITY,1]) or after avascular necrosis of the talar body (n = 1). The custom made component was calculated on base of standard X-rays (as compared with the contralateral side) and CT scan. After a stable situation of talar head to calcaneus was achieved by screw fixation to get the anterior tibiotalar joint fused, the component was inserted and placed to the calcaneal body. For tibial side, a standard component was used. The usual clinical parameters and standard X-rays were u sed for follow-up controls.
Results: There was a major complication in one patient after a superficial wound healing problem which progressed and resulted in a deep infection. It was finally treated by a fusion. At a follow-up of 5.3 (1–11) years, all other 12 ankles were stable and showed no radiologic signs of loosening. The mean range of motion at last follow-up was 23° (15°–42°). 10 patients (83%) were satisfied/highly satisfied with the obtained result, and 2 patients (17%) were satisfied with reservation.
Conclusion: The use of a custom made talar component to compensate for a major loss of bone stock yielded satisfactory results with regard to functional result and stability at mid- to long-term. Despite the increased size of implants, load transfer and created shear forces between bone implant interface remained obviously within physiological norm. Obtained mid- to long-term results and the high level of patient satisfaction encourage continuing revisional TAR with custom designed talar components as an alternative to ankle arthrodesis.

P42

Subjective vs. Objective Assessment in Early Clinical Outcome of Modified Lapidus Procedure for Moderate to Severe Hallux Valgus Deformity

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Introduction: Most studies assessing the outcome of hallux valgus (HV) surgeries based on subjective questionnaires (AOFAS-Score) report a score of >80% at 6 month post operatively. Our study aims to assess modified Lapidus surgery 6 months postoperatively with objective gait assessment (GA) methods to determine if biomechanical improvement effectively correlates with this excellent AOFAS score and the radiological results.
Method: 10 feet from 10 healthy volunteers and 10 HV feet from 9 patients listed for modified Lapidus correction were included. These HV patients were followed at 6 months postoperatively. GA was performed using pressure insoles (Pedar-X, novel, DE) and 3D inertial sensors (Physilog, BioAGM, CH). Spatiotemporal (STP), kinematic and plantar pressure parameters (PPP) were assessed. Clinical assessment includes AOFAS, FAAM, and radiographic results. Inter and intra subject comparisons were made ($p < 0.05$).
Results: Compared to controls, HV group showed gait deviation in STP, kinematic and PPP as seen in previous gait studies. Postop vs Preop: STP results showed no improvement in most parameters compared to preop with the reportedly longer foot-flat and shorter push-off in the stance phase and reduced toe-off pitch angle ($p < 0.05$). Kinematis: hallux mobility was reduced significantly compared to preop while the sagittal plane movement at midtarsal and ankle joints was increased. PPP: The hind foot, mid foot and lateral forefoot showed increased while hallux showed reduced contact duration postoperatively ($p < 0.05$). Max force and max pressure was seen to be reduced in both hallux and lateral toe regions compare to both controls and preop results.
Gait results showed existing gait defects 6 months after modified Lapidus, while AOFAS and radiographic results still showed significant improvement. FAAM (preop 73.46 (19)/ postop 74.46 (11.79), $p = 0.59$), AOFAS (preop 43.37 (8.78)/ postop 83.7 (13.12), $p = 0.01$), Intermetatarsal angle (preop 15.8 (2.1) / postop 5.3 (2.7), $p = 0.005$), Hallux valgus angle (preop 31 (5.6)/ postop 10.4 (7.3), $p = 0.005$).
Conclusion: Our study supports objective GA for a more accurate clinical presentation of the condition at follow up. FAAM should be preferred over AOFAS for follow up of HV surgeries. Study reports a longer recovery period after modified Lapidus and aims to follow these patients for a long term outcome.

P43

Non-operative treatment of acute ruptures of the achilles tendon

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Treatment of acute traumatic rupture of the Achilles tendon can be operative or non-operative. The main difference is the nature of the early complications – more re-ruptures versus wound infection and nerve lesions – while the ultimate function and patient satisfaction are equivalent. We present the results of a standard non-operative treatment protocol prospectively evaluated over 16 years.
171 patients were enrolled. An equinus ankle cast (6 weeks) and a boot (12 weeks) were used, with immediate full weightbearing and calf muscle training. Follow up visits were scheduled at 2, 4 and 6 weeks, then at 3, 6 and 12 months. At the latest visit patients were interviewed regarding subjective parameters such as pain, meteosensitivity, loss of strength, return to previous activity level and general satisfaction with the treatment outcome. Clinical assessment included plantar flexion strength and endurance, calf circumference and tendon length. Subjective and clinical parameters were then used to calculate a modified Thermann score.
Of the 171 patients, 8 were operated within two weeks after trauma because of inadequate early tendon healing. Of the remaining 163 patients, 5 were lost before the 3 months follow up and 8 had re-ruptures until then. At one year another 27 patients were lost to follow-up. 131 patients at 12 months follow-up, 17 not participating in functional testing. Additionaly 3 re-ruptures occured: in total 11 re-ruptures (mean 9 ± SD 4, range 5-18 weeks after trauma) eight with an adequate trauma and three without. Re-rupture rate at 3 months was 5.1%, at 1 year 8.4%.
114 patients reached a minimum follow-up of 12 months (mean 27 ± SD 20, range 12–88). The mean Thermann score was 84.5 ± 12.6 (41–100) points and subjective satisfaction was rated “very good” and “good” in 89.5%. General complications were deep venous thrombosis (5) and CRPS I (1), minor problems were transient heel pain (3), skin abrasion in the cast (4), transient numbness (1).
In conclusion the re-rupture rate is higher in non-operative treatment while the total complication rate is lower. Ultimate function and patient satisfaction are equivalent to operative treatment. There was a positive inverse correlation between tendon length and muscle strength. Our protocol of non-operative treatment with immediate rehabilitation is a valuable and safe option for acute ruptures of the achilles tendon.

P44

Fixed and mobile bearing total ankle prostheses: a comparative numerical study

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Introduction: Two major kind of ankle prosthesis exist, including those with a fixed and those with a mobile bearing insert. The goal of this paper is to compare these two prostheses through a validated numerical model [1] and evaluate the tibial bone strain and interfacial shear stress under an axial compression.
Method: Two finite element model of three component ankle prosthesis were developed: one with a fixed and one with a mobile-bearing insert. An axial compression of 3’750 N (5 times body weight of 75 kg) was imposed to the fixed, mobile centered and mobile excentered (anterior position of 3.68 mm [2]) models. The octahedral shear strain in bone and the shear stress at bone-implant interface were studied to quantify a difference between the two implants.
Results: The bone octahedral shear strain was maximal around the implant keel. A smaller bone volume fraction of octahedral shear strain over 0.5% was observed in the fixed model compared to mobile-bearing model. The bone surface fraction of shear stress over 3 MPa was 30% smaller in the fixed case compared to the excentric position. The octahedral shear strain over the line defined before showed two peaks of strains. The biggest peak was posterior for the centered cases and anterior for the excentered model. The average was around 0.5% for the three models. Thus, the excentration of the insert just shifted the peak. All three models exceeded 1% of octahedral shear strain. In the cortical bone, the maximal value for octahedral shear strain was 1.82% for the mobile excentred and around 1.15% for the two centered models. However, the maximal value in the trabecular bone was 1.46% for the mobile excentered, 1.85% for the mobile centred and 1.58% for the fixed model.

Conclusion: The excentered position tend to shift the strains but not to decrease them. We concluded that, even if slight differences are observed between fixed and mobile bearing inserts, it is not enough to put forward the superiority of one of these implants regarding their reaction to axial compression. The present study can be used for further applications like improving implant designs and fixation.

P45

Outcome of displaced distal tibial metaphyseal fractures in children between six and fifteen years of age treated by elastic stable intramedullary nails

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Introduction: Displaced closed fracture of the distal metaphysis of the tibia in children traited with elastic stable intramedullary nails.
Methods: From June 1995 to August 2012, 18 children were treated surgically using elastic stable intramedullary nails for displaced closed fractures of the distal metaphysis of the tibia. The patients were followed radiographically and clinically on a regular basis until union was clinically and radiographically achieved.
Results: Thirteen boys and five girls with a mean age at trauma of 11 ± 2.9 years (range: 6 to 15) were included in the study. Radiographically, all fractures healed without evidence of delayed union, re-fracture, hardware migration. All patients were pain free at last follow up and all regained full, normal activities including sports.
Conclusions: We proposed a treatment with stable intramedullary nails for thoses fractures that is not common but in our experience it's a good option with excellent clinical results.

