Annual meeting of the
Swiss Society of Orthopaedics and Traumatology

Lausanne (Switzerland), June 26–28, 2013
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Influence of vastus medialis obliquus deficiency on patellar bone strain after in TKA
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Introduction: The causes of anterior knee pain (AKP) after TKA with non-resurfaced patella remains unclear. Weakness of Vastus Medialis Obliquus (VMO) has been frequently associated with patellofemoral pain (PFP) syndrome. It has been shown that VMO weakness may lead to the patellar maltracking. However, there is limited knowledge of its influence on the strain state of the patellar bone. Strain can be used to assess tissue damage. Furthermore, changes in strain state can influence the metabolic activity of the bone cells that are known to be mechanosensitive. This bone remodeling activity may be linked to AKP. In this study we assessed the influence of VMO deficiency on the strain state of the patellar bone using 3D musculoskeletal and numerical model of the knee with a TKA with non-resurfaced patella.

Methods: A subject-specific 3D musculoskeletal numerical model of the knee after TKA with a non-resurfaced patella was developed from CT sequences of a cadaver. The model included the femur, the tibia, the patella with cartilage and the four heads of the quadriceps. A postero-stabilized knee prosthesis was inserted under supervision of a knee surgeon. The patellar bone was modeled as linear elastic material with no local properties extracted from CT data. A loaded squat movement controlled by the elongation of the Vastus Intermedius (VI) was simulated from full extension to 90° of flexion. Forces in the muscles were assigned proportional to their ratios found in literature. Two situations were compared: a normal and a deficient VMO. Deficiency of VMO was simulated by reducing its ratio by 50%. In the superior-posterior quarter of the patella, two regions of interest (ROI) were defined: medial and lateral. Octahedral shear strain volume of strained bone were predicted and compared in these 2 ROI for the normal and deficient VMO.

Results: Since the patellar bone experienced relatively small strains below 70° of flexion, the comparison was performed from 70° to 90° of flexion. The volume of highly strained bone in the lateral part of the patella was 2-fold larger in the case of VMO deficiency than for a normal VMO. Conversely, it was twice smaller in the medial part for deficient VMO than for a normal VMO. The medial side of the patella experienced higher strains than the lateral side in both cases.

Conclusions: Deficiency of VMO caused increased bone strain in the lateral part and decreased strain in the medial part of the patella. Increased bone strain may be associated with anterior knee pain development.

Radionuclide Bone Scintigraphy accuracy in the detection of aseptic loosening of total knee arthroplasty
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Introduction: Aseptic loosening is the major cause of total knee arthroplasty (TKA) revision and is widely investigated pre-operatively by radionuclide bone scintigraphy. However literature about the accuracy of this tool is scarce. Our purpose was to evaluate the validity of radionuclide bone scintigraphy in the detection of aseptic loosening of TKA using intra-operative findings as a gold standard.

Method: Retrospective study of 31 radionuclide bone scintigraphies performed on our patients prior to surgical TKA revision. All blinded examinations were interpreted by two experienced nuclear medicine physicians and the interobserver agreement was determined by κ statistics. Sensibility, specificity and accuracy of radionuclide bone scintigraphy for detecting TKA loosening was assessed using intra-operative findings as the reference.

Results: Thirty one patients were included in the study. The mean patient age at the time of surgical revision was 70.1 ± 10.0 years. Radionuclide bone scintigraphy and surgical revision were respectively performed 4.7 ± 4.1 years and 5.4 ± 4.1 years after primary TKA. The sensibility, specificity and accuracy of radionuclide bone scintigraphy for detecting TKA loosening, respectively, were 70.6%, 60.5% and 63.3% for reader 1 and 100%, 41.9% and 58.3% for reader 2. Separate analysis of femoral and tibial components showed that the tibial plate had the poorest accuracy in both readers. The value of 0.38 reflected a fair agreement between both nuclear medicine physicians.

Conclusion: Radionuclide bone scintigraphy reliability for detecting aseptic TKA loosening was low and the interpretation of the images was partially interobserver dependent. Therefore, surgical revision of a TKA should not be initiated only on the basis of this examination and new tools have to be developed in the future.

Revision of UKA: Is There a Difference Compared to Primary TKA and Revision TKA?
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Introduction: Unicompartimental knee arthroplasty (UKA) is an alternative procedure to total knee arthroplasty (TKA) for the treatment of osteoarthritis localized to one compartment. Nevertheless, because UKA procedures are rising, revisions of UKA are also increasing. In the literature, revision of UKA is presented less difficult than revision of TKA and results after UKA are better than after revision of TKA, but worse than after primary TKA. However, there is no study which compares directly results for these 3 categories of patients. Therefore, we aimed to compare in this monocentric study the patient function, quality of life and complications of revision UKA versus primary TKA and revision TKA.

Materials and Methods: This retrospective study reviewed patients operated for revision of UKA with TKA in our institution between 1998 and 2009. On 54 UKA (54 patients) revisions (28 R-UKA and 26 R-TKA), 48 patients have been included in our study. 5 patients were lost of follow up and 1 patient died at 7 months after surgery without local complication of the prosthesis. This group of patients has been matched with 2 other groups regarding age, sex, BMI and one group of primary TKA (Group P-TKA) and one group of revision TKA with TKA (Group R-TKA). Cemented implants were used in the three groups with standard PS implants in the P-TKA group, and PS augmented implants in the UKA group in 59% of the cases and in 100% in the R-TKA group. At last follow-up patients were analyzed clinically and radiographically with the KOOS, the Charnley score and the Knee Society (KS) Score by an independent observer.

Results: At a mean follow-up of 8 years (2 to 14 years) after the revision, the improvement of the KSS was comparable in the two groups R-UKA and R-TKA, but results were better in the group of primary TKA. At the last follow-up, 56% of patients presented a B or C Charnley categories in R-UKA and R-TKA while only 20% of patients in the group P-TKA were B or C. Range of motion was 104° in the group R-UKA, 102° in the group R-TKA and 125° in the group P-TKA (p <0.001). Results of the five items of KOOS were statistically comparable in the two groups R-UKA and R-TKA, but worse than in the group P-TKA. We observed less complications in the groups R-UKA and R-TKA than in the group P-TKA.

Discussion and Conclusion: Even if a revision of UKA is technically less complicated, results of our study show that functional scores and rate of complications are worse than after primary TKA but are comparable to a revision of TKA. UKA is a bone preserving technique but surgeons cannot advocate that results of revision will be as good as a primary TKA.

Gait analysis and patients outcome after TKA comparing dependent vs. independent bone cut technique:
A preliminary study
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Introduction: Total knee arthroplasty (TKA) can be performed using independent or dependent bone cuts. While with the first technique the ligament balancing is performed after all bone cuts were made, with the latter technique bone cuts rely on the first cut after adequate ligament balancing. The hypothesis is that patients operated with dependent bone cuts have a better stabilization of the knee in flexion. Therefore, the aim of this study was to determine if the use of a bone dependent technique has an influence on patients’ outcomes in terms of gait, pain, function, quality of life and satisfaction following TKA.

Materials and Methods: Forty patients (69 ± 7 years old; 24 women / 16 men) were evaluated before (V1), three months (V2) and one year (V3) following a primary TKA using the same implant (P.F.C.® Sigma®, DePuySynthes Orthopaedics, Warsaw, USA). Thirty patients were operated using independent bone cuts (group 1). Ten patients were operated using the dependent bone cuts using the Specialized® TRAM (DePuy France S.A.S. - Saint-Priest, France) for a ligament balancing technique (group 2). A three-dimensional motion analysis system was used to measure the gait of individuals in terms of spatio-temporal, kinematics and kinetics parameters. The pain and functional levels were assessed using the SF-12 questionnaire. The global satisfaction of patients as well as their satisfaction related to pain and functional levels were evaluated.
at each follow-up evaluation using a 5-Likert scale (very unsatisfied; unsatisfied; neutral; satisfied; very satisfied). To evaluate patients’ evolution, repeated measures ANOVA were performed using surgical techniques as the categorical predictor factor.

Results: No significant difference was found between both groups of patients in terms of age, body mass index, pain and functional levels at baseline evaluation. Moreover, no surgical technique effect was observed for biomechanical gait and clinical outcomes as well as for patients’ satisfaction level at both follow-up evaluations. However, considering all patients (i.e., groups 1 and 2 combined) a significant increase of the gait velocity (V1: 1.07 m/s; V2: 1.08 m/s; V3: 1.19 m/s) was found at one year following TKA compared with preoperative and the early follow-up evaluations. Maximal knee flexion was also significantly improved at one year following TKA compared with early follow-up (V1: 46°; V2: 45°; V3: 48°). In addition, significant improvements were observed for the mean scores of the WOMAC (pain & function) at both follow-up evaluations. Finally, patients reported to be satisfied to very satisfied at one year post-TKA in 82.5%.

Conclusion: In this preliminary study, our hypothesis was not confirmed. There was no significant difference between both surgical techniques in patients’ outcomes following TKA. However, the assessment of gait, pain, and function at three months and one year following TKA demonstrated significant improvements. Further studies with a larger sample of patients and with the assessment of more specific outcomes are needed to confirm our results.

**Short Term Outcome of Bi-cruciate Stabilized Total Knee Replacement measured using the Knee injury and Osteoarthritis Outcome Score (KOOS)**

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**Backgrounds:**

Bi-cruciate stabilized knee prostheses aim at a reconstruction of the knee ligament balance, which is of paramount importance for patients suffering from advanced symptomatic knee osteoarthritis. The main goals of knee prosthetics are pain reduction and restoration of knee motion. New implants on the market such as the bi-cruciate stabilized Journey knee implant promise a reconstruction of a more physiological function of the knee with a close to normal range of motion and therefore higher patient satisfaction.

**Purpose:** The aim of this study was to analyze the patient-based Knee Injury and Osteoarthritis Outcome Score (KOOS) outcome after total knee replacement with the bi-cruciate stabilized Journey knee prosthesis.

**Study Design:** Prospective, consecutive case-series.

**Patients:** Ninety nine patients, who received bi-cruciate stabilized Journey total knee prosthesis between January 1st 2006 and May 31st 2012, were included in the study. All patients were operated by a single surgeon. There were 61.1% females and the overall average age was 68 years (range 41–83 years). Left knee was replaced in 55.6%.

**Methods:** The patients filled in KOOS questionnaire pre- and 1 year postoperatively. Range of motion (ROM) was studied preoperatively and at 1-year follow-up. The pre- and postoperative KOOS subscores and ROM were calculated using the Wilcoxon signed rank test.

**Results:** There significant improvement of all KOOS subscores. Ninety percent of patients have reached the minimum of clinically relevant 10 points in symptoms, 94.5% pain, 94.5% activities of daily living, 84.9% in sports and recreation, and 90% in knee related quality of life. Postoperatively, the average passive ROM was 131° (range 110–145°) and the average active ROM 122° (range 105–135°). The highest correlation coefficients for ROM and KOOS were observed for the activity and pain subscores. Very low or no correlation was seen for sport subscore.

**Conclusions:** Bi-cruciate stabilized knee prosthetic offers a solid outcome at 1 year based on the results measured with the KOOS evaluation questionnaire. The Patients showed a generalized improvement in all domains measured in the KOOS of minimally 35, and up to over 52 points, which was statistically significant. Patients described the level of functionality close to double compared to the preoperative status. Despite the good to excellent patient-described results, studies show a high complication rate using the Journey knee implant.

**Key words:** total knee replacement; Knee Injury and Osteoarthritis Outcome Score; Journey; bi-cruciate stabilized knee prosthesis; short term outcome.