P46

Panton-Valentine Leucocidin in Staphylococcus aureus muskuloskeletal infections in children: report of three cases and review of the literature

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CHUV

Introduction: Staphylococcus Aureus (SA) strains producing Panton Valentine (PVL) Leucocidin are associated with particularly severe clinical features, including necrotizing pneumoniae, soft tissues and osteoarticular infections. During the last decade, there has been a worldwide increase of PVL positive (+) SA osteomyelitis.
Method: We present the cases of three consecutive pediatric patients treated in our institution for PVL + SA osteomyelitis between 2010 and 2013. Demographics, clinical features, laboratory values, radiographic findings and treatments are reported.
Results: 3 male patients sustained PVL + SA osteoarticular infection. Mean age was 12.3 years (10–15), and mean follow up 1.5 years (0.5–3). Two patients had furuncle history; one was 6 weeks post pre-B leukemia treatment. Symptoms duration at presentation were 5.6 days (4–8). Affected joints were knee in two patients and shoulder in one patient. All had osteomyelitis with subperiosteal abscess and articular involvement. All patients had severe inflammatory status at presentation with severe local pain, temperature superior than 40°C, and CRP above 100 mg/l. White blood cell count was normal in two cases and 17 G/L in one case. Standard initial x-rays were normal, MRI showed large osseous involvement with subperiosteal abscess in all cases. Pejoration of clinical status despite sensitive antibiotherapy with CRP superior of 250 mg/L, a mean of 2.6 (1–4) repeated surgical drainages and osteotomies were necessary. When we had a high index of suspicion or a confirmed PVL + SA infection, clindamycin was associated to the initial beta-lactamase and/or glycopeptid antibiotic treatment. We had no secondary visceral involvement. Mean hospitalization stay was 40 days (14–56) Late complications are one distal femoral hemiepiphysiodesis, one pathological humeral fracture and one chronic osteomyelitis necessitating a surgical procedure.
Conclusion: Potentially lethal osteoarticular infections caused by PVL + SA strains are associated with rapid severe local and greater systemic inflammatory response necessitating prompt treatment, including long duration parenteral antibiotherapy associated with several surgical procedures. Antibiotics should associate a bacterial protein synthesis inhibitor with betalactames and/or glycopeptids. Severe pain, high inflammatory response, normal or low white blood cell should prompt the suspicion and treatment of PVL + SA osteoarticular infections.

P47

Cartilage matrix infection in children younger than 4 years old by Kingella kingae

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Introduction: Kingella kingae is nowadays considered as the leading bacterial cause of osteoarticular infection (OAI) in children aged less than 4 years. OAI due to K. kingae may present as arthritis, osteomyelitis, osteoarthritis, spondylodiscitis, or even as dactylitis. We report here a new form of osteoarticular lesion due to K. kingae where the infection affects the non-ossified bony structures, causing thus real chondritis.
Methods: Medical charts of 3 children presenting with cartilage matrix infections were analysed.
Results: 3 children were brought to the emergency department complaining of limping or refusal of weight bearing. At the admission, all children were afebrile. Conventional X-Rays showed no bony structure involvement, whereas MRI revealed the OAI: for the first child an abscess of the first cuneiform bone, for the second child an abscess of the right non-ossified greater trochanter and for the third child an erosion into the distal non-ossified fibular epiphysis. The diagnosis of K. kingae OAI was established since PCR assays specific for this microorganism were positive in cartilage's abscess aspiration samples. All children had an uneventful recovery after antibiotic treatment.
Conclusions: infections due to K. kingae may affect non-ossified bony structures, and cause real chondritis which is more difficult to diagnose. Pediatricians must keep in mind this unusual but specific manifestation of OAI due to K. kingae, and this especially when dealing with very young children.

P48

Outcome of two-stage exchange with short (≤6 weeks) vs. long (>6 weeks) prosthesis-free interval

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Backround: Prosthetic joint infection (PJI) leads to high morbidity and long term treatment. We evaluated the outcome of two-stage exchange with short (≤6 weeks) and long (>6 weeks) interval.
Methods: All the patients hospitalized in CHUV for a PJI were included during the period between 1999 to 2012. PJI was defined as growth of the same microorganism in ≥2 tissue or synovial fluid culture, visible purulence, sinus tract or acute inflammation on tissue histopathology. Outcome analysis was performed at outpatient visits, followed by contacting patients, their relatives and/or treating physicians afterwards.
Results: 123 patients (88 THA and 35 TKA) with infected PJI treated by two-stage exchange were identified. The median age was 65 years (range: 19–102y); 44.7% were women. The median hospital's stay was 72.7 days (range: 11–361). The patients were followed for a mean of 14,7 months (range: 0.7–201). 5 patients were excluded of this study. The main reason of joint replacement was osteoarthritis (n = 98), followed by trauma (12), rheumatoid arthritis (6), hip dysplasia (3), aspeptic necrosis (2), and others (one tuberculosis and one tumor). 8 infections were diagnosed as early (≤3 months), 30 as delayed (4–24 months) and 85 as late (≥24 months).
118 patiens were included in the study, 54 with short intervals (≤6 weeks/less 50 days) and 64 with long intervals (≥6 weeks/ more 50 days). In the short interval group, three patients had one or more operation to eradicate persistent infection and one had to be reoperated due spacer's dislocation. In the long one, 7 patients needed additional operation; 4 for persisting infection and 3 for mechanical reason. The microbial outcome is good for all the patients, but the functional remained unsatisfactory for 4.2% (due to persistant pain or impaired mobility due to spacer, amputation or Girdlestone).
Conclusion: the short or long intervals have the same result for mechanical and infectious outcome. These intervals have to be adopt according to bacteria's type, infection type and patient's comorobidities.

P49

Case report of a chronic Clostridium difficile infection after internal fixation of a proximal femur fracture – The therapeutic challenge of sporulating bacteria

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Introduction: Bone and joint infections caused by Clostridium are rarely seen, especially involving C. difficile. We present a case of C. difficile infection after internal fixation of the proximal femur and discuss the therapeutic challenges caused by these sporulating bacteria.
Methods: This is a case report with description of a single case and discussion of the diagnostic and therapeutic challenges.
Results: A 79 years-old male with a history of an active polycythemia vera sustained in August 2010 a trochanteric fracture of his left femur. Internal fixation with a trochanteric nail was performed urgently in another hospital. A postoperative massive hematoma caused by a lesion of the lateral femoral circumflex artery was treated by embolization. Four months later, the patient was referred to Vascular Surgery because of a painless mass of the thigh, corresponding to an encapsulated hematoma, which was drained. As biopsies identified C. glycolicum, an antibiotic treatment with initially piperacillin/tazobactam iv, relayed by amoxicillin/clavulanate orally, was given for 3 months. However no extensive debridement and no revision of the proximal femur were performed.
It was only two and half years later that the patient was referred to Orthopedic Surgery as he had developed recurrence of the abscess. As the fracture had consolidated, the nail was removed, the abscess thoroughly debrided and the dead space filled with CaSO4-beads with vancomycin. Microbiological samples identified C. difficile possibly associated with P. acnes. Under systemic antibiotic treatment with amoxicillin/clavulanatate, initially iv with oral relay, evolution was good, except that a large seroma had to be drained surgically after 3 months. Now 6 months after the end of systemic antibiotics, there are no signs of relapse.
Conclusion: Clostridium osteomyelitis is very rare. In this case, it probably was only caused by C. difficile, the former identification of C. glycolicum in 2010 through phenotypical APIE tests being less reliable than MALDI-TOF used in 2013. In terms of treatment, possible sporulation of these bacteria may be a therapeutic challenge. Considering risks and benefits in this particular patient, we opted for a 6 months therapy in order to eradicate persisters reverting from spores. As this happens only in anaerobic environment, it might well be that longer treatment periods could be necessary.

P50

What are the 'costs' to detect metastases from soft tissue sarcomas, that could be treated successfully

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Rationale: We wish to bring some data about the expenses generated to detect metastases from soft tissue sarcomas, that could be treated successfully curative.
Materials and methods: Patients: From July 2008 until July 2013 our team has treated 49 patients with soft tissue sarcomas (myxoid liposarcoma 8, liposarcoma 5, synovial sarcoma 3, other types of high grade sarcoma 22) without synchronous metastases, mean f/u is 2.5 years. Part of these patients were referred after incidental contaminated resections.
For systemic follow-up all patients got Thorax-CT at maximally 6month-intervals.
Results: Only one patient had a local recurrence with a well differentiated 2.5 kg liposarcoma of sclerosing type of the ischiocrural muscle group 2 years following a R1 resection; local recurrence was resected following adjuvant radiotherapy, at present no metastases. None of the other 48 patients with definitive R0-resections developed local recurrence, but five developed metastases (lung, soft tissue distant to the primary site, cerebral) at 2 to 14 months after definitive local treatment of the primary tumor. 2 patients had thoracotomies for wedge resections, the other appeared not amenable to surgery. 4 of these patients died between 1 and 2 years after treatment of the primary tumor. One patient, now 78 years old, appears diseasefree 27 months after the primary treatment and 17 months after metastasectomy. 2 patients died from problems unrelated to their tumors.
Conclusions: The overall result shows a high rate of healing of the primary tumor following R0 resections. One of the 5 patients developing metastases appears DF at a mid-term interval. To achieve this curative result roughly all 49 patients had a total of more than 250 CT-scans over the period of observation.
We interpret this as a contribution of those patients, who remained diseasefre or with unsuccessful treatment of their metastases to the one appearing to have definitely profited from careful systematic follow-up studies on all patients.

P51

Reconstruction of the femur with the MUTARS® intramedullary system

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Rationale: In cases of severe bone loss of the femur due to tumor or following repeated revisions not allowing for bony fixation of knee or hip endoprostheses or both, one option is the MUTARS® intramedullary reconstruction system allowing for a stable fixation between a hip and knee reconstruction system.
As this is a rare situation we want to present 2 cases thus treated as salvage procedures.
Patients and methods
Patient 1: L.M., female, *1931: At age 79 years following several revisions the patient had loose hip and knee replacements on the left side. Severe bone loss appeared to prevent fixation of a new femoral stem. It was therefore chosen to reconstruct with the MUTARS® intramedullary system replacing the hip and knee joint connected with the intramedullary rod leaving the femoral diaphysis with the muscle attachments.
Patient 2: Y.E., female, *1966: At age 28 years she was treated for a systemic Non-Hodgkin lymphoma with systemic chemotherapy; recurrencies were treated 2003 and 2009 with chemotherapy, total body irradiation and allogenic bone marrow transplantation. 2009 uncemented hip replacement was performed for femoral head necrosis. In 2012 a bioptically proven local recurrence in the ipsilateral distal femur was treated with local irradiation with 30 Gy. In 2013 a large recurrence filling the distal femur from the knee joint up to 4 cm distal to the femoral stem of the hip endoprosthesis with thinning of the femur and threatened fracture was detected. Curative resection of the distal femur appeared possible, but the bone left below the femoral stem component was too short for fixation of a tumor replacement prosthesis. It was therefore opted to resect the tumor bearing femur, removing the femoral stem component of the hip prosthesis and replacing both by using the MUTARS® intramedullary replacement.
Results: The 2 patients regained full weight bearing and walking without the need for additional support at 4 years and 6 months follow-up time.
Conclusions: Intramedullary connection of a hip and knee replacement system is an option, if there is insufficient bone stock for stable fixation of a hip as well as a knee replacement system.

P52

Preliminary results of cryoablation in the management of locoregional recurrence of chordomas

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Background: Chordoma is a low grade malignant bone tumor of the spinal column, with a predilection for sacrum or skull base. Wide resection remains the mainstay of treatment. While distant metastases are rare, this radio- and chemoresistant tumor has a high rate of local recurrence after resection. Patients usually die after a long course from loco-regional complication related to tumor progression.
Cryoablation is a minimally invasive procedure consisting in freezing (–40°C) lesions under CT/US control. The purpose of this study is to evaluate our experience with cryoablation for local recurrences of chordoma.
Methods: Four patients with locoregional recurrent sacral chordoma treated with cryoablation were retrospectively reviewed.
Local control was assessed with CT and MRI. Pain was evaluated from medical charts before, immediately after the procedure and at every oncologic medical visit.
Results: No patient suffered from complications related to the procedure. Median follow-up was 10 month (4–21). All patients remained alive. However, one patient had stable disease at last radiological examination, whereas three were in progress after initial stability. Three out of four patients reported significant pain reduction immediately after intervention (24–48h), persisting at further evaluations.
Conclusion: Cryoablation may be a valuable modality in the palliative management of sacral chordoma. More studies are necessary to better define the indication for this treatment and to evaluate its role in local control of the progressive disease.

P53

Resection of the distal fibula – is reconstruction required in any case?

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Introduction: Reconstructive surgery for ankle instability is frequently performed, most often in chronic lateral ligament instability. Most techniques focus on reconstruction with repair or reconstruction with either tendon autograft or allograft. After tumor resection of the distal fibula the methods for reconstruction remain controversial.
Method: (= Case report) We present a 31 year-old male electrician who had a high grade telangiectatic osteosarcoma of the left distal fibula. The diagnosis was confirmed with a biopsy, two months after he detected an indolent swelling of the left lateral ankle region. A staging was performed and no suspect lesions for metastases were found. After discussing the case at an inter-disciplinary sarcoma board, neo-adjuvant chemotherapy were administered. Three months after biopsy the distal fibula with the tumor was finally resected. Preoperatively we discussed surgical options in detail with the patient who has high physical demands. We opted for the resection of the left distal fibula and reconstruction of the remaining soft tissues, but with postoperative immobilization in a non-weightbearing cast for six weeks and further mobilization in a stabilizing shoe for about three months. The surgical margins were free of tumor and the peroneal tendons could be preserved. Postoperatively, the patient received adjuvant chemotherapy. The patient was made aware that in case of ankle instability, arthrodesis may needed to be taken into account.
Results: At the latest follow-up 26 months postoperatively the patient is satisfied with the result, had an adequate ROM and no signs of instability, and moves without problems even on uneven grounds. Radiographically, there were no signs of osteoarthritis.
Discussion: Satisfactory ankle stability with normal ROM is possible even in a case after resection of the distal fibula without reconstruction. Use of allograft, or transposition of the fibula to reconstruct the lateral malleolus may not be always necessary.

P54

TYPE III INTERNAL HEMIPELVECTOMY OF THE OS PUBIS AND THE ANTERIOR INFERIOR INTRAARTICULAR PART OF THE ACETABULUM FOR SPINDLE-CELL/SCLEROSING RHABDOMYOSARCOMA

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Introduction: Sclerosing rhabdomyosarcoma is a rare type of rhabdomyosarcoma and occurs mainly in soft tissue of children and young adults, predominantly in the upper extremity and head-neck region. Intraosseous manifestations are extremely rare and possibly arise from metastatic lesions or per continuitatem. We present the 6 month results after right internal hemipelvectomy in a 29 year old male with a large spindle-cell/sclerosing rhabdomyosarcoma.
Methods: A 29-year-old man noticed intermittent severe right-sided groin pain for one year.
On clinical examination there is no tenderness on palpation or neurovascular deficiencies and a normal range of motion of the right hip. Conventional x-rays of the pelvis show an intraosseous tumor in the os pubis with osteolytic and sclerotic areas. The first MRI showed a contrast agent-enhancing process in the os pubis and the acetabulum of unknown etiology. Preoperative workup with transcutaneous needle biopsy showed a spindle-cell/ sclerosing rhabdomyosarcoma. The tumor cells were positive for muscle markers such as Myogenin and Myo D1.
Three cycles of preoperative chemotherapy were performed and regression of the adjacent soft tissue edema but no reduction of tumor mass was seen on the follow-up MRI.
Right type III internal hemipelvectomy with resection of the os pubis and the anterior inferior part of the acetabulum was performed, with the acetabular osteotomy being performed intraarticularly under visualization but without dislocating the hip and thereby sparing the weight bearing zone. Postoperatively the patient received a combined chemotherapy and radiotherapy.
Results: Pathoanatomical analysis confirmed the diagnosis and showed wide tumor margins. At 6 months from the operation the patient shows no local or distant tumor recurrence. He is able to walk normally without instability or pain in the hip joint.
Conclusion: A type III hemipelvectomy including resection of one fourth of the acetabulum (but sparing the weight bearing zone of the acetabulum) and the os pubis can result in good functional outcomes even in young and active patients.