**5 years post-operative results of a new ultra-congruent postero-stabilized TKA with mobile-bearing using gait analysis**

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**Introduction:** In order to address the more specific needs of the young and active patients suffering from severe knee osteoarthritis, a new total knee arthroplasty (TKA) has been designed. The FIRST knee prosthesis (Free Insert in Rotation Stabilized in Translation, Symobos SA) is an ultra congruent, postero-stabilized total knee arthroplasty with a mobile bearing expecting to reduce significantly polyethylene wear, to improve the range of motion and the overall stability of the knee while ensuring a physiological ligament balance. Gait analysis has proven to give really objective and outcome parameters after lower limb surgery. Using an ambulatory device, our goal was to compare subjective and objective results of this new TKA with standard models used all over the world.

**Materials and Methods:** Clinical prospective monocentric cohort study of 126 consecutive patients undergoing a FIRST TKA for primary osteoarthritis. Mean age of the cohort is 69.7 ± 8.3 years (47–86) and mean BMI is 28.6 ± 5.6 kg/m² (18.7–69). Follow-ups of the study were done at 6 weeks, 12 weeks, 6 months, 1 year and 5 years. Data included subjective evaluations (EQ-5D and WOMAC scores), semi-objective questionnaires (KSS score and radiography evaluation of the position of the components, of the patella and any loosening sign) and objective gait parameters from 2 walking trials of at least 30 meters long, performed at different speeds with an ambulatory gait analysis system (Physilog, BioAGM CH). The outcomes of 89 patients after 5 years of follow-up are reported here and compared to the results of a randomized controlled trial performed in the same center just before this study comparing 29 NexGen® postero-stabilized TKA (Zimmer Inc) with a fixed bearing to 26 NexGen® postero-stabilized TKA with a mobile bearing using the same methods.

**Results:** Post-operative subjective and semi-objective scores (EQ-5D, WOMAC and KSS scores) are improved for all types of TKA (p >0.05). FIRST 5 years mean results included VAS 1.45 (SD 2.03), WOMAC function 58.6 (SD 20.46), KSS operated knee 78.78 (SD 13.10) and EQ-5D 73.31 (SD 18.20). No radiological loosening was observed in the FIRST implants cohort after 5 years of follow-up. As for the ambulatory gait analysis, the comparison of several temporal and spatial gait parameters at different walk paces (slow, normal and fast) showed significant differences between the 3 types of prosthesis in favour of the FIRST TKA in term of Gait cycle time (GCT) (s): 1.12 (SD 0.02), Limb %GCT: 124 (SD 13.5), Stride length (m): 1.37 (SD 0.02), Gait speed (m/s): 1.22 (SD 0.04) and Knee maximum rotation angular velocity (°/s): 363.35 (SD 10.11)

**Conclusions:** We present the updated results of a new total knee arthroplasty, based on an ultra-congruent, postero-stabilized and mobile bearing that showed very encouraging clinical outcomes: we confirm similar subjective and semi-objective results and a comparison with widespread TKA designs but statistically significantly better objective gait outcomes after five years of follow-up for the FIRST TKA. The validity of these positive results will have to be confirmed by updating the results obtained with the FIRST TKA in the future. To our knowledge this is the first study to report the complete outcome of a new TKA since its introduction using gait analysis.

**Differences in patient characteristics prior to TKA between Switzerland and the US**

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**Introduction:** Total knee arthroplasty (TKA) results, including patient-reported outcome measures (PROMs), complication rates, and specific implant survival rates are often generalized across countries. However, patient- and environment-dependent factors may differ considerably between countries and continents resulting in differences in the longevity of specific implants and the national revision burden. Reports from national registries mostly lack detailed patient-information especially information on BMI, co-morbidities, pain and function level.

**Objectives:** Our objective was to describe and compare preoperative patient characteristics prior to TKA from two large cohort studies, one in Switzerland (with patient characteristics comparable to those reported in the Swedish and Danish registries) and the second a national cohort from the US.
Methods: Patient characteristics were collected prospectively on all elective primary TKAs performed (1) at a large tertiary center in Geneva, Switzerland between 1/2009 and 12/2011 and (2) in FORCETJR, a diverse, national sample of more than 100 surgeons in the U.S. between 6/2011 and 8/2012. Information was obtained on age, sex, BMI, diagnosis, medical co-morbidities (diabetes, cardiac disease and stroke), and patient-reported outcome measures including the WOMAC pain and function (reduced form-Swiss; estimated from KOOS-US), and a global health questionnaire, SF-12 (SF36/US) physical and mental component scores. Higher scores indicate less pain and better function/health. We calculated risk ratios, and mean differences, as well as effect sizes to compare preoperative scores.

Results: Overall, 2508 TKAs from the U.S. cohort and 855 TKAs from the Swiss cohort were evaluated. Patients undergoing primary TKA in the U.S. compared to those in Switzerland were younger (mean age 67 vs 72 yrs.; 23% US <60 years vs. 10% Swiss), more obese (BMI ≥35: 27% vs 17%), and had more cardiac disease. Patients in the U.S. had higher preoperative WOMAC pain scores (52 vs 41 points) indicating less knee-specific pain at time of TKA. While significant pre-operative physical disability (SF) was reported in both countries, the US reported higher (33 vs 28 points).

Conclusion: We found substantial differences in baseline characteristics with younger age, greater obesity, and more cardiac disease in the US TKA patients. While preoperative knee pain was greater in the Swiss cohort, similar and significant disability was reported in both countries. Further research is needed to understand the differing pain reports. These findings have potentially important implications for the comparison of TKA results, especially complication and revision rates and postoperative clinical outcomes, reinforcing the need for adequate risk adjustment in cross-cultural comparisons.

Introduction: Is known to play a central role in longevity of total knee arthroplasty (TKA), particularly in young active patients. This is why TKA using patient specific instrumentation (PSI) this rate could decrease dramatically.

Objectives: This study is the first to investigate component alignment of medial UKAs implanted through a patient-specific cutting block technique.

Methods: We investigated pre- and postoperative CT-scans of medial UKAs implanted with patient-specific cutting blocks and compared the accuracy of postoperative outcome with the preoperative planning. We included 25 knees from 24 patients (10 male, 14 women, mean age 70 y, range 59–86 y). CT-scans were made from the operated knee pre- and postoperatively with additional views of the ipsilateral hip and ankle to measure the mechanical axis (HKA).

Postoperative tibial varus-valgus, posterior slope and rotational alignment was measured through 3-dimensional reconstruction and compared to the preoperative planning. Additionally, we compared the HKA measured by CT-scans with conventional long-leg standing x-rays.

Results: Postoperative HKA showed mean values of 177° ± 2.8° (preoperative planning 175.4° ± 2.5°). The mean deviations of HKA with conventional x-rays showed comparable results with 177.2° ± 2.8°. The difference between the final bone cut compared to the preoperative planning showed for the tibial valgus/varus a mean of 0.5° ± 1.2° (2.9° ± 0.7 valgus planned), for the tibial posterior slope 0.7° ± 2.0° (4.6° ± 1.3° planned), and for the femoral implant rotation a mean difference of 1.6° ± 3.5° external rotation (0° planned).

Conclusion: This study shows excellent results in rotational and varus-valgus alignment of the tibial implant in patients undergoing unicompartimental knee arthroplasty. Considering the crucial role of correct alignment of implant positioning for the survival of UKAs, the patient-specific cutting block technique seems to be a promising technique to optimize implant positioning.

Unicompartmental knee arthroplasty after 85 years old

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Introduction: The unicompartmental knee arthroplasty (UKA) continues to gain popularity as a viable treatment option for arthritis isolated to one compartment. It has been reported to provide decreased perioperative morbidity, faster recovery, quicker and easier rehabilitation, and excellent longterm survival: these advantages may benefit octogenarians. Then we hypothesized that UKA is may be a viable alternative to total knee arthroplasty (TKA) as the definitive treatment of localized arthritis in patients over 85 years old.

Methods: From 1995 to 2011, patients over 85 years old with severe unicompartmental knee osteoarthritis were included, even if mild patello-femoral osteoarthritis was present. Other inclusion criteria were: pre-operative hip-knee-ankle angle less than 10°, no ligament laxity, good range of motion (at least 90° of knee flexion and less than 5° of extension loss), no inflammatory joint disease. The main complaint was severe localized pain. UKA were implanted by a short medial arthroscopy for medial femoro-tibial arthritis, versus lateral arthroscopy for lateral femoro-tibial arthritis.

Results: UKA were implanted in 26 consecutive patients, representing 31 knees: 24 medial UKA and 7 lateral UKA. 92% of patients were females. All patients were 85 years-old or older (mean 87 y.o. range 85–91 y.o.). Mean body mass index was 23. In the postoperative days, only one patient needed a blood transfusion, and none had deep venous thrombosis or infection. Knee Society knee and function scores improved at an average of 3.5 years follow up (range 1–10 years). 90% of patients were satisfied or very satisfied and would have surgery again. The mean postoperative knee range of motion was full extension and 130° of flexion. Only one of the 31 knees (3%) required revision surgery into total knee arthroplasty for an early implant failure. At final follow up, 8 patients (11 knees) had died with all having the index UKA in place and functioning well; mean postoperative survival was 5.4 years.
Conclusion: Although total knee replacement has proved to have high success rate in elderly patients, UKA can be expected to provide reliable and durable results in certain patients of this age group. Lower morbidity and faster recovery after UKA may benefit octogenarians and UKA should be regarded as a definitive treatment option in appropriately selected patients over 85 years old.

10 year results of the tension controlled, ligament balanced total knee arthroplasty
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Introduction: Posterior cruciate ligament (PCL)-retaining prostheses are commonly used and give good outcomes. After 10 years of total knee arthroplasty (TKA) in situ wear, radiolucent lines and osteolysis are commonly observed and the long-term data on soft tissue orientated surgical technique are currently available. This study investigated the 10 year results of primary TKA using the ligament balancing technique.

Methods: As part of a cross-sectional retrospective investigation this study evaluated the data on patients treated in the Swiss clinics with the first series of balanSys total knee prostheses (Mathys Ltd. Bettlach, Switzerland) using the soft tissue orientated surgical technique. Between 1998 and 2003, 408 cases (361 patients) were operated and were responsible for the prostheses with either a fixed (78.5%) or a mobile (21.5%) posterior cruciate ligament bearing polyethylene inlay. At the 10 year follow-up (FU) examination, range of motion (ROM), knee society score (KSS), visual analogue scale (VAS) for pain and satisfaction were determined and radiographs were evaluated. Safety evaluation included postoperative complications and revisions.

Results: Out of 408 cases, 137 were lost to FU due to death, 21 due to unknown address. In 43 cases a phone interview was done, 57 indicated that at least an implant is in situ. Finally, 128 cases (82 female; 46 male) performed the FU after 11.2 (±1.1) years. Patients' mean age at FU was 79.6 (±6.6) years. Mean total KSS was 155.8 (±25.9) points and mean passive flexion was 114.7 (±12.3)°. VAS mean scores for pain and satisfaction were 1.5 (±2.2) (best 0) and 8.7 (±2.3) (best 10), respectively. No loosening or migration of all implants was observed. Out of all implants 22 (15 mobile, 7 fixed bearing) were revised due to limited ROM (6), instability (4), infection (3), loosening (3), prosthesis size (2) or others (4). Only 18 minor complications were mentioned, 9 fall (12), mobilisation under anaesthesia (1), infection (1), others (4).

Conclusion: This study suggests that TKAs performed with the PCL-retaining prostheses by using a soft tissue orientated surgical technique is a safe procedure and associated with very good long term results (KSS and VAS) as well as only few complications in this elderly population. Long term results of implants in combination with a specific surgical technique are needed to draw conclusions on the clinical outcome and safety.