P55

The impact of molecular diagnostics: Dedifferentiated Liposarcoma of the spermatic cord

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Introduction: There are more than 50 different soft tissue sarcomas described up to now. Each one has its own biology. The histological and IHC analyses continue to be the mainstay in the diagnosis of soft tissue sarcomas. However, with the advent of molecular diagnostics, many soft tissue sarcomas become reclassified, and the biology becomes more predictable. Herein, we report a patient who was wrongly diagnosed for years, but thank to modern molecular diagnostics, the biology and outcome can be predicted.
Methods: A 60 year old man had a lump in his scrotal area whereupon the testis was consequently removed. The pathology at that time was read as malignant mesothelioma, no adjuvant treatment was chosen. Six years later, the tumor relapsed locally in the inguinal area. Local preoperative radiation therapy (50 Gy) was performed, and then the tumor was resected together with parts of the superior ramus, but sparing the vessels (R1 resection). The histology at this time was read as "MFH". The patient was followed over years, with local postoperative alterations indistinguishable from local recurrence. Again 7 years later, a seemingly increased soft tissue mass locally was noticed. Because this mass clearly progressed over the following year, an ultrasound-guided biopsy was performed.
Results: RT-PCR and FISH analyses found an amplification of the mdm2 gene, indicating a dedifferentiated liposarcoma of the spermatic cord. At no time there were any metastases defected. The patient underwent a complete local excision with placement of a local pedicled rectus abdominis flap. In retrospective, this has always been the same tumor, but at the time of initial diagnosis the molecular diagnostics tools were not yet available. At two years of follow up, the patient has no pain and no evidence of recurrence.
Conclusions: A dedifferentiated liposarcoma of the spermatic cord can be mistaken for another inguinal soft tissue sarcoma. Molecular diagnostics can clearly identify this biological entity. It is typical for this tumor that it locally recurs but only infrequently metastasizes (20%).

P56

Denosumab, a RANK ligand Inhibitor, leads to Mineralization of an Intracortical Aneurysmal Bone Cyst

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Introduction: The treatment of giant cell tumors of bone mainly involves curettage and bone grafting, despite the fact that it may be at times destructive and put a joint into jeopardy. Recently, the use of Denosumab, a RANK ligand inhibitor was popularized because it leads to a mineralization of the tumor. Giant cell tumors of soft tissues are usually resected, and Denosumab has not been described for this entity. Because we diagnosed a patient with a GCT of soft tissues at a difficult anatomic location, we proceeded to use Denosumab.
Methods: A 20 year old saleswoman noticed a swelling in the proximal forearm particularly over the radial head. An initial biopsy revealed a giant cell tumor of the soft tissues. Because complete excision was not an option because of the relationship to neurovascular structures, we proceeded to treat the patient with Denosumab (6 injections à 120 mg Prolia).
Results: Intraoperatively, the lesion became mineralized such that it could be reected en bloc without compromising neurovascular structures. Surprisingly, the final pathology did not confirm our initial diagnosis of a giant cell tumor of the soft tissues, but an intracortical aneurysmal bone cst.
Conclusions: The efficacy of Denosumab in the setting of an intracortical anyeurysmal bone cyst has not yet been described yet. Interestingly, had the initial diagnosis been correct initially, the patient would not have received this drug and therefore could not have benefited from this desired effect.

P57

Localized Tuberculosis of the Pelvis: The Importance of Early Diagnosis

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Introduction: Bone and soft tissue lesions need to be thoroughly and systematically assessed and staged. Depending on the biology, the treatment not only varies much, but can at times be entirely wrong. Therefore, a team approach is required which involves all necessary subspecialities. Herein, we present a patient with a localized pelvic lesion which turned out to be a rare differential diagnosis for which surgical therapy would be wrong.
Methods: A 42 year old female patient showed up with a history of 4 week long pain in the left pelvis, particularly night pain accompanied by night sweats. NSAR only incompletely relieved this pain. The patient is worried because her mother died of cancer. Imaging showed a lytic lesion in the acetabulum and ilium, with accompanying soft tissue extension. Staging did not reveal any other lesion neither in the skeleton nor in the chest. A CT-guided biopsy was performed.
Results: There were no tumor cells found, however, a Ziehl-Neelsen staining revealed a localized tuberculosis. Anti tuberculo-static therapy was initiated. There was a prolonged drainage through the biopsy site, undermining the importance of being prohibitive towards a surgical intervention in such cases.
Conclusions: Localized tuberculosis of the pelvis is a rare finding. Any skeletal lesion needs to be carefully approached and characterized to avoid treatment associated complications and dismal consequences. A thorough biological characterization of a lesion is mandatory before initiation of any treatment.

P58

Extraarticular Resections for Tumour Involvement of Major Joints

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Introduction: Tumor involvement of major joints of the body can have detrimental implications. Not rarely, these situations may end up in amputations, or in intralesional resections, or resulting in important functional deficits. There are only a few reports dealing with the management of extraarticular resections of major joint of the body.
Methods: We provide an overview of surgical details and function after complete resection of the shoulder, elbow, hip, knee and ankle joints.
Results: The shoulder joint can be completely resected when the joint capsule can be safely separated from the rotator cuff superiorly, inferiorly with the extension of the axillary pouch, as well as medially with the extension underneath the subscapular muscle. The scapular osteotomy can be achieved laterally of the coracoid process. This leaves the option for arthrodesis or inserting a prosthetic spacer. At the elbow, total joint resection often involves major vessels and nerves, which need to be reconstructed, often accompanied by free tissue transfer together with a total elbow prosthesis. The hip joint can be completely resected with a periacetabular osteotomy. The defect is reconstructed either with an allograft or by creating a pseudarthrosis. The knee joint can be completely resected while preserving the extensor mechanism. The difficulty is to separate the capsule from the retinaculum at the level of the patella, as well as performing the osteotomies of the patella and the proximal tibia to stay outside the capsule. The ankle joint is technically less difficult to remove, however, the feasibility is given by the local extent of the tumor involving neurovascular structure or not.
Conclusion: The technical knowledge of surgically removing major joints of the body because of tumour involvement is critical. If correctly performed, the resulting function is comparable to intraarticular resections.

P59

HOW TO IMPROVE PREOPERATIVE RADIOTHERAPY IN THE TREATMENT OF SOFT-TISSUE SARCOMA

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Introduction: Soft-tissue sarcoma (STS) is treated by a combination of radiotherapy (RT) and surgery. Preoperative RT may have better results concerning functional outcome by reducing late radiation morbidities than postoperative RT alhough wound complications were shown to be significantly increased with preoperative RT. The purpose of this study was to identify risk factors for wound complications (WC) in patients treated with preoperative radiotherapy.
Methods: In this retrospective study a total of 64 patients treated with preoperative RT before resection of a STS between 2002 and 2012 were evaluated for wound complications. 4 patients underwent neoadjuvant and 4 patients underwent adjuvant chemotherapy (CT). 9 patients underwent conventional RT (CRT), 45 3D-conformal RT (3D-cRT) and 10 Intensity-modulated RT (IG-IMRT). The mean dosage applied was 50.2 Gy (24–64). 28 patients were additionally treated with the flab method RT for maximum dose build-up to the skin. All operations were performed by two surgeons (Group A and B). The postoperative WC were monitored in terms of the necessity of surgical revision.
Results: Uneventful primary wound closure was observed in 42 (66%) patients, while 4 (6%) had secondary wound healing and 5 (8%) were treated with VAC-therapy. A total of 18 (28%) patients needed additional surgery. No significant differences concerning revision surgery were observed comparing the different RT techniques.Patients that needed additional surgery had a insignificantly ($p = 0.1$) higher mean planning target volume (PTV) of 2589cc, compared to 1633cc.3 of 4 patients undergoing neoadjuvant CT needed additional surgery (2 VAC removal, 1 WC). No WC was observed in 4 patients undergoing adjuvant CT. In the flab group, 3 of 28 needed additional surgery which was significantly ($p = 0.01$) less then in the group which had no flab therapy (15/36). In group A, 16/27 patients needed additional surgery which was significantly ($p = 0.0001$) more then in group B (2/37).
Conclusion: Overall WC in our series was 28%. We observed significantly less WC in patients who underwent flab therapy indicating that increased RT dosage does not lead to increased WC.Significantly less WC were however observed in group B which might show that surgical management is an important parameter regarding WC. In our series PTV was higher in the revision group, although a significant difference was not achieved.

P60

Meta-Analysis on Biomechanical Properties of Meniscus Repairs. Are Devices better than Sutures?