Decision making for Surgery in Trochlea dysplasia – Laterale Trochlea Titl
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Introduction: The lateral trochlea titl is a helpful tool for surgical indication in patellofemoral instability with trochlea dysplasia. The patellofemoral instability becomes more understood in the last years. And still it is a phenomenon because of the multifactorial causality. Beside the muscular imbalance, abnormalities in frontal (valgus/varus) or rotational axis, TTTG, MPFL tension, height and dysplasia of the patella is the Trochlea dysplasia one of the most important factors. As there is no possibility to determine the level of malrotation. We hypothesize, that these shortcomings may be overcome by using two new reference lines used are difficult to place, tibial dysplasia is not taken into account for and there is no possibility to determine the level of malfusion. We therefore orientated our investigation to the layers of the quadriceps tendon and the superficial layer of the QT is formed by the tendon of the rectus femoris.

Introduction: To successfully plan a derotational osteotomy or to reduce a fracture of the tibia, an exact assessment of torsion is necessary. Measuring tibial torsion by CT imaging using the conventional methods of Jakob and Elgeti, rely on measuring the angle between the tibial plateau and the malleolar axis. The shortcomings of these approaches are, that the reference lines used are difficult to place, tibial dysplasia is not taken into account for and there is no possibility to determine the level of malfusion. We hypothesize, that these shortcomings may be overcome by using two new reference lines along the medial cortical of the proximal and distal tibia.

Methods: A retrospective study was performed bilaterally on 30 tibial torsional CTs, which were routinely made during 2011 and 2012 as part of our preoperative diagnosis (19 men and 11 women). The tibial torsional angle was measured between the proximal reference lines according to Elgeti (tangential to dorsal proximal tibial condyle) (PE) and to Jakob (transversing the widest part of the tibial plateau) (PJ) and distally using a transtibial reference line (DE) and two further reference lines were placed tangential to the medial cortical of the tibia. The proximal cortical tangent (PC) was placed just proximal of the proximal malleolus, whereas the tibia is still flat. Angles were measured between the reference lines and statistically analyzed.
Results: All results are in mean and standard deviation. Men were 39 ± 12 years and women 35 ± 13 years old. The mean external torsion using PE and DM was 34 ± 10.4° for the right side and 28.3 ± 8.7° for the left side. Using PJ and DM we found a torsion of 35.6 ± 11.5° for the right side and 29.3 ± 10.4 for the left side. Using the side and 24.3 ± 8.7° were measured. The external torsion between PE and DC was 60.5 ± 8.4° for the right and 64.8 ± 8.1° for the left side.

Conclusion: Our measurements of tibial torsion using PEDM and PJDM reflect those of other groups (28.8° and 30° respectively). Measurements of tibial torsion using the PC and DC yield a smaller standard deviation, compared to measurements using PEDM and PJDM indicating a more precise, probably simpler measuring technique. The PC correlates well to PE and PJ, as does the DC to the DM, showing clinical relevance, as PE, PJ and DM are reference lines attempting to reflect the axis of articulation. As the PC and DC reference lines are tangents along the medial tibial cortex, which may be easily appreciated in clinical examination, they may offer additional information to torsion without using radiography. Although the PC and DC reference lines do not reflect an axis of articulation, they may be useful to find the correct torsion during surgery, where determination of torsion may be difficult.

Factors influencing posterior tibial slope and tibial rotation in opening wedge high tibial osteotomy: A cadaveric study
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Introduction: Opening wedge high tibial osteotomy (HTO) is an accepted treatment option for medial compartment knee osteoarthritis with associated varus lower limb axis in younger, more active patients. A concern with the use of this technique is that posterior tibial slope (PTS) and tibial rotation can be altered.

Methods: A cadaveric model and surgical navigation system were used to evaluate the influence of certain intra-operative factors of the degree of PTS and tibial rotation change observed during medial opening HTO. Parameters evaluated included: degree of osteotomy opening, knee flexion angle, location of limb support (thigh versus foot), performance of a posteromedial release, the status of the lateral cortical hinge, and the degree of osteoarthritis present in the knee.

Results: Combining measurements of all specimens and parameters, a mean PTS increase of 2.7 ± 3.9 degrees and a mean tibial internal rotation of 1.5 ± 2.9 degrees were observed. Clinically significant changes in tibial slope (greater than 2 degrees) occurred in 50.4% of corrections, while significant changes in tibial rotation (greater than 5 degrees) occurred in only 11.9% of corrections. Patients with significant osteoarthritis and concomitant flexion contracture, cases where large corrections were required, and procedures in which the lateral cortical hinge was disrupted were associated with increased PTS change. The other factors evaluated did not exert a significant influence of the degree of PTS change observed.

Conclusion: Surgeons should be vigilant for possible PTS change, particularly in high-risk situations as outlined above. We recommend routine use of an intra-operative measure of PTS to avoid inadvertent slope change.

A simple arthroscopic fixation technique of intercondylar eminence fractures in children without remaining artificial fixation devices
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Introduction: Growth disturbances are the main fear while treating eminence fractures in children. Different epiphyseal sparing techniques are described to reduce this risk, but leaving non-resorbable screws or sutures necessitate removing. The purpose of this study was to compare an established fixation technique with one using absorbable threads and transosseous fixation without compromising the physses.

Methods: We retrospectively analyzed 11 cases (McKeever Type II or higher) since 2005 treated with either non-absorbable thread fixation and tibial screw fixation (Group A, n = 5, mean age 13.2 years, mean follow up 58.2 months) or with absorbable thread and transosseous fixation (Group B, n = 6, mean age 12.0 years, mean follow up 20 months).

Results: No significant difference in both groups concerning function according to the IKDC (Group A: three A, two B, Group B: four A, two B), laxity or stability comparing the different operation techniques was found. Complete osseous integration of the fracture was achieved in every case within three months. Lysholm score in Group A was 86.9 (range 68–100), in Group B 92.6 (range 70–100) with no significant difference. There was no significant difference in ACL side to side laxity in every case.

Conclusion: Treatment of intercondylar eminence fracture with absorbable thread and extraarticular transosseous fixation is simple and leads to a high rate of good results. Furthermore there is no need for metal removal and no persistent artificial material within or about the knee joint.

Management of Schatzker VI tibial plateau fractures: Case series and review of literature
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Introduction: Management of high energy intra-articular fractures of the proximal tibia is a challenging condition. The treatment of such fractures, need to pay specific attention to the soft tissue envelope around the knee with an acceptable reduction. They are only a few papers in the literature concerning the hybrid external fixation method treating this type of fractures.

Methods: We present a case series of 5 patients who were admitted to our hospital, a level I trauma centre, with a closed Schatzker VI tibial plateau fracture between march 2010 to november 2012. All patients were treated with a hybrid external fixator (Tenxor Stryker-Howmedica) and the reduction was performed most often by closed means or through mini-open reduction Mean follow-up was 23.5 months (range 7 to 32 months) and were evaluated with radiographs.

Results: In 2 cases the hybrid fixation was the final treatment and in 3 cases we removed the temporary hybrid fixation which was followed by re-osteosynthesis by LCP plate. Radiographic evidence of union was observed at 5.8 months (range 3 to 9 months). No pin track infection was observed.

Conclusion: We found the hybrid external fixation method as a suitable solution for closed Schatzker VI tibial plateau fractures in terms of radiologic consolidation with acceptable reduction. It can be used as a final solution or as temporary fixation followed by removal and re-osteosynthesis by plate. It has theoretical advantages in terms of the soft tissues but the benefit over internal fixation has not been yet demonstrated in terms of improved outcome in the literature.
Cerebral activation related to shoulder apprehension in patients with glenohumeral instability and in healthy volunteers
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Introduction: Apprehension is the most frequent complaint of patients after traumatic anterior glenohumeral dislocations [1]. Also, some patients have shoulder apprehension even after successful open or arthroscopic stabilization [2–5]. It is not always clear whether the origin of apprehension is true instability or whether it stems from a cerebral pattern linking a certain motion or position to a subjectively unpleasant sensation. Furthermore, identifying this condition may allow establishing adequately targeted rehabilitation protocols.

Hypothesis: Apprehension is consecutive to brain activation and cerebral remodelling. Shoulder instability could lead to cerebral reorganization and thus, apprehension could persist even in the case of a mechanically stable glenohumeral joint. Therefore, in some cases, the sensation of apprehension could be linked to abnormal cerebral conditioning and not necessarily to persisting instability.

Purpose of the study: The purpose of the study was to localize the zones of cerebral activation and to investigate the functional activation patterns using event-related fMRI while the subjects are visualizing provocative videos depicting situations stimulating apprehensive reactions.

Materials and methods: Multimodal neuroimaging including functional connectivity, grey matter (GM) and white matter (WM) morphometry was used to assess the unexplored neuronal mechanism mediating shoulder apprehension. This prospective study included 7 consecutive right-handed male patients with right-sided shoulder apprehension and 11 healthy male right-handed control participants.

MR protocol: A video projector was used to project the stimuli onto a translucent screen mounted to the table of the MR imager. Stimuli were seen via a goggles head coil. Each run consisted of twelve movies evoking shoulder instability and twelve control movies.

Multimodal analyses include functional connectivity tensorial independent component analysis during visual stimulation of movies showing typical apprehension movements vs control videos, voxel-based morphometry analysis of GM and tract-based spatial statistics analysis of WM.

Results: Patients with shoulder apprehension had cerebral remodelling with significant (p <0.05 corrected) increase in functional connectivity notably in the ipsilaterial motor (Smode +151%, component 16) and less pronounced in anterior (Smode + 131%, component 19) and posterior (Smode + 41%, component 10) parts of the default mode network despite the absence of potentially confounding structural changes in GM or WM.

Discussion: Shoulder instability is often associated with peripheral nerve injury. This is the first study that demonstrates that a peripheral orthopaedic pathology could also lead to a central neurological impairment. Shoulder apprehension induces functional reorganization of the brain with notably up-regulation of ipsilateral motor areas as well as alteration of the default mode network. This premier observation offers novel insights into the neuronal effects of shoulder instability which could, with future studies, be generalized to other joints. These original findings may open new horizons leading to improved management regimens for articular instability.

References:

A Comparison of Single Row versus Suture Bridge Techniques
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Introduction: Multiple techniques exist for arthroscopic suture anchor fixation of small bony bankart fragments; however, there is little evidence supporting a preference for one technique. As an alternative to the standard single row suture anchor technique, a suture bridge technique has been described. While the standard technique a single loop passes around the bone fragment, the suture bridge technique places an anchor at the articular margin of the defect and second suture to the anterior glenoid vault. This study investigated whether the use of suture fragment passing through the medial anchor along the bone fragment to the lateral anchor. The objective of this study was to compare the fixation stability, strength and load transfer of these techniques.

Methods: Sixteen shoulders (8 pairs) were treated with an intact glenoid, after creating a 15% bony bankart lesion and after fragment fixation using a single row or suture bridge technique. Paired specimens were randomly assigned to each technique. Cyclic loading was applied to the glenoid concentrically and then eccentrically according to a 7 step staircase protocol. Fragment displacements, failure strength, glenoid strain load transfer and contact area were quantified.

Results: Centralized loading produced significant differences in fragment displacement at 5, 10, and 20N (p <0.045) and approached a difference at 50 and 100 N (p =0.061). In all cases the single row technique permitted greater translation, ranging from 0.06–0.28 ± 0.07–0.13mm, compared to the greater fragment displacement in the single row group for all loads above 25N as compared to the suture bridge (mean range, 0.38–0.63 ± 0.23–0.28 vs. 0.14–0.19 ± 0.11–0.27 mm, respectively (0.009 < p <0.048)). Load transfer measurements did not differ between techniques (p >0.318), nor between the suture bridge technique and the intact glenoid (p >0.181); however, single row strain results approached a difference to intact at 5, 10 and 25N (p =0.072).