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Introduction: Meniscal repair devices have been extensively tested during the past decades as reported in the literature. Reviewing the different meniscal repair devices and sutures with their respective biomechanical properties.
Methods: For this meta-analysis, we conducted a systematic online search using PubMed, EMBASE, CCTR, and CINAHL using the search terms “Meniscus OR Meniscal AND Biomechanics AND Repair). Load-to-failure (LtF), stiffness, and cyclic outcome measures were extracted independently and in duplicate. The systematic search revealed 841 manuscripts in total. After exclusion of duplicates and irrelevant publications, 41 studies remained for final analysis. The studies were published in English and German from 1995 to 2013. Due to differing cyclic force protocols, cyclic outcomes had to be excluded.
Results: Overall, sutures had a higher load-to-failure (suture: 87.7 ± 0.3N (weighted mean ± standard error), device: 56.3 ± 0.1N) and stiffness (suture: 8.9 ± 0.1 N/mm, device: 8.6 ± 0.04N/mm) than devices, both $p < 0.05$. In LfT testing, PDS 0 Vertical (145.0 ± 8.1 N), OrthoCord 2-0 (143.6 ± 11.3 N) and Ethibond No 0 Vertical (133.4 ± 7.7 N) were the strongest sutures and Meniscal Viper (140.9 ± 5.1 N), MaxFire Vertical (136.2 ± 11.3 N) and FasT-Fix Vertical (115.2 ± 1.6 N) were the strongest devices. Second-generation devices were significantly stronger and stiffer than first-generation devices ($p < 0.001$).
Conclusions: Suture repair remains the gold standard with a vertically oriented suture configuration showing superior load-to-failure values compared to a horizontal configuration. Nevertheless, some meniscal repair devices have similar biomechanical properties to suture repairs. Both suture repairs and devices have a place in meniscal restoration.

P61

IN VIVO GLENOHUMERAL TRANSLATION UNDER EXTERNAL LOADING IN AN OPEN-MRI SETUP

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Introduction: The evaluation of the glenohumeral joint (GHJ) laxity requires an accurate estimate of the joint translations (linear displacements of the humeral head center (HHC) with respect to the glenoid) resulting from shoulder movements and/or external forces applied. To the authors' knowledge, several studies have been conducted to estimate GHJ translations in vivo but data under loading conditions has not been collected yet. The aim of this study was to develop a non invasive methodology based on magnetic resonance

imaging for the in vivo evaluation of the GHJ translations due to a force applied anteriorly.
Methods: Thirteen asymptomatic shoulders were acquired using a horizontal open magnetic resonance scanner. Recordings were made with the subjects in the supine position both at 15 deg and 90 deg of arm abduction with and without an anterior force of 20 N applied to the humerus.
Results: When no load was applied, from 15 deg to 90 deg of arm abduction, the HHC moved, both in the anterior (1.6 ± 1.3 mm) and superior (1.9 ± 1.3 mm) direction while smaller displacements were observed in the medio-lateral direction (0.3 ± 0.7 mm). Under the application of the anterior force the HHC moved with respect to the glenoid 1.7 ± 1.3 mm and 1.3 ± 0.7 mm at 15 deg and 90 deg of arm abduction, respectively. The level of precision associated to the GHJ translation estimates was estimated to be less than 0.33 mm along all directions i.e. one order of magnitude smaller than the relevant translations.
Conclusions: This novel system of measuring glenohumeral translations in-vivo is capable of adequately measuring translations occuring with an anteriorly load on the humerus in healthy subjects.

P62

Lentivirus mediated VEGF gene transfer enhances human muscle derived stem cells survival and proliferation after transplantation in a strain-injured muscle

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Introduction: Muscle strain injuries occur very frequently in sports medicine and pose challenging problems in traumatology. A number of factors including fibrosis development, impaired regeneration and limited angiogenesis may participate to this compromised tissue healing. In the present study, we explored the potential benefit of VEGF expression in the survival, proliferation and regeneration capacity of human muscle derived stem cells (MDSC) transplanted in injured mice skeletal muscle.
Methods: Procedures undertaken with human tissue and mice were in compliance with national and international guidelines. Human muscle samples were obtained during corrective orthopedic surgery of patients without any known neuromuscular disease. After enzymatic digestion of muscle biopsies, the fractions of hMDSC that express pericyte markers (CD146) or co-express myogenic (CD56) and endothelial cell markers (CD34, CD144) were isolated by flow cytometry. After infection with two lentiviral vectors encoding respectively the Renilla luciferase bioluminescence marker gene (Rluc) and the human VEGF165 (VEGF), hMDSC were injected in gastrocnemius muscles of immunodeficient mice, 4 days after muscle injuries. Cell survival and cell proliferation was assessed at various time post injection using non-invasive bioluminescent techniques.
Results: We isolated human MPC, defined as CD45-/CD56+/CD146+/CD34-/CD144- cells and human pericytes, defined as CD45-/CD56-/CD146+/CD34-/CD144- cells. They represent respectively, 56.5 ± 4% and 4.1 ± 1.3% of the analyzed population. After lentiviral infection, 85% of the cells expressed VEGF and/or Rluc transgenes. Transduced MPC and pericytes kept their myogenic properties to proliferate and to form myotubes in vitro, with fusion indexes respectively of 85% and 15%. By imaging luciferase activity up to one-month post injection, quantitative analyses showed that VEGF-pericytes and VEGF-MPC proliferate early after injection, with a fourfold and a twofold increase as compared to control cells.
Conclusions: VEGF expression improves significantly hMDSC survival and proliferation after transplantation in injured muscle. The effect of VEGF-expressing cells on the modulation of angiogenesis, muscle regeneration and fibrosis is currently under investigation. With further development, this approach could lead to the development of novel therapeutic options for promoting the healing of skeletal muscle after any injury.

P63

Worse prognosis in osteosarcoma patients expressing IGF-1 in a tissue microarray

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Introduction: Currently, it is not possible to define OS patients at greatest risk for short survival times. Valuable tumor biomarkers for OS remain barely studied. Insulin-growth factor-1 (IGF-1) has been controversially discussed as a tumor biomarker for OS, but has not been studied as an indicator of prognosis so far. A valuable tool to investigate tumor biomarkers in a large number of tissue samples is a tissue microarray (TMA). Our goal was the investigation of IGF-1 in regard to patient demographics and survival time in OS patients using a TMA.
Materials and methods: Tumor tissue specimens from surgical primary tumor resections were collected from bone tissue of 67 patients with OS. A TMA was set up and sections were stained with anti-IGF-1. Grading was performed in a semi-quantitative manner by two independent investigators who were blinded to clinical information. Kaplan-Meier curves were used to calculate overall patient survival and the log-rank test assessed statistical differences between groups.
Results: We analyzed immunohistochemical expression of IGF-1 in a human OS TMA. Follow up data was available for every patient and the mean clinical follow up time was 98 (range 7 to 213) months. The overall 5-ysr was 73%. Twenty-two (33%) patients stained negatively and 44 (66%) patients stained positively for IGF-1. Kaplan-Meier survival analysis did not show significant differences between groups stratified for gender ($p = .808$) or tumor type ($p = .345$). Significantly shorter survival was seen in patients ≥40 years ($p = .003$), axial tumors ($p = .0008$), local recurrence of the tumor ($p < .0001$), non-responders to chemotherapy ($p = .0007$) and metastasis ($p < .0001$). Significantly shorter survival was also detected with expression of IGF-1 ($p = .007$). The 5-ysr for patients expressing IGF-1 was 63% compared to 92% in patients without expression of IGF-1. Non-responders to chemotherapy, who stained positively for IGF-1 manifested a significantly ($p = .002$) shorter survival. The shortest survival time of 50 ± 10 months ($p < .0001$) was found in patients with metastasis and expression of IGF-1.
Conclusion: OS patients ≥40 years, axial tumor location, non-responders to chemotherapy, local recurrence, metastasis and expression of IGF-1 in primary tumor tissue are prone to significantly shorter survival times. Expression of IGF-1 in primary tumor tissue appears to significantly affect the aggressiveness of OSs and may predict survival time, irrespective of the presence of metastasis.

P64

Intraarterial cisplatin-based chemotherapy in an osteosarcoma xenograft model

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Introduction: Osteosarcoma (OS) is the most common malignant cancer of bone among adolescents with five-year-survival rates of approximately 60%, despite the application of multi-drug chemotherapy. In contrast to standard systemic intravenous (IV) application of highly cytotoxic drugs such as cisplatin (CDDP), intraarterial (IA) chemotherapy allows the delivery of higher drug loads to the tumor. Thus, it can potentially improve treatment efficacy (e.g. reduce metastasis) and reduce side effects such as nephrotoxicity. In order to compare the efficacies of IV and IA chemotherapy under controlled conditions, we first sought to determine an effective concentration of IA CDDP in two pilot studies first.
Methods: OS was induced in an orthotopic xenograft mouse model using 143B OS cells stably transduced with mCherry. Tumor growth was monitored using caliper measurements as well as in vivo fluorescence imaging and microCT scans. CDDP (at 0.5, 2 or 4 mg/kg) or vehicle was slowly infused under sterile conditions using custom-made polyethylene catheters (Berndt et al., JAALAS, 2012) and a syringe pump at approximately 19 days post cell injection. This procedure was repeated three times, once every three days. Kidney function was evaluated using the fluorescent dye GFRvivo and body weights were monitored. After sacrifice, metastases were visualized via X-gal staining.
Results: Compared to a vehicle-treated group, we observed a dose dependent reduction of relative tumor size (up to 87%) with IA injections of CDDP. Of the tested concentrations, we consider 4 mg/kg of CDDP as an effective concentration because a reduction of tumor volume was observed without a threatening reduction of body weight. Furthermore, preliminary results showed reduced kidney function when 4 mg/kg of IA CDDP were administered. Whether kidney damage will be larger if the animals will be treated with 4 mg/kg of IV CDDP has yet to be established.
Conclusion: We show that 4 mg/kg of CDDP is sufficient for reducing tumor size. Hence, this concentration will be used for subsequent studies evaluating the efficacy of IA versus IV chemotherapy.

P65

Functional characterization of C-MET point mutations in Osteosarcoma cells in vitro

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Introduction: Osteosarcoma (OS) is the most frequent primary malignant tumor of bone typically affecting children and young adults. It is associated with a very poor prognosis particularly for those patients with metastasis at diagnosis. C-MET is a receptor tyrosine kinase with hepatocyte growth factor (HGF) as natural ligand. In a variety of solid tumors the activity of C-MET is deregulated by mutation and the identification of the activating mutations of c-MET provides direct evidence linking C-MET directly to human oncogenesis. The major aim of this study was to evaluate if the identified C-MET point mutations have an effect on the functional properties of C-MET in different in vitro assays.
Methods: For mutation analysis of the intracellular domain of C-MET the individual exons were amplified from genomic DNA of primary OS cells by PCR. Nucleotide sequences of the amplification products were verified by sequencing in both directions. SAOS-2/LacZ cells stably overexpressing HA-tagged C-MET proteins with the identified point mutations were generated by retroviral infection. The functional properties of the identified C-MET point mutations on cell proliferation and cell migration were analyzed in vitro. In addition, the cell lines were starved and afterwards incubated with 100 ng/ml HGF in the presence or absence of specific C-MET inhibitors. Phosphorylation of the kinase domain of C-MET was analyzed by western blots.
Results: We identified three C-MET point mutations each localized in the juxtamembrane domain of the protein. A reduced proliferation rate was found for the cells overexpressing C-MET with the G1137A point mutation. In the cell migration assay we observed for the cells overexpressing C-MET with the T1010I point mutation an increased cell migration in the absence of HGF. For all cell lines overexpressing the different C-MET proteins an HGF dependent increase in cell migration was observed. When the C-MET overexpressing cells were treated with HGF no difference in phosphorylation of the kinase region was found. However, for the cells with the G1137A point mutation a reduced sensitivity to C-MET inhibitors was observed.
Conclusions: Individual C-MET point mutations identified in primary OS cells impair the functional properties in C-MET overexpressing cells and therefore may contribute to osteosarcomagenesis. The influence of the C-MET point mutations will be further analyzed in in vivo tumor models.

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The Aggressive Phenotype of LM8 Osteosarcoma Cells is Partially Dependent on a Reduced Latency in the Metastatic Niche

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Introduction: Metastasis is the major cause of death of osteosarcoma patients and the diagnosis of disseminated single cells or small cell clusters remains difficult. Furthermore, those micrometastases often rest in a state of dormancy, which might enable them to escape the chemotherapeutic treatment, and then induce recurrence of the disease after years or even decades. We recently showed that murine Dunn osteosarcoma cells equipped with a lacZ reporter-gene disseminate from subcutaneous primary tumors as frequently as their highly metastatic sub-line LM8, but only LM8 cells grew out to develop macrometastases.
Methods: Here, in a in vivo time-course study, LacZ-transduced Dunn and LM8 cells were injected into the tail-vein of C3H mice and individual animals in both groups were randomly selected and sacrificed at different time points up to 25 days after tumor cell injection. In a second survival study, C3H mice i.v. injected with lacZ-transduced Dunn and LM8 cells were examined until they became moribund and had to be sacrificed. In vitro both cell lines were compared regarding their intercellular adhesion, contact inhibition and invasiveness. Furthermore gene expression profiles of both cell lines were compared in a mouse genome RNA microarray.
Results: In the time-course study, tail vein-injected Dunn and LM8 cells colonized at same frequencies the lung, liver and kidney of mice within 24 h. Furthermore, mice injected with Dunn cell also developed macrometastases, but, compared to LM8-injected mice, with a delay of two weeks in lungs and one week in livers and kidneys, consistent with a prolonged survival of the mice. In vitro, Dunn cells showed less invasiveness and stronger contact inhibition and intercellular adhesion than LM8 cells and several cancer- and dormancy-related genes were differentially expressed.
Conclusion: In conclusion, Dunn, compared to LM8 cells, have a similar capability but a longer latency to form macrometastases and provide an interesting new experimental system to study tumor cell dormancy.

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Photodynamic Therapy as a Novel Strategy for the Treatment of Osteosarcoma

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Introduction: Photodynamic Therapy (PDT) is minimally invasive and makes use of a photosensitizer, a small molecule with laser light-inducible cytotoxic activity. In osteosarcoma (OS), the ultimate therapeutic goals include most complete tumor resection, elimination of tumor tissue at delicate sites and the inhibition of metastatic spread. We propose an experimental setup for the application of PDT in OS, and present in vitro and in vivo results of PS-uptake and PDT treatment using three different formulations of the PS mTHPC; Foscan, a liposomal formulation, and a lipid-nanoparticle based carrier (LNP).
Methods: mTHPC uptake was quantified by measuring the fluorescence in a spectrophotometer, after PS incubation in human 143 OS cells. Dark- and photo-toxicity was assessed by incubating 143B cells 5h in the dark with mTHPC. The cells were kept in the dark or illuminated with a laser diode. The toxicity was quantified with a WST-1 assay and light microscopy.
Local i.t. tumor formation was induced by i.t. injection of human 143B OS cells in female SCID mice. Mice were i.v. injected with the three PS formulations. Uptake of the PS was measured in hind limbs, using a fluorometer, IVIS and FMT. In vivo PDT was applied by injection the PS, after a DLI of 24h the primary tumor was illuminated with laser light to induce PDT. Changes in tumor growth were followed by caliper and in vivo imaging techniques such as IVIS, µCT and X-ray.
Results: The uptake of Foscan was faster compared to Foslip and the LNPs in vitro. All formulations cause cytotoxicity upon light illumination. The liposomal formulation and LNP (mTHPC) have a lower dark-toxicity compared to Foscan.
In vivo results showed a significant, time-dependent uptake of all three PS formulations in the primary tumor. Foscan, the liposomal formulation, and LNP (mTHPC) were taken up more efficiently in the tumor leg than in the control leg. Induction of PDT caused a significant slower tumor growth for Foscan and the liposomal formulation.
Conclusion: Efficacy of all Foscan, liposomal mTHPC formulation and LNP (mTHPC) was shown in vitro. Efficient uptake of all mTHPC formulation in primary OS tumors was also shown. Foslip was proven to be more effective in our mouse model compared to the clinically used mTHPC formulation, Foscan. The next step is to apply PDT in a syngeneic OS mouse model with an intact immune system, to demonstrate more efficient tumor eradication.

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ΔNp63α-GLI2 oncogenic network in Osteosarcoma progression

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Introduction: Osteosarcoma (OS) is the most common type of primary bone cancer. It arises in bone during periods of rapid growth and primarily affects adolescents and young adults. ΔNp63α and GLI2, a hedgehog signalling component, are transcription factors capable of inducing motility, invasion and metastasis in many types of cancer but their role in OS is poorly understood. We are investigating the influence of ΔNp63α and GLI2 in OS progression and our study provided a mechanistic link between the established tumorigenic factor, ΔNp63α and GLI2 signaling in osteosarcoma.
Methods: ΔNp63α stable SaOS-2 cell lines were generated by retroviral infection. The expression levels of ΔNp63α and GLI2 was analysed by western blot (WB) and real time PCR (qRT PCR) in OS cell lines. Co-expression analysis of ΔNp63α and GLI2 were performed by immunocytochemistry. Efficacy of knock down of p63 was accessed by WB. ChIP assay was done to determine the promoter binding activity of ΔNp63α to GLI2. FACS was utilised for determination of cell cycle stage on treatment with GANT61.
Results: We could show that expression of ΔNp63α and GLI2 is upregulated in invasive OS cell lines. Silencing of p63 in OS cells endogenously expressing ΔNp63α attenuated the expression of GLI2 indicating that GLI2 is regulated by ΔNp63α. ChIP assay revealed that ΔNp63α directly binds to GLI2 promoter. In ΔNp63α overexpressed SaOS-2 cell lines (SaOS-2-ΔNp63α) treatment with GLI2 inhibitor (GANT61) in SaOS-2-ΔNp63α and 143B cells drastically reduced the expression of GLI2 when compared with SaOS-2-EV. Cell cycle analysis by FACS revealed that GANT61 treatment induced G0/G1 arrest in SaOS-2-ΔNp63α and 143B cells thereby suggesting that GLI2 mediates the oncogenic characteristics of ΔNp63α invitro.
Conclusions: Our results reveal new information on molecular mechanisms of ΔNp63α -GLI2 interplay in OS progression. Our data warrant further investigation of treatment of OS tumors with high levels of GLI2 expression through inhibition of ΔNp63α. We seek to determine its efficacy in vivo, and hope to bring it to the clinical trials.