No significant differences in failure strength were found between the two techniques (mean range, single row: 74 ± 28N vs suture bridge: 77 ± 56N, p = 0.91).

Conclusion: Interface displacement results demonstrate that the suture bridge technique provides significantly greater fracture fragment stability; however, it does not provide failure strength. Thus, the suture bridge technique provides improved initial fragment stability; however, its overall strength is comparable to the single row repair.

In anterior shoulder dislocations the degree of displacement of the humeral head correlates with rotator cuff tears
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Introduction: Rotator cuff tears (RCT) are a well-known complication of anterior shoulder dislocations. Several studies have shown that the incidence increases with increasing age. We hypothesized that the risk of a tear also increases with the degree of dislocation of the humeral head.

Methods: Three independent observers retrospectively reviewed the charts and initial x-ray pictures of 155 consecutive patients with a traumatic first time anterior shoulder dislocation. The severity of dislocation was graded according to the position of the humeral head relative to the glenoid plane on standard anteroposterior x-ray pictures: grade I) the geometric center of rotation (CR) of the humeral head is lateral to the glenoid plate; grade II) the CR is in the plane of the glenoid; grade III) the CR is medial to the plane of the glenoid; grade IV) the entire humeral head is medial to the plane of the glenoid. The reliability of the classification was assessed using an intra-class correlation ICC(2,k). A multivariate logistic regression model was used to reveal relevant predictors for RCT. The analyzed co-variates were age (< / ≥ 45y), gender(m/f), side(r/l), greater rotator cuff fractures(y/n), glenoid fractures(y/n), neurologic lesions(y/n), and the grade of dislocation.

Results: The ICC showed a high reliability (0.93). The proportions of RCT for grades I-IV were 8%, 19.3%, 36.7% and 62.5%, respectively. The adjusted regression analysis showed that patients with a grade III dislocation had an 8.5-time (K95% 1.5–473) and patients with a grade IV dislocation a 19.9-time (K95% 2.9–135.2) higher likelihood for RCT compared with patients with a grade I dislocation. Additionally, patients older than 45 years had a 2.9-time (K95% 1.2–7.4) higher likelihood and patients with a greater rotubersity fracture a 0.16-time
Clinical and radiological results following arthroscopically assisted stabilization of acute grade III and IV AC joint separations

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Introduction: Persistent horizontal instability after an acute acromioclavicular (AC) joint separation may provoke unsatisfactory results of conservative treatment.

Hypothesis: The arthroscopically assisted double flip button stabilization of an acute grade III and IV AC joint disruption results in full functional restoration and stable radiological reposition.

Method: 21 patients who were treated for an acute grade III or IV AC joint separation were enrolled in this study and clinically evaluated using the Constant Score (CS) and the Simple Shoulder Test (SST). Functional outcome was tested for correlation with radiographic results.

Results: 19 individuals with a mean age of 37 years (17 men, 2 women) were available for clinical and radiological examination after a minimum follow-up of 14 months (range 2–21 months). From injury to surgery, the mean time interval was 12.5 days (range 4–21 days). According to Rockwood’s classification 3 type III and 16 type IV injuries were treated. There was no statistically significant difference between the Constant Score of the study group and the age adjusted normative values. The mean Constant Score was 90.2 points (SD 3.4) and the mean Simple Shoulder Test scored 11.5 points (range 8–12). The overall satisfaction was 8.2 on the visual analogue scale. 16 patients would undergo the intervention again. The functional outcome of these patients was not affected by the radiographic findings. Complications occurred in 4 cases and were treated surgically in 2 patients.

Conclusion: Patient satisfaction after arthroscopically assisted double flip button stabilization for acute grade III and IV AC joint separation is high. Clinical outcome shows similar results to age adjusted normative values. Loss of reduction is a radiographic finding in approximately one third of patients but not affecting clinical outcome.

Immobilization in internal or external rotation does not change recurrence rates after traumatic anterior shoulder dislocation

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Introduction: A major complication of anterior dislocation, and the main reason for subsequent shoulder instability, is damage to the anterior tissues of the shoulder, specifically the anterior-inferior labrum and/or glenoid rim, better known as a Bankart lesion. If this lesion heals, as it does in 50% to 80% of all patients, recurrent dislocations are less likely. In 1999 Itoiet al. made an argument that immobilization in external rotation would reduce damaged anterior-inferior tissues to the glenoid via ligamentotaxis, improve the healing rates of Bankart-type lesions, and thus result in a reduction of recurrence rates. A number of randomized, controlled trials have tested this theory, but have reached conflicting results. It is the objective of this study to systematically review and quantitatively synthesize the data on recurrence rates after shoulder immobilization in internal versus external rotation in first time, traumatic dislocators.

Methods: We performed a systematic search of the keywords “(external rotation OR internal rotation AND immobilization AND shoulder)” in the online databases PubMed, EMBASE, CINAHL, and the Cochrane Library.

Internal validity was assessed using a modified Jadad scale which ranges from 0 points (poorest result) to 3 points (best result), attributing 1 point for each randomization, blinding, and attrition. Publication bias among the included studies was assessed graphically using Egger’s regression.

The presence of between-study heterogeneity was qualified by Cochrane’s Q test. Random effect models were used to calculate the cumulatively pooled risk ratios (RR) of recurrent shoulder dislocations. All analyses were also stratified by age.

Results: Our search strategy generated 254 studies online and by citation tracking. After exclusion of duplicates, studies not focusing on clinical treatment or outcome, animal studies, studies without any intervention and one study with unacceptable high attrition, five studies including 471 patients (n = 230 in internal rotation and n = 241 in external rotation) remained for analysis. The included studies were published between 2001 and 2011 in English. The mean Jadad score for the included trials was 1.6 points (95% confidence interval 0.6 to 2.6 points).

There was no evidence for publication bias (p = 0.252) in Egger’s regression.

Between studies heterogeneity was borderline significant (p = 0.055) with an I² index of 56.7%.

The pooled, cumulative, DerSimonian-Laird random effects risk ratio (RR) for recurrence of shoulder dislocations at all ages was 0.74 (95% CI 0.44 to 1.27), not consistent with a statistically significant difference (p = 0.278) (figure 2). The pooled, cumulative power for the test was 94.5%. In the meta-regression we found a significant influence of age on the risk ratio (p = 0.003).

The pooled, cumulative, DerSimonian-Laird random effects risk ratio (RR) for recurrence of shoulder dislocations at ages 30 years or younger was 0.70 (95% CI 0.38 to 1.29) (figure 3). Again this risk ratio was not significant (p = 0.250) with a power of 99.8%.

The pooled, cumulative, DerSimonian-Laird random effects risk ratio (RR) for recurrence of shoulder dislocations at ages 30 years and higher was 0.78 (95% CI 0.32 to 1.88) at a p-value of 0.579, but with a power of only 12.2% (figure 4).

Conclusion: The currently available best evidence does not support a relative effectiveness of immobilization in external rotation compared to internal rotation in reducing recurrent shoulder dislocations in patients with traumatic anterior shoulder dislocations. However, after reviewing the current clinical data and the available basic science it is our opinion, that yet to be determined subgroup of patients could benefit from such treatment. Future investigations are needed to test this hypothesis.

Use of autologous segmental bone graft for large humeral head defects after posterior shoulder dislocation

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Introduction: During posterior dislocation an osteochondral impression fracture of the anteromedial humeral head is produced. Engaging defects predispose for recurrence and require reconstruction of the humeral head contour. The McLaughlin procedure or the transfer of the lesser tuberosity is recommended for osteochondral lesions, and thus result in a reduction of recurrence rates. A number of randomized, controlled trials have tested this procedure or the transfer of the lesser tuberosity. For larger defects, the use of allograft has been advocated. However, there are concerns about availability and transmission of viral infections. In this case series, clinical and radiological results with the use of autologous segmental cortico-cancellous bone from the iliac crest were presented.

Methods: Three patients (age 43, 57, 63) with locked traumatic posterior shoulder dislocations were retrospectively reviewed. The osteochondral lesions measured on axial CT involved more than 40% of the joint surface (A4,5). They were treated by open reduction and reconstruction of the anteromedial head lesion by two segments of cortico-cancellous bone from the iliac crest. The grafts were fixed with screws. Congruency of the humeral head was achieved in all cases. One patient needed ORIF of a concomitant humeral head fracture. There were no complications from the donor site.

Results: At a mean follow-up of 23 months (10, 11, 50) no redislocations occurred. There were no radiological signs of osteoarthritis (according to Samilson and Prieto) or osteonecrosis. Mean absolute Constant score was 86 (76, 88, 96), mean relative Constant score 94 (86, 95, 100), mean subjective shoulder value 83% (80, 80, 90), Maximal abduction was 140–170°, flexion 145–160°, external rotation 35–45°. Clinical outcome was assessed graphically using Egger’s regression. The clinical and radiological outcome is comparable to the results achieved by allograft in terms of subjective satisfaction, range of motion and resumption of daily life.

Conclusion: Large bony defects of the humeral head after posterior dislocation require reconstruction. In the literature several surgical procedures are described. This small case series presents mid-term results of anteromedial humeral head reconstruction with the use of autologous cortico-cancellous bone graft. The clinical and radiological outcome is comparable to the results achieved by allograft in terms of subjective satisfaction, range of motion and resumption of daily life.
Anatomy of the humeral insertion of the supraspinatus

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Introduction: The rate of severe degenerative changes of the supraspinatus varies between 30 and 45%. No other tendon in the human body has such a rate of degenerative tear.

Many authors demonstrated that most of the lesions appear at the deep surface of the supraspinatus. An anatomical and biomechanical research has been undertaken to try to explain the cause of the supraspinatus lesion.

Material and methods: 20 shoulders from fresh human cadavers were dissected. The patterns of insertion, the course of the tendon and the variations of the orientation of the fibers at the level of their bony attaches were studied during the movements of scapulohumeral joint.

Results: In most of movements studied the humeral head worked as a pulley for the subscapularis and infraspinatus tendons. As a consequence there was very little change at the level of the tendon’s rotation didn’t change anything to subscapularis and infraspinatus tendons whereas the same amount of rotation was measured for the supraspinatus.

Discussion: These results strongly suggest that the attach of the supraspinatus sustains a huge range of plication and/or torsion by comparison with to the other cuff muscles that may explains the high rate of degenerative lesions.

Furthermore a more general anatomic study demonstrated that most of the transverse-diameter rotation didn’t change anything to subscapularis and infraspinatus tendons whereas the same amount of rotation was measured for the supraspinatus.

Therefore, the anatomy of the supraspinatus attach is very peculiar regarding not only the cuffs tendon but also the whole body and may therefore indeed be preferable.

The humeral surface is not spherical

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Klinik Sonnenhof

Introduction: Anatomic shoulder prostheses with spherical heads very often do not perfectly cover the osteotomy surface of the anatomical neck. This may result in a prosthetic overhang anteroposteriorly with the risk of damaging the rotator cuff or an insufficient coverage of the metaphysis inferiorly with the risk of glenohumeral impingement, resulting in asymmetrical loading and potential looseness of the glenoid component. The purpose of the present study was therefore to assess the geometry of the humeral head in order to improve the design of shoulder prostheses.