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Chromosomal instability of osteosarcoma cells during long-term in vitro culture contributes to altered gene expression

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Introduction: Osteosarcoma (OS) is characterized by genomic instability including whole chromosome losses or multiplications, regional copy imbalances and structural rearrangements. By microarray analysis, we have shown the instability of gene expression during prolonged in vitro culture in five out of six investigated OS cell lines. Here, we have applied array comparative genomic hybridization (aCGH) to explore the in vitro genomic stability of osteoblastic SAOS cells with low metastatic potential and its metastatic derivative, the LM5 cells.
Methods: SAOS and LM5 cells were cultured in vitro to achieve more than 150 cell doublings. DNA from early and late passaged cells was extracted and subjected to aCGH analysis using Affymetrix HD CytoScan arrays. Regions of copy number (CN) gains and losses were compared between the different samples as well as with a published SAOS cell line genotype.
Results: Compared to the diploid human genome, the mean extent CN gains and losses involved 40% (range 38–43%) and 6% (range 5–8%), respectively, of cell line genomes. The ratio of gain to loss was highest (8.6) in early SAOS cells, most likely in closest representation of the primary tumor, and lowest (4.8) in late LM5 cells. During in vitro culture, SAOS and LM5 cells showed 4.4% and 3.9% CN gains and 7.7% and 6.9% CN losses, respectively, in late versus early passaged cells. Commonly affected regions in SAOS and LM5 were CN gain in 12p and CN losses in 3qter, 9q and 14q. Comparison of aCGH analysis and microarray expression data showed a correlation predominantly of up-regulated genes and CN gains (ratio of observed to expected of 2.4 and 3.0 in SAOS and LM5, respectively), located in SAOS in 1q and 12p and in LM5 in 4p, 12p and 21q, respectively. Passage independent differences included a gain in 5p and losses in 3p, 4q, 20q and Xq in LM5 compared to SAOS-2.
Conclusions: The osteoblastic OS cell line SAOS and its metastatic derivative LM5 display similar amounts of 45–48% CN alterations with 5–8 fold more gains than losses and with different affected chromosomes. During in vitro culture both cell lines showed an 11–12% change in CN alterations, correlating in part with altered gene expression. Although part of CN alterations overlapped in SAOS and LM5 cells, the observed genomic instability during in vitro culture may differentially affect the cellular behaviour and may also obscure the analysis of metastasis relevant genes.

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SPATIAL ASSOCIATION OF SUBCHONDRAL OSTEOSCLEROSIS WITH ENHANCED MARROW IMMUNE CELL INFILTRATION AND OSTEOCLAST ACTIVITY IN HUMAN KNEE OSTEOARTHRITIS

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Introduction: Osteosclerosis of subchondral bone is a pathological hallmark of osteoarthritis (OA) and increasing evidence supports a pivotal and active role of this tissue in experimental and human OA. The cellular and molecular regulation of subchondral osteosclerosis remains poorly understood. In this study we investigated whether an interaction between immune and bone systems might contribute to the regulation of subchondral osteosclerosis in human knee OA.
Methods: Subchondral bone mineralization density (BMD) of explanted OA tibial plateaus was mapped using computed tomography osteoabsorptiometry (CT-OAM) analysis. Presence of immune cells in subchondral bone marrow tissue was investigated using immunohistological and flow cytometry analyses for expression of CD3 (T-lymphocytes), CD20 (B-lymphocytes) and CD68 (macrophages). Functional osteoclasts were identified by histochemical staining for tartrate-resistant acid phosphatase (TRAP). Outgrowth cultures of bone were stained for TRAP and alkaline phosphatase (ALP) activity. The effect of conditioned medium from nonsclerotic and sclerotic subchondral bone pieces on human primary OA osteoblasts was investigated using ALP assay.
Results: Subchondral BMD distribution was heterogeneous and displaying focal areas of relatively high mineralization density that spatially overlapped with areas of severe cartilage degeneration. Histomorphometric analysis revealed an increase in subchondral bone area fraction in sclerotic (0.662 ± 0.120) tissue sections. Immunohistological and flow cytometry analyses of subchondral bone marrow tissue showed a highly specific increase in $CD68^+$ mononuclear and multinucleated cells and $CD20^+$ B-lymphocytes in sclerotic subchondral bone tissue. Corresponding with an increase in multinucleated $CD68^+$ cells, TRAP staining revealed a strong increase in functional osteoclasts that associated with $CD34^+$ vascular structures. Sclerotic OA osteoblasts showed poor in vitro mineralization and increased basal ALP activity. Lack of osteoblastic ALP induction by conditioned medium from sclerotic subchondral bone pieces suggested a proresorptive milieu in immune cell infiltrated marrow tissue.
Conclusion: We have shown for the first time that the interaction between immune and bone systems, including enhanced osteoclast activity and immune cell infiltration, along phenotypic alterations in osteoblasts are involved in uncoupled and aberrant bone remodeling that leads to osteosclerosis in OA.

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SPECT/CT IMAGING OF ANKLE OSTEOARTHRITIS: ENHANCED BONE-SEEKING TRACER UPTAKE CORRESPONDS HISTOLOGICALLY TO SUBCHONDRAL INTRAMEMBRANOUS BONE FORMATION

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Universitätsspital Basel

Introduction: Single photon emission computed tomography (SPECT)/CT enables accurate non-invasive and simultaneous acquisition of information on tissue morphology and biological processes in disease. SPECT/CT imaging using a radiographic bone tracer, such as ^{99m}Technetium-dicarboxypropane diphosphanate (^{99m}Tc-DPD), is frequently applied for differential diagnosis of foot and ankle pathologies that pose a diagnostic challenge due to their complex anatomy. Uptake of bone-seeking radiotracers is primarily determined by the degree of bone perfusion and chemisorption to the hydroxyapatite structure of bone tissue and can be influenced by environmental factors, such as pH. In this study we sought to identify the cellular and morphological changes that associate with increased ^{99m}Tc-DPD uptake in ankle joint osteoarthritis (OA).
Methods: Six consecutive patients with end-stage ankle OA scheduled for total ankle replacement received preoperative ^{99m}Technetium-dicarboxypropane-diphosphanate (^{99m}Tc-DPD) SPECT/CT scanning. The American Orthopedic Foot and Ankle Society (AOFAS) and visual analog scale (VAS) were used for clinical evaluation of preoperative function and pain. Tissue morphology of tibial and talar resection specimens from SPECT/CT-positive and negative areas was evaluated using histology. Osteoclast activity was visualized using tartrate-resistant acid phosphatase (TRAP) staining.
Results: Preoperative AOFAS and VAS were 40 ± 15 points and 7.5 ± 0.84. Accumulation of ^{99m}Tc-DPD was located beneath the subchondral bone plate of both tibial and talar resection specimens and exclusively found in areas displaying subchondral bone sclerosis. Hematoxylin and eosin staining revealed marked infiltration of subchondral marrow spaces by fibrovascular tissue and abundant bone-lining osteoblasts in SPECT/CT-positive tissues. Active osteoblasts were surrounded by randomly organized collagen fibers. De novo and pre-existing bone tissues were devoid of TRAP-positive osteoclasts. Osteoblast presence was significantly correlated with ^{99m}Tc-DPD uptake, collagen deposition and severity of cartilage degeneration
Conclusion: SPECT/CT is a valuable imaging modality for human OA. Histological evaluation of SPECT/CT-positive ankle OA revealed subchondral intramembranous bone formation rather than increased bone remodeling through coupled activities of osteoclasts and osteoblasts.

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Shorter survival time in patients with osteosarcoma expressing MSH2 and MSH6 in a human tissue microarray

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Introduction: Currently, it is not possible to define osteosarcoma (OS) patients at greatest risk for short survival times. Valuable biomarkers for OS remain barely studied. Recently, soft tissue sarcomas have been linked to a deficiency in mismatch repair (MMR) genes. However, MutS protein homolog 2 (MSH2) and 6 (MSH6) are MMR proteins that have not been reported as biomarkers for OS. Our goal was the analysis of two possible biomarkers, MSH2 and MSH6 in regard to survival time in OS patients using a tissue microarray (TMA).
Materials and methods: Tumor tissue specimens from surgical primary tumor resections were collected from bone tissue of 67 patients with OS. A TMA was set up and sections were stained with MSH2 and MSH6. Grading was performed in a semi-quantitative manner by two independent investigators who were blinded to clinical information. Kaplan-Meier curves were used to calculate overall patient survival and the log-rank test assessed statistical differences between groups.

Results: We analyzed immunohistochemical expression of MSH2 and MSH6 in a human OS TMA. Follow up data was available for every patient and the mean clinical follow up time was 98 (range 7 to 213) months. Fifty-eight (87%%) and 57 (85%) OS patients stained negatively, compared to 9 (13%) and 10 (15%) OS patients staining positively for MSH2 and MSH6 respectively. Survival time and expression of MSH2 ($p = 0.292$) were not significantly correlated. However, significantly shorter survival was seen with expression of MSH6 ($p = 0.026$) and a combination of MSH2 and MSH6 (MSH2/6) ($p = 0.018$). The 5-year-survival rates (ysrs) for patients expressing MSH6 and MSH2/6 were 50%, compared to 77% and 63%. Also, significantly shorter survival was seen in non-responders to chemotherapy with expression of MSH6 ($p < 0.0001$) and MSH2/6 ($p = 0.028$). The same holds true for patients with metastasis and expression of our studied markers ($p < 0.0001$), for example 17 ± 5 months, compared to 203 ± 7 months for MSH2/6.
Conclusion: Expression of MSH6 and MSH2/6 appears to significantly affect the aggressiveness of OSs and may predict survival time. Non-responders to chemotherapy and patients with metastasis, who stain positively for MSH6 or MSH2/6 may be at risk for very short survival times. Expression of MSH2 in metastasis also seems to be associated with significantly worse survival times. Even though commonly reported as a repair system, MMR proteins may favor worse prognosis in OS.

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Three Dimensional Measurement of In Vivo Shoulder Abduction Using Biplane Fluoroscopy in Healthy Shoulders – The Glenohumeral Rhythm

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The purpose of this study was to measure the 3D position of the scapula, humerus and claviclein vivoin healthy subjects during abduction in the scapular plane with biplane fluoroscopy in order to be able to relate the global humeral elevation angle to the glenohumeral angle. The hypothesis of this study is:
The global humeral elevation angle is positively correlated to the glenohumeral angle and is linear throughout abduction (Inmans' 2:1 ratio).
Ten healthy male subjects (5 right / 5 left shoulders; age: 30 ± 7 years; height: 184 ± 5 cm; weight: 90 ± 9 kg) were recruited according to the inclusion criteria for this study. Data collection consisted of two parts, namely performing abduction in the biplane fluoroscopy system, and a CT scan of the shoulder. The motions were recorded simultaneously with a standard Motion Analysis System (MAS) using retro reflective markers to provide context for the analysis.
The hypothesis is confirmed by the results. The regression analysis proved the statistical significance of the linearity. The elevation was depicted at a 1.61: 1 ratio and a slope of 0.619 for the included subjects. Therefore all data were within the 4-sigma confident interval according to Inman and Abbott (1944) who first quantified the glenohumeral to scapulothoracic rhythm as a linear 2:1 ratio. In this 1944 study, the findings were based on x-rays taken in 45 degree increments in the coronal plane of arm elevation. Since the first 30 degrees were found by Inman to have inconsistent motion patterns, they were described as a setting phase and excluded from the calculations. Since we found motion variability overall throughout abduction, the first 30 degrees of elevation were included.
In general, this study provides the clinician and researcher with basic background information and more detailed data about the shoulder motion with the highest level of accuracy. It can be a useful tool and data for the clinician for clinical evaluation to look at potential pathologies and further research pre and post surgery can lead to evaluations, changed techniques and better outcome for the patients.

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Three Dimensional Measurement of In Vivo Shoulder Abduction Using Biplane Fluoroscopy in Healthy Shoulders – The Scapular Rotations relative to Humeral Elevatio

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The purpose of this study was to measure the 3D position of the scapula, humerus and claviclein vivoin healthy subjects during abduction in the scapular plane with biplane fluoroscopy in order to be able to correlate the acromioclavicular rotations during abduction to global humeral elevation. The hypothesis of this study is:
The acromioclavicular elevation (medial rotation), scapular posterior tilt and protraction/retraction are linearly correlated to global humeral elevation.
Ten healthy male subjects (5 right / 5 left shoulders; age: 30 ± 7 years; height: 184 ± 5 cm; weight: 90 ± 9 kg) were recruited according to the inclusion criteria for this study. Data collection consisted of two parts, namely performing abduction in the biplane fluoroscopy system, and a CT scan of the shoulder. The motions were recorded simultaneously with a standard Motion Analysis System (MAS) using retro reflective markers to provide context for the analysis.
Over the course of arm elevation the scapular rotations showed certain characteristics. Medial rotation was found at an almost linear ratio throughout arm elevation, whereas scapular posterior tilt showed increasing values without linearity. Scapular protraction was found to have differences within two groups. The scapular adjusted through pro/retraction with described motion patterns for the anterior or posterior plane of humeral arm elevation.
In general, this study provides the clinician and researcher with basic background information and more detailed data about the shoulder motion with the highest level of accuracy. It can be a useful tool and data for the clinician for clinical evaluation to look at potential pathologies and further research pre and post surgery can lead to evaluations, changed techniques and better outcome for the patients.

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USE OF SMALL ANIMAL MULTI-MODALITY IMAGING FOR IN VIVO ASSESSMENT OF TENDON-TO-BONE HEALING

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Introduction: Bone formation at the tendon-bone interface is essential for healing; however, the limited availability of a non-invasive means to evaluate healing in vivo impedes a more refined analysis. Positron Emission Tomography (PET) is a minimally invasive imaging modality. ^{18}F-Fluoride is a bone-seeking agent that reflects bone turnover. The aim of this study was to evaluate the use of micro PET/computed tomography (CT) to serially characterize and quantify ACL graft healing in vivo, using an established rat reconstruction model. We hypothesized that serial µPET/CT scans would be feasible and safe, and that this method would capture differences in bone turnover along the graft tunnel.
Methods: Six male Sprague-Dawley rats underwent ACL reconstruction using a flexor digitorum longus autograft. An external fixator was placed across the knee. The rats were assigned to immobilization (N = 3) or daily loading (N = 3, daily 50 cycles of ROM from 0-90°) groups. The animals were scanned using µPET/CT scans (spatial resolution 1.4 mm) and ^{18}F fluoride as a tracer at 7, 14, 21 and 28d after ACL reconstruction. Each bone tunnel and the surrounding bone were divided into 3 equal regions of interest (ROI) along each tunnel (intraarticular aperture (IAA), midtunnel (MT), and extraarticular aperture (EAA)). Standard uptake values (SUV) were calculated for each ROI. All rats were euthanized at 28d and ex vivo high-resolution µCT analysis was performed on all ACL tunnels.
Results: The µPET/CT imagingprovided quantifiable evidence of bone turnover in and around the bone tunnels over time. On the tibial side, there was a gradient in SUV, with most bone turnover at the IAA and least at EAA in both groups. The same pattern was observed for the immobilized group on the femoral side at 14, 21 and 28d. The µCT scan at 28d showed a significantly higher bone volumetric density in the loaded group at the femoral IAA when compared to the immobilized animals. A gradient was seen on the tibial side, with most bone volume at the EAA and least at IAA. In the loaded group, all the femoral ROIs showed bone volumetric densities of ~40%.
Discussion: Considering the current lack of knowledge of the tendon-bone healing process due to the limited availability of in vivo studies, our data highlights the feasibility and potential of repetitive µPET/CT scanning to provide further insight into the healing process and to directly measure the effect of interventional strategies in tendon-bone healing.

Acker A 7 S
Adamczewski B 47 S
Akiki A 18 S
Albers CE 20 S
Antoniadis A 30 S
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Attinger MC 38 S

Bachmann M 47 S
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Wirth B 34 S

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