Material and Methods: Thirty-seven dry cadaver humerii without macroscopic lesions were included in this study. The bones were fixed in a custom made frame, with the humeral head surface pointing upwards and the anatomical neck in a horizontal plane. The anatomical neck, as well as the craniocaudal and anteroposterior meridians were marked with two cross line lasers and scanned with use of a hand held Microscribe 3D digitizer. The data were stocked and analyzed in Excel files.

Results: In all except one specimen the anteroposterior diameter was smaller than the craniocaudal diameter. This difference was statistically significant. The anteroposterior meridian had a smaller radius of curvature posteriorly than anteriorly, indicating an asymmetry of the humeral head in the transverse plane. Such a difference could not be found in the craniocaudal plane.

Conclusions: The humeral head surface is not spherical. Therefore, currently used shoulder prostheses do not perfectly restore the normal anatomy and biomechanics of the shoulder joint. Malpositioning of a prosthetic head could lead to an unsatisfactory result.

Fair to good correlation of goutallier rating of supraspinatus fatty changes on axial and parasagittal reformatted computed tomography images

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Purpose: To compare the assessment of fatty infiltration of the supraspinatus muscle on parasagittal views with the standard Goutallier grading on axial computedtomographic images.

Methods: Three independent readers rated fatty changes of the supraspinatus muscle on CT scans of 91 shoulders. Goutallier grades were assessed on axial and parasagittal-reformatted CT images in two different reading sessions. Paired t-test was used to find differences between grading results on axial and parasagittal-reformatted images. Pearson correlation coefficient (PCC) and weighted kappa statistics were employed to quantify linear correlation, intrareader and interreader agreement.

Results: Average Goutallier grading on axial images among all readers was 0.80 (range, 0.4–4; standard deviation 1.16) and 0.89 (range, 0–4; standard deviation 1.08) on parasagittal reconstructions. The was a trend to a slightly higher Goutallier grading on parasagittal reconstructions, however not significant (paired t-test: p = 0.07). PCC was 0.702 (p <0.001). Weighted kappa statistics indicated a moderate to good intrareader (range of weighted kappa 0.53–0.62) and interreader (weighted kappa: axial images 0.55; parasagittal-reformatted images 0.65) agreement.

Conclusion: Grading of fatty infiltration of the supraspinatus muscle on parasagittal CT images is comparable with the standard Goutallier grading on axial images and is characterized by a moderate to good intrareader and interreader agreement. Parasagittal assessment is characterized by a slightly higher interreader agreement and may therefore indeed be preferable.

The balloon, a new revolutionary technique for massive irreparable rotator cuff tears: Preliminary results at 1 year follow-up, after balloon degradation

Leslie Naggar

Introduction: Patients having massive irreparable rotator cuff tears with painful functional impairment represent a therapeutic challenge when conservative treatment has failed. The objective of this study is to introduce a new revolutionary mini-invasive technique for the treatment of massive irreparable rotator cuff tears, consisting of an inflatable “balloon” introduced arthroscopically in the subacromial space. The initial results of this new technique will be presented.

Methods: This is a prospective and on-going series of the first 35 balloons implanted. This report concerns the first 22 cases, counting 13 females and 8 males (1 case operated on both shoulders), with a mean age of 69.3 years (range 50–88), and a follow-up greater than 1 year (mean 24 months). The biodegradable balloon, consists of a copolymer of poly-L-lactide-co-epsilon-caprolactone membrane.

The balloon will restore shoulder kinematics, by acting as a subacromial spacer and by repositioning the center of rotation of the humeral head. The surgical technique is arthroscopic. After having checked the non-reparability of the cuff, a minimal bursectomy is performed. An acromial roughening, but not a normal acromioplasty, is then done, taking care not to section the coracoacromial ligament. Before implantation, the size is measured, and the balloon is introduced folded, inside an insertion sheath, then it will be inflated with a saline solution. Mobilizing the humeral head then checks stability of the balloon. The balloon can also be used in partial cuff repairs. The long head of the biceps is also addressed through tenotomy or tenodesis.

Results: The results are good and excellent in 86% of the cases, with complete pain relief and a very rapid recovery (often after 6 weeks) of active and painless range of motion. The mean Constant score is improved and almost doubled postoperatively. The progress in power can continue up to 18 months postop, which is way beyond the period that is usually noted for balloon degradation (10 to 12 months maximum).

Conclusion: The ideal indication for the balloon is an irreparable massive rotator cuff tear, particularly in patients aged less then 70 years of age, in which a reverse shoulder prosthesis should not be implanted, as well as in older patients. The balloon implantation is ideal for massive irreparable rotator cuff tears, as it is a simple, low risk and less invasive operation than conventional techniques.
Correlation Between ASES and SANE Scores After Rotator Cuff and SLAP Repair

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Background: Over 44 scores have been proposed to measure the shoulder function. Among the most popular are the American Shoulder Evaluation (SANE) scores. However, the ASES score contains overall 41 items based on objective and subjective measures and can hence be time-consuming compared to the SANE score, which only consists of 10 items. A high degree of correlation between ASES and SANE score has already been found for shoulder instability, but nothing had yet been demonstrated for other shoulder pathologies.

Purpose: The purpose of this study was thus to compare the ASES and SANE scores after rotator cuff and superior labral tear from anterior to posterior (SLAP) repairs.

Methods: This study was a retrospective review of a prospective recorded database of patients operated arthroscopically by the same shoulder surgeon in a single institution. The patient database included prospectively recorded preoperative and outcome measures, notably ASES and SANE scores. Pearson coefficient was used to establish correlation between these scores. The respective scores were compared in the three groups separately and altogether.

Results: 262 patients were included in our analysis. The mean age was 56.8 years old (+/-13.6) with 177 male (68%). Three patients groups were identified based on the presence of rotator cuff tear (r = 0.76), SLAP repair (N = 54) and cuff repair (N = 73). The overall mean ASES score and SANE score after surgery were 82.7 (+/-20.2) and 83.3 (+/-19.6) respectively. The Pearson's correlation coefficient (r) between both scores was 0.8. (p < 0.001) demonstrating a very good (high) correlation. In subgroup analysis, the correlation was was highest in the cuff repair group (r = 0.88, p = <0.001), followed by the SLAP group (r = 0.78, p = <0.001) and primary cuff group (r = 0.75, p = <0.001).

Conclusion: SANE score is rapidly administered, simple, comprehensive and cost-effective compared to the ASES score. This study reports a high correlation between SANE and ASES scores in rotator cuff and SLAP repairs. We thus recommend the SANE score as a reliable outcome indicator for iterative follow-ups, which can be wisely combined with the ASES for preoperative and final assessment.

Influence of fatty supraspinatus muscle degeneration on rehabilitation after arthroscopic rotator cuff repair: A prospective case series

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Introduction: Fatty muscle degeneration has been known to diminish function after rotator cuff reconstruction and contributes to failure of surgical repair. It, however, is yet uncertain what extent fatty degeneration influences speed of postoperative recovery. This prospective case series aims to identify how fatty supraspinatus degeneration (graded according to Goutallier) affects early rehabilitation after cuff repair.

Methods: 69 patients undergoing arthroscopic supraspinatus tendon double row suture anchor repair were followed prospectively for one year after surgery. Clinical analysis and scoring was acquired by an independent examining physician not performing the surgery. Quick-DASH and SPADI scores, as well as range of motion and abduction starting strength were measured preoperatively and at 3, 6 and 12 months after surgery. 8 patients were lost to follow-up due to incomplete independent clinical analysis. For the remaining 61 patients, radiographic analysis was performed by an MRI-experienced radiologist in order to determine fatty degeneration equivalents in preoperative arthro-MRI scans. Group 1 (Goutallier 0) included 31 patients (50.8%), group 2 (Goutallier 1) 21 (34.4%) and group 3 (Goutallier 2) 9 patients (14.8%). No patients with higher graded fatty degeneration had qualified for arthroscopic repair. T-Test and Spearman-correlation were used for statistical analysis, significance was defined at p < 0.05.

Results: At 3 months, group 1 displayed significantly faster improvement in SPADI (Δ1=–14.5 ± 19.9; Δ2 = –12 ± 27.1; Δ3 = –5.7 ± 13.1) and Quick-DASH (Δ1 = –23.1 ± 23.7; Δ2 = –11.5 ± 20.0; Δ3 = –12.0 ± 16.1). The amount of improvement had levelled with groups 2 and 3 at 6 months after surgery. No significant correlation was found. Improvement in SPADI and Quick-DASH scores during the first 3 months. Faster short-term recovery after arthroscopic repair can be expected in this group. At 6 months, however, Goutallier 1 and 2 had caught up in terms of functional improvement. Goutallier 0 implies higher potential of restoring abduction strength postoperatively.

Conclusion: Patients with supraspinatus degeneration Goutallier grade 0 display quicker recovery in SPADI and Quick-DASH scores during the first 3 months. Faster short-term recovery after arthroscopic repair can be expected in this group. At 6 months, however, Goutallier 1 and 2 had caught up in terms of functional improvement. Goutallier 0 implies higher potential of restoring abduction strength postoperatively.

Secondary Latissimus Dorsi Transfer for Residual Dysfunction after Reverse Total Shoulder Arthroplasty

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Uniklinik Balgrist

Introduction: Reverse Total Shoulder Arthroplasty (RTSA) allows restoration of overhead elevation in patients with pseudoparalysis for elevation due to irreparable rotator cuff tear. However, loss of external rotation can often not sufficiently be addressed. RTSA and Latissimus dorsi Transfer (LDT) as a single stage procedure has been described for combined pseudoparalysis of elevation and external rotation.

Secondary LDT in patients with functional loss of external rotation, which persisted or decreased after previous RTSA has not yet been studied. The aim of this retrospective study was to evaluate the clinical results of secondary LDT in such a patient group.

Methods: Between February 2006 and October 2010, ten patients were treated with LDT at a mean of 27±(4–134) months after RTSA. In 6 patients the teres major was additionally transferred according to the technique of l'Episcopo. All patients had preoperative and postoperative clinical evaluation including a structured interview and the assessment of the Constant score (CS) and the Subjective Shoulder Value (SSV).

Results: With 58 RTSA the preoperative relative CS increased from 26% (11–67) to 51% (20–100) (p = 0.05). However, patients were dissatisfied mainly because of loss of active external rotation. At a mean of 49 (23–67) months after LDT relative Constant score increased to 58% (26–100). This further increase reached statistical significance (p = 0.14) but remained significantly increased compared to pre RTSA (p = 0.021).

The SSV was 15% (0–30) before and 44% (20–70) after RTSA (p = 0.27) and 50% (30–80) after LDT (p = 0.92) which was a significant improvement compared to pre RTSA (p = 0.042).

Flexion increased from 36° (0–130°) to 86° (10–140) after RTSA (p = 0.024) and further increased to 109° (70–140) after LDT (p = 0.017). Similarly abduction increased from 31° (0–85) to 80° (40–130) (p = 0.011) and 92° (50–130) (p = 0.039).

Active external rotation decreased from 0° (~80–50) to –18° (~50–10) after RTSA (p = 0.079) and was improved to 2° (~40–40) after LDT (p = 0.024).

Discussion and Conclusion: The clinical results for these patients are inferior to the results of single stage RTSA and LDT for combined pseudoparalysis of elevation and external rotation. Secondary LDT after RTSA improved active mobility significantly, CS and SSV were improved but not significantly.

The ventral Latissimus dorsi transfer for irreparable subscapularis tears. A cadaveric study with anatomical aspects

Friederike Krupp, Christian Gerber, Dominik Meyer, Stephan Writh Uniklinik Balgrist

Background: Chronic, irreparable tears of the subscapularis tendon often result in weakness and disabling pain of the affected shoulder. If there is a combination with an irreparable superior rotator cuff tear, results of pectoralis major tendon transfers are poor and there are currently no treatment options except for total shoulder arthroplasty. We hypothesized that due to a potentially more favourable direction of pull, a ventral proximal transfer of the latissimus dorsi tendon insertion may be a new option to restore shoulder function in such patients. This anatomical cadaveric study was therefore designed to explore this new surgical option and the associated technical details and risks.

Methods: We performed a study of five human cadavers (three left and two right shoulders) fixed in Thiel solution. One shoulder was affected by a partial subscapularis tear with a concomitant medial subluxation of the long head of the biceps. Through a deltopectoral approach the pectoralis major tendon was released from its insertion at the humeral shaft. Following the exposition of the insertion of the latissimus dorsi tendon, measurements of anatomical references including the axillary nerve, the radial nerve and the musculocutaneous nerve were taken. The latissimus dorsi tendon was shifted proximally...
along the posterior surface of the conjoined tendon and fixed with transosseous sutures to the minor tuberosity where the subscapularis had been previously released.

Results: In all five cadavers the mobilization of the latissimus dorsi tendon was performed without difficulty. The distance of the proximal insertion of the latissimus tendon was 28 mm (+/-5 mm) to the axillary nerve and 27 mm (+/-5 mm) to the radial nerve, which is crossing the latissimus dorsi muscle directly on its ventral surface and must be protected together with the musculocutaneous nerve by lifting the conjoined tendon ventrally using a retractor. The mean distance of transfer was 43.2 mm (+/- 7.66 mm).

Discussion: This new surgical technique could be reliably performed in the tested cadavers and appears to be reasonably safe to the proximal neurovascular structures. As hypothesized, the latissimus dorsi tendon can be transferred to the lesser tuberosity and does anatomically insert in a favourable angle, according to its line of action simultaneously performing both internal rotation and depression of the humeral head.

Neuropathy of the Suprascapular Nerve and Massive Rotator Cuff Tears. A prospective Electromyography Study
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Introduction: An association between massive rotator cuff tears (RCT) and suprascapular nerve neuropathy (SSNN) have been previously suggested. The anatomical course of the suprascapular nerve is relatively fixed along its passage. Injury to the nerve by retraction and nerve impingement remains unclear. We aimed to prospectively evaluate the suprascapular nerve for preoperative electromyography (EMG) abnormalities in shoulders with massive RCT.

Methods & Materials: A prospective study was performed in two centers. Fifty patients with retracted tears of both supra- and infraspinatus were evaluated. This was confirmed with preoperative computed tomography (CT) arthrograms, and the fatty infiltration of the affected muscles was graded. Forty-nine preoperative EMGs were performed in a standardized fashion and the results analyzed twice.

Results: Six of 49 (12%) shoulders had neurological lesions noted on EMG, one SSNN, one radiocarpal lesion of the CS root, one affected EMG in the context of a previous stroke, three cases of partial axillary nerve palsy with a history of shoulder dislocation. No difference or diminution of the latency or amplitude of the EMG curve were found in the cases that presented significant fatty infiltration.

Conclusion: An EMG study did not detect a suprascapular lesion in the majority of cases of massive RCT. With a low association of neuropathy with massive RCT, there is no support for the routine suprascapular nerve release when performing a RCT repair.

Intraoperative fluoroscopy for ORIF of distal radius fractures
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Introduction: Intraoperative fluoroscopy is the only readily available tool to assess quality of reduction and implant placement in operative fracture treatment. Although of key importance in the everyday practice of the orthopaedic surgeon, there are no commonly accepted guidelines in the use of intraoperative fluoroscopy in terms of application, incidences, anatomic landmarks, assessment of reduction and implant placement.

Method: We have compiled and analysed the recent literature and our own experience on radiologic assessment of distal radius fractures during operative treatment. We selected appropriated techniques for intraoperative use with fluoroscopy in order to assess 1) extrarticular reduction, 2) reduction of the radiocarpal joint, 3) the DRUJ, 4) dorsal screw penetration 5) articular screw penetration, and 6) correct implant placement. In anatomic specimens we marked the anatomic landmarks with lead in order to identify them under fluoroscopy. We then reproduced the described radiologic techniques to assess their feasibility in an intraoperative setting using fluoroscopy. Standard projections were also investigated in order to give guidelines for their correct use.

Results: We identified several additional radiologic views of the wrist joint that can be used intraoperatively using fluoroscopy. An algorithm was then developed with the correct use of standard projections and additional projections to intraoperatively assess reduction and implant placement in the operative treatment of distal radius fractures.

Conclusion: Intraoperative fluoroscopy of the wrist can be standardized during operative treatment of distal radius fractures in order to correctly assess reduction and implant placement and minimise surgical errors.

Does implantation of a denatured cellulose adhesion barrier improve finger function after P1 fracture ORIF
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Introduction: Postoperative extensor tendon adhesions after osteosynthesis of finger P1 fractures often lead to results with dissatisfaction functionality. The idea of an adhesion barrier has often been mentioned. Due to unconvincing results, however, they have not reached a level of acceptance among hand surgeons. This means that the problem of postoperative adhesions remains unresolved. It is the aim of our prospective randomised trial to evaluate the value of a product consisting of denaturated cellulose.
Methods: 38 of 42 projected patients have been included between February 2010 and February 2013, of whom 32 were conclusively evaluated. The trial included all isolated and closed P1 fractures which had an indication of plate osteosynthesis. The trial excluded patients with multiple injuries and those with pre-existing functional deficits. Pre-operative randomisation into two groups (with or without application of the adhesion barrier). Measurement after 6 weeks and 6 months after surgery of range of motion as an expression of functionality of the affected finger in comparison with the unaffected opposite side and measurement of DASH score. Recording of need for intraoperative tenolysis as part of the metal removal six months after osteosynthesis.

Results: After six weeks, the group which had been treated with an adhesion barrier showed a significantly better ROM and DASH score. After six months, both groups showed practically identical measurements. One patient refused further check-ups, two patients had to be excluded due to infection of excessive screw lengths.

Conclusion: The results after six weeks are interesting, as they indicate clearly better results for the group with adhesion barrier. It remains to be discussed why the results of both groups were practically identical after six months. The risk of infection when cellulosis matrix is used will have to be critically monitored. One infection had to date been detected in a patient with adhesion barrier. After analysis of the so far acquired data the use of such a device has to at least be questioned. Final results of the entire patient group will have to be obtained before conclusive recommendations to the standardised use of adhesion barriers can be made.

Ligament origins are preserved in distal radial intraarticular two part fractures: A computed tomography based study

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Background: Operative fixation of displaced intraarticular distal radius fractures is increasingly common. A greater understanding of fracture patterns will aid surgical fixation strategy. Previous studies have suggested ligamentous insertions may less commonly be involved, but these have included heterogenous groups of fractures and have not addressed listers tubercle.

Hypothesis: Fracture lines of distal radial intraarticular two-part fractures (DRIF's) have reproducible fracture patterns. They propagate through the cortical bone between ligament origins and do not involve Lister's tubercle.

Methods: Axial CT scans of 2 part intraarticular distal radius fractures were assessed. The fractures were mapped onto a grid and the cortical breaches measured and expressed as a percentile of the total radial width or length. The cortical breaches were compared to the known ligamentous insertions on the distal radius of the long and short radioluminate, the radioscapohacipitate, dorsal radial carpal ligaments and listers tubercle. Associated injuries were also documented.

Results: The cortical breaches occurred between the ligamentous insertions in 85%. Listers tubercle was not involved in 95% of fractures. Three major fracture patterns emerged; radial styloid, dorsal and volar. Each major fracture had 2 subtypes. Associated injuries were common. Scapholunate dissociation was associated with all types, not just the radial styloid fracture pattern.

Conclusion: The fracture pattern of 2 part intraarticular fractures mostly involved the interligamentous zones. Three major groups were identified. Radial styloid Dorso-ulnar, and volar. Listers tubercle was preserved with fractures tending to pass radial or ulnar to this structure.
Infection and functional outcome of hip and knee Prosthetic Joint Infection – A retrospective multicenter study
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Introduction: Prosthetic joint infections (PJI) lead to significant long-term morbidity with high costs of healthcare.

Objectives: We evaluated outcome of hip and knee PJI in two centers over a 14-year period.

Methods: Hospital charts of patients aged >18 years presenting with a hip or knee PJI from 1995 to 2008 were reviewed, stratified according to whether a treatment algorithm (Zimmerli W, NEJM 2004) was followed. Good outcome was defined as functional prosthesis in place and significant reduction of pain allowing return to normal daily activities.

Results: We included 272 episodes, 193 hip and 79 knee PJI (median age 72 years, range 19–102 years, 53% males) with a median follow-up of 3.4 years (range 0.1–4.2 years). PJI were treated with (i) debridement & retention without change of mobile parts in 30 cases (11%), (ii) debridement & retention with change of mobile parts in 99 cases (36%), (iii) 1-stage exchange in 21 cases (7%), (iv) 2-stage exchange in 100 cases (37%), and (v) definitive prosthesis removal in 18 cases (6%). 170 patients (63%) were treated according to the algorithm. The infection outcome was overall favorable in 82% and differs according to surgical treatment: 40% for debridement without change of mobile parts, 81% for debridement with change of mobile parts, 76% for 1-stage exchange and 92% for 2-stage exchange.

Microbiological cure was reached in all patients, but in 34 cases by definitive prosthesis removal. Final functional outcome was significantly better when treated according to the algorithm (76% vs 24%, p < 0.0001). The best functional outcome was achieved with debridement & retention with change of mobile parts (93%), compared to 70% for debridement & retention without change of mobile parts, 80% for 1-stage exchange, and 70% for 2-stage exchange.

Conclusion: Debridement & retention without change of mobile parts is often associated with failure. Debridement & retention with change of mobile parts have excellent results. Eradication of infection was associated with a good functional outcome in 76% if the algorithm was followed, compared to 24% when it was not.

Does spacer usage in prosthetic joint infections influence infect resolution?
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Background: Since two-stage exchange is the most common strategy for treating prosthetic joint infections the use of spacers during the interval before reimplantation remains discussed controversially. We investigated the influence of antibiotic-loaded cement spacers on microbiological cure and clinical outcome.

Methods: 120 consecutive patients with confirmed infection of total hip arthroplasties [THA] or total knee arthroplasties [TKA] were treated with a two-stage exchange concept. Patients were retrospectively allocated in two groups: patients with and patients without spacer implantation. Our hypotheses were primarily that spacer implantation improves the overall success rate regarding infect resolution and secondary, that spacer implantation reduces the success rate in patients with bacteria graded as “difficult to treat.”

Results: Patients with and without spacer implantation did not vary significantly in age, sex, weight, height, and body mass index (BMI). A backward-stepwise multivariate logistic regression model neither showed an association between spacer use and definitive infect resolution with an adjusted odds ratio of 1.2 (95% CI 0.4 to 3.2) at a p-value of 0.756 nor between spacer use and clinical infect resolution with and adjusted odds ratio of 1.0 (95% CI 1.0 to 1.70) at a p-value of 0.056. Again spacer use and “laboratory infect resolution” with an adjusted OR of 4.3 (95% CI 0.7 to 27.9) at a p-value of 0.127 did not show a significant correlation. Additionally we were not able to show any adjusted significant association between infectious organisms graded as “difficult to treat” and spacer use effectiveness.

Conclusion: Our data does not support the use of spacers regarding infect resolution in prosthetic joint infections treated in a two-stage exchange. Infectial organisms “difficult to treat” did not show a significant association with infect resolution and spacer use either.

Increased risk of infection in MIS total hip arthroplasty with an anterior approach?
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Kantonsspital BL Liestal

Introduction: MIS hip replacement has an increasing popularity but there is a lack of data concerning probable complications. The minimally invasive direct anterior approach (Smith Peterson, MIS) was introduced as routine procedure at our hospital. Patients were followed in a prospective cohort study and we observed problems in wound healing. The purpose of this work is 1) to evaluate the prevalence of infection and 2) to identify patient-related risk-factors for infection.

Methods: 601 consecutive hips in 551 patients (286 males, mean age 70 years) undergoing MIS primary hip replacement since 03/2009 have been included, no patient was lost to follow-up. Standardized clinical and radiological data were collected. Infection was diagnosed in case of presence of symptoms, delayed wound exsudation, a fistula, at least two positive microbiological samples or positive histology.

Results: There were 12 cases of infection (2.0%). Coagulase-negative staphylococci were the most frequent pathogens (9/12, 75%). In 58% of cases, polymicrobial infections were present. Among them, pathogens that could be attributed to fecal flora (enterococci, enterobacteriaceae, anaerobes) were found in 42%. Ten infections occurred within ninety days after operation, the median time to the diagnosis of infection was 13 days (10 to 416 days). All infected hips were re-operated. In nine cases, an early debridement was performed and in three cases an exchange of the implants (2 two-stage revisions and 1 one-stage revision).

A higher BMI (mean BMI 33.6 vs 26.9, p < 0.001) and a higher ASA Score (p < 0.001) were found for the infected group. Gender, age, diabetes mellitus, elective/nonelective or transfusion/no transfusion showed no differences.

Conclusions: The infection rate for the studied MIS cohort was rather high (2.0%) compared to published data in conventional hip replacement (0.5 to 1.0%). The high proportion of polymicrobial infection and fecal pathogens points to a critical role of the skin flora in the groin and near the incision site. A more lateral incision leading away from the groin might be preferable, especially in obese patients. But further data are necessary to ensure that infection is not the major disadvantage of the MIS anterior hip replacement.

Performance and cost evaluation of Gram and Acridine staining for prediction of septic arthritis stratified among different patient populations
Gregory Cunningham, Khalid Seghrouchni, Pierre Hofmeyer, Ilker Uckay
H.U.O. Genève, RSV Sion

Background: Gram staining has a low sensitivity in the diagnosis of native joint septic arthritis. Little is known about the accuracy of other staining techniques or among patients with arthroplasty infections, ongoing antibiotic medication, immune suppression, gout or other crystal arthropathies.

Methods: Cohort study with cost evaluations at the Orthopedic Service of Geneva University Hospitals January 1996-October 2012. Patients with and without spacer implantation did not vary significantly in age, sex, weight, height, and body mass index (BMI). A backward-stepwise multivariate logistic regression model neither showed an association between spacer use and definitive infect resolution with an adjusted odds ratio of 1.2 (95% CI 0.4 to 3.2) at a p-value of 0.756 nor between spacer use and clinical infect resolution with and adjusted odds ratio of 1.0 (95% CI 1.0 to 1.70) at a p-value of 0.056. Again spacer use and “laboratory infect resolution” with an adjusted OR of 4.3 (95% CI 0.7 to 27.9) at a p-value of 0.127 did not show a significant correlation. Additionally we were not able to show any adjusted significant association between infectious organisms graded as “difficult to treat” and spacer use effectiveness.

Conclusion: Our data does not support the use of spacers regarding infect resolution in prosthetic joint infections treated in a two-stage exchange. Infectial organisms “difficult to treat” did not show a significant association with infect resolution and spacer use either.

Performance and cost evaluation of Gram and Acridine staining for prediction of septic arthritis stratified among different patient populations
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Background: Gram staining has a low sensitivity in the diagnosis of native joint septic arthritis. Little is known about the accuracy of other staining techniques or among patients with arthroplasty infections, ongoing antibiotic medication, immune suppression, gout or other crystal arthropathies.

Methods: Cohort study with cost evaluations at the Orthopedic Service of Geneva University Hospitals January 1996-October 2012. Results: Among 500 arthritis episodes (196 with immune suppression; 227 with underlying arthropathies; 69 with gout or other crystals in microscopic synovial count), Gram staining revealed pathogens in 146 episodes (146/500, 29%) or in 146 of 400 culture-positive episodes (37%), while acridine staining yielded pathogens in 100 of 400 culture-positive episodes (25%). Correlation between the Gram and acridine staining of the same examination was good (Spearman 0.85).

Overall, the sensitivity, specificity, positive and negative predictive values for the prediction of culture-positive arthritis was 0.37, 0.99, 0.99, and 0.28, respectively. Sensibility values were similar for subgroups of the study population. It was 0.33 for arthroplasty infections, 0.40 in immune suppressed patients, 0.36 in patients under antibiotic administration and 0.52 with concomitant synovial crystals. For culture-negative cases, the Gram and the acridine staining caused 45% of all laboratory costs, for culture-positive cases both stainings made 25% of the expenditures.

Conclusion: The sensitivity of Gram or acridine staining for the prediction of culture-positive arthritis is low, independently of underlying material, ongoing suppression, or antibiotic therapy. The sensitivity in presence of synovial fluid crystals is moderate. Acridine orange reveals the same performance as Gram staining. Considering the costs, both staining cannot be supported as necessary diagnostic tool for septic arthritis.
Are infantile non tuberculous spondylodiscitis mostly due to Kingella kingae? A prospective study

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Study design: Prospective study to gather clinical, paraclinical, and radiographic data of spondylodiscitis of children aged between 6 and 48 months, and to test a new bacteriological diagnosis’ approach.

Objectives: To analyze and assess the clinical, laboratory, and radiologic findings in children aged between 6 and 48 months, and to document the efficacy of a new approach of the diagnostic algorithm based on K. kingae-specific real-time polymerase chain reaction (rtPCR) assays from peripheral blood and throat swabs.

Background Data: Infantile form of spondylodiscitis is a rare entity that often presents with a mild-to-moderate non-specific clinical picture. Laboratory studies generally demonstrate an increased ESR, whereas WBC count and CRP can be normal or slightly elevated. Blood cultures are usually negative, and identification of the causative can be difficult even on disk or vertebral aspiration. Assessment of the clinical manifestations, and of the biologic microbiologic characteristics is essential for prognosis and for justification of the nonoperative treatment.

Methods: Ten children (4 girls and 6 boys) with a mean age of 24 months (range: 13 to 39 months) were hospitalized for spondylodiscitis between January 2009 and December 2012. Parameters related to the duration of symptoms, clinical manifestations, diagnostic workup, and course of the treatment were prospectively collected.

Results: All the children presented with uncharacteristic signs and symptoms. The laboratory markers of inflammation were only moderately elevated. The diagnosis of spondylodiscitis was established in average after a delay of 29 days (range: 3 to 62 days). Blood cultures taken as initial investigations were all negative. K. kingae-specific rtPCR assays were positive in peripheral blood in two cases, whereas the test was always positive on throat swabs.

Conclusions: Our study showed that the course of spondylodiscitis in children aged between 6 and 48 months is characterized by a mild-to-moderate clinical and biological inflammatory response. It suggests also that detecting K kingae DNA in the oropharynx provided strong enough evidence that this microorganism is responsible for the spondylodiscitis. Early bacteriological diagnosis can thus prevent unnecessary testing and invasive intervention.

Is there a place for conservative treatment of osteomyelitis of the hallucal sesamoids? A monocentric case series study

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Introduction: Osteomyelitis of the hallucal sesamoids in young and healthy patients is a rare entity, and may originate from a hematogenous spread. But in diabetic patients with peripheral neuropathy it often results from direct contiguous seeding from adjacent ulceration. In our institution, all patients are treated conservatively, before eventually requiring a surgical procedure. We present a monocentric case series, in order to determine the effectiveness of a conservative therapy for osteomyelitis of hallucal sesamoids. To our knowledge, no such study has been conducted yet.

Material & Method: We reviewed 18 patients (4 women and 14 males) / 18 feet with a clinical and radiological diagnosis of osteomyelitis of the hallucal sesamoids treated in our institution during a 13 year period (2000–2012). The inclusion criteria were a signal alteration on MRI, CT or conventional radiography, combined with clinical symptoms. Conservative therapy consists in frequent wound treatment, immobilisation in a cast or other device, and empirical oral antibiotics.

Results: Among the 18 patients, 11 were diabetic, 14 had a peripheral neuropathy, 10 had a peripheral arterial disease, 10 were immunosuppressed. After a period ranging from 4 weeks to several month of conservative therapy, 83% (15/18) patients/feet required surgical debridement, excision, internal resection or amputation.

Conclusion: Most of the patients in the present study (14/18) were either diabetic, vascular or have a peripheral neuropathy. In this population, conservative therapy does not seem to be a valuable option. Patients should be advised, before starting a conservative therapy, that treatment takes long and is demanding, and very often ends with a surgical procedure.

Surgical Treatment of Calcaneal Osteomyelitis in the Diabetic Patient

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Introduction: Calcaneal osteomyelitis (CO) is a common complication of diabetic foot ulcers. Both knee amputation and two stage calcanectomy, and eight below-knee amputation. Demographic and clinical characteristics at time of diagnosis, complications during follow up and need for revision surgery were documented.

Results: Mean follow-up after initial diagnosis was 76 ± 36 months (range 3–140 months). Sensory neuropathy was present in all 19 patients (100%), additional peripheral vascular disease in twelve (63%) and nicotine abuse in eight (42%). Most isolated pathogenic microorganisms were coagulase-negative Staphylococci, followed by Staph. aureus and E. coli. Patients who initially underwent subtotal calcanectomy required secondary below-knee amputation in two cases (22%) and secondary total calcanectomy in one case (11%). One patient with primary total calcanectomy needed secondary below-knee amputation (50%). In one patient with primary below-knee amputation, secondary knee exarticulation was necessary (13%). Four out of five patients (80%) with revision surgery had additional peripheral vascular disease, one out of five (20%) nicotine abuse. Four patients died during follow up due to reasons not directly related to the interventions.

Conclusions: (Sub)total calcanectomy in diabetic patients with calcaneal osteomyelitis is associated with a high rate of secondary below-knee amputations. In patients with additional risk factors as peripheral vascular disease it can therefore not be recommended as an alternative to below-knee amputation.

Short anterior correction of double major adolescent idiopathic scoliosis compared to standard posterior technique

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Uniklinik Balgrist

Introduction: Short anterior correction is an accepted method of treatment for single thoracic curves as well as for single thoracolumbar and lumbar curves in adolescent scoliosis (AIS). For double major curves, the standard of treatment is the anterior short correction of both curves from posterior. The purpose of this study was to compare the novel technique of anterior short correction of double major curves to standard posterior pedicle screw instrumentation.

Methods: 19 consecutive patients with a double major AIS were treated surgically either by standard posterior pedicle screw instrumentation (n = 11) or by anterior short instrumentation (n = 8). All patients were followed at least 2 years (mean 5.6 ± 3 years, range: 2 to 10 years) clinically, radiographically and with pulmonary function tests. Patients’ satisfaction was assessed with SRS-24 questionnaire.

Results: The curves were similar, the upper curves being 54 ± 7° and 59 ± 13°, lower curves being 63 ± 15° and 55 ± 9° in the anterior and posterior group, respectively. The upper curve correction was 77% in the posterior group and 72% in the anterior group. The lower curve correction was 70% in the posterior group and 56% in the anterior group. The amount of fused vertebrae was 76 ± 0.7 in the anterior and 12 ± 1 in the posterior group. The preoperative pulmonary function (%FVC) of 70–79% remained unchanged to the last follow-up in both groups. Patients’ satisfaction assessed by SRS-24 questionnaire was high in both groups without statistical difference (SRS score range 98-101 at the last follow up).

Conclusion: Significantly less motion segments were fused to achieve a satisfactory correction through anterior instrumentation in double major curves of AIS. Pulmonary function and patients’ satisfaction were comparable in anterior and posterior techniques.
Incidence and Risk Factors for Early Adjacent Vertebral Fractures after Balloon Kyphoplasty for Osteoporotic Fractures – Analysis of the SWISSspine Registry
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Purpose: The SWISSspine registry was launched in 2005 to assess the safety and effectiveness of balloon kyphoplasty (BKP). In the meantime, repeated reports on high rates of adjacent vertebral fractures (ASF) after BKP of vertebral insufficiency fractures were published. The causes for ASF and their risk factors are still under debate. The purpose of this study was to report the incidence and potential risk factors related to adjacent vertebral fractures within the SWISSspine registry database.

Methods: The SWISSspine data points are collected perioperatively and during follow-ups, with surgeon- and patient-based information. All patients documented with a monosegmental osteoporotic vertebral insufficiency fracture between March 2005 and May 2012 were included in the study. The incidence of ASF, potential predictors (patient age, gender, fracture location, cement volume, pre- and postoperative segmental kyphosis) and influence on quality of life (EQ-5D) and back pain (VAS) are analyzed.

Results: A total of 375 patients with a mean follow-up of 3.6 months were included. ASF was found in 9.9% (n = 37) and occurred on average 2.8 months after surgery. Preoperative segmental kyphosis >30° was found to be a significant predictor for ASF (p = 0.025). Further on, patients with ASF had significantly higher back pain at the final follow-up. No further predictors for ASF were revealed in the adjusted analysis.

Conclusion: The findings suggest that patients with a preoperative segmental kyphosis >30° are at high risk of ASF within three months after the index surgery. In case of an ASF event, back pain levels are significantly increased.

Reduction of cement leakage by sequential PMMA application
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Introduction: Cement leakage is the most common complication of percutaneous cement augmentation of the spine (vertebroplasty/kyphoplasty) which, if present, can cause severe complications like pulmonary embolism. The viscosity of the polymethylmethacrylate (PMMA) cement is one main factor of the aetiology of cement leakages. Different application techniques can influence the viscosity of the PMMA cement during the polymerization gradient between body and room temperature. The aim of this study was to evaluate different augmentation techniques ("all-in-one", "2-step", "sequential") concerning their ability to avoid cement leakage and concerning optimal cement distribution in the vertebral body.

Material and Methods: For this study standardized vertebra models with a preformed leakage-path, simulating a ventral vein, were used. 3 different injection techniques of 6ml PMMA were defined: "all-in-one" (application of 6ml PMMA in one single step), "2-step" (application of 1ml PMMA within 30s, 1 Min of holding time, application of 5ml PMMA), and sequential (sequential application of 0,5 ml PMMA, 1 Min holding time between the application steps). The application was performed via a 8 Gauche standard vertebroplasty needle in a 37,5 °C water bath at a room temperature of 19 °C. Standard PMMA vertebroplasty cement was used (Vertecem+, Synthes, Bettlach, Switzerland). The application was started 4 Min after the mixing process as suggested by the company. The leakage was assessed using a zonal graduation of the applied cement in a standard x-ray (1:intraspongious (= no leakage), 2: extraspongious/leakage, 3: extracortical (= great leakage)).

Results: There were 10 vertebral body models used per groups. Leakage was significantly reduced in the "sequential" group (2/20 leakages) compared both other groups ("All-in-one" 20/20 leakages, "2-step": 15/20 leakages) (Chi-Square 36.5; P <0.001). Compared to the "sequential" group leakage was 10 times higher in the "All-in-one" group, and 27-times higher in the "2-step" group.

Discussion: The sequential cement augmentation is a safe method to avoid leakage in the vertebral body. Using the temperature gradient between body and room temperature accelerates the polymerization progress of the PMMA cement in the vertebral body. By using sequential application of small cement amounts possible leakage paths were blocked before reapplication of the low-viscous cement. In how far these results are reproducible in clinics is topic of ongoing studies.

Prophylactic adjacent segment vertebroplasty during kyphoplasty in single segment osteoporotic vertebral fractures – A radiographic analysis
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Introduction: Percutaneous kyphoplasty (PK) is an option to treat painful osteoporotic compression fractures. The most frequently observed complications are adjacent segment fractures (ASF). Little information exists about the benefit of prophylactic adjacent segment augmentation of the adjacent vertebrae. Thus, it was the aim of this study to investigate the benefit of prophylactic vertebroplasty (PV) in single segment osteoporotic vertebral fractures treated with PK.

Methods: From January 2007 to August 2012 68 patients treated with PK for painful osteoporotic single segment compression fractures were included for this retrospective study. Patients were treated, according to surgeon’s preference, with PK alone or with additional PV of the adjacent segment(s). General data of all included patients (gender, age, hospital stay, fracture level, complications) was taken from medical records and operation protocols. The radiographic assessment consisted of plain lateral radiographs preoperatively, immediately postoperatively, at 5 months and at final follow-up. The fractures were classified analog to the AOspine classification system and the segmental kyphosis angle was measured on each radiograph. The occurrence of new vertebral fractures was assessed for patients with a significant PV and without PV.

Results: A total of 60 patients met the inclusion criteria. 2 patients died and 7 patients had incomplete follow up. 52 (87%) patients (45 females) with a mean age of 73.5 years (range Y-Y) and a mean follow-up of 401 days were included for the analysis. In most of the patients (71%) the fracture was between Th10 and L2. 23 patients were treated with PV and 29 with PK only. The two groups did not differ significantly concerning age, gender, hospital stay, fracture location, segmental kyphosis, follow-up and complications.

Conclusion: Prophylactic vertebroplasty of adjacent vertebra could not lower the risk of ASF in patients with single segment osteoporotic vertebral fractures. Therefore it ‘s benefit is questionable considering possible complications and higher costs.

The patient’s perspective on the outcome of surgery for lumbar degenerative scoliosis
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Introduction: The treatment of degenerative lumbar scoliosis (DLS) represents an increasing challenge, with the demand for surgery rising but the indications for appropriate treatment remaining controversial. Most studies to date have only examined outcome from the clinical and radiological perspective; few have evaluated patient-oriented outcomes. We examined patient outcomes in a consecutive series of patients being treated for DLS by simple decompression, limited fusion, or full correction with longer constructs.

Material and Methods: Our local spine surgery database (part of the Eurospine Spine Tango Registry) was used to acquire the data from patients with DLS as the main pathology undergoing first-time surgery at least 12 mo ago, using decompression (D) and/or fusion (F) as the operative procedure. Pre-operatively and at 12 mo follow-up (FU), patients completed a 35-item lumbar dimension of the Core Outcome Measures Index (COMI: 0-10); at 12 mo FU, global outcome was rated on a Likert-scale and dichotomized as ‘good’ and ‘poor’.

Results: 175 patients took part (121 (69%) women, 54 (31%) men). 83 (47%) patients underwent D alone at 1 to 5 levels (mean ± SD 2.2 ± 0.8 levels), while 92/175 (53%) patients underwent F of 1 to 7 levels (2.6 ± 1.5), 79% with D and 21% without. 53 patients had short F (≤2 segments) and 39 long F (>3 segments). The D group was significantly (p <0.0001) older (76 ± 7y) than the F group (66 ± 11 y) and had higher comorbidity (p = 0.0001). All groups benefited significantly from surgery without significant difference between them: improvement in COMI was 3.2 ± 2.9 for D, 3.5 ± 3.1 for short F and 3.2 ± 2.7 for long F (p = 0.84); good global outcome was 68% for D, 79% ± 3.2 for short F and 78% for long F (p = 0.39). Patient-rated complications were not significantly different between the groups (p = 0.99).

Discussion: Despite the high complexity of the disease, patient-oriented outcomes were similar to those reported using the same instruments in conditions such as lumbar stenosis and degenerative
spondylolisthesis. There was a tendency for better results in the short fusion patients; this should be further investigated in larger groups. In good results from the patient’s perspective. This most likely reflects conclusion, both decompression and fusion for DLS yielded similarly careful and appropriate patient selection. Further analyses are warranted to identify baseline variables predicting the 20–30% cases with poor outcome.

### Relationship between sedimentation sign and morphological grade in symptomatic lumbar spinal stenosis

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**Introduction:** There is no consensus on the radiological classification of lumbar spinal stenosis (LSS). Dural sac cross sectional area has been the main radiological measurement used in clinical practice but it does not always correspond to the degree of entrapment of the neural structures. The morphological grading of stenosis based on the rootlet/cerebrospinal fluid relationship as seen on axial MRI images and comprised of 4 grades (A to D) has been shown by its proponents to carry a prognostic value with C and D grades being strong predictors of failure of conservative measures. Simultaneously another research team described the sedimentation sign, measured also on axial MRI images but at the level of the pedicle adjacent to the maximal stenosis level with a view to discriminate patients with neurological claudication from asymptomatic persons. The aim of our present study is to find the relationship between those two radiological descriptions.

**Material and methods:** A total of 137 patients divided in three groups were included in this study. The first two groups comprised 110 patients with symptomatic LSS of whom 69 were treated surgically and 41 conservatively. A control group of 27 subjects with low back pain and no claudication (LBP) constituted the third group. We examined MRI images using Osirix software and studied the morphological grades of stenosis at disc level and looked for evidence of positive sedimentation sign, the latter being measured above or below the level of maximal stenosis, at pedicle level.

**Results:** No patient with grade A morphology had a positive sedimentation sign, while it was present in 58% of those with grade B stenosis. In patients with grade C and D the sedimentation sign was positive in 69% and 76% of cases respectively. The sedimentation sign was positive in 66% (46/69) of the surgically treated patients, in 39% (16/41) in the conservatively treated patients and only in 8% (2/25) of the LBP patients. Comparing patients with symptomatic LSS (both surgically and conservatively treated) and LBP subjects, we found that the presence of a sedimentation sign in the LSS group has a sensitivity of 56%, a specificity of 93%, a positive predictive value of 77% and a negative predictive value of 34%. The presence of a positive sedimentation sign carried an odds ratio (OR) of 16 between those two groups. In the group of patients with LSS who were either treated surgically or conservatively the presence of a sedimentation sign in the surgical group carried a sensitivity of 66%, a specificity of 60%, a positive predictive value 74% and a negative predictive value of 52%. The positive sedimentation sign carried an OR of 3.13 between the two LSS groups.

We found the presence of C or D morphological grades in 97% (67/69) of the surgical group, in 41% (17/41) of the conservative group and in 18% (5/27) of the LBP group. The presence of a C or D grade was a strong predictor of surgical treatment in the LSS group with an OR of 47 (P <0.001).

**Discussion:** In this cohort of patients we found that the presence of a C or D stenosis grade was a stronger predictor of failure of conservative treatment than the presence of a positive sedimentation sign. Even though the sedimentation sign might be useful in identifying patients belonging to a claudicating or non-claudicating population, it might be less useful in deciding which patient needs surgical treatment. Additionally it is measured at the pedicle level it is probably not suited in deciding which levels need to be surgically decompressed.

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**Spinal fusion versus non-operative treatment in patients with chronic low back pain: An average 11-year follow-up of three randomized controlled trials**

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**Introduction:** Chronic LBP (cLBP) is a complex and poorly understood problem and continues to be a major challenge to our healthcare systems. The relative efficacy of surgery over non-operative care for the treatment of cLBP remains controversial, and little is known of the long-term outcomes. This study compared the clinical outcome at long-term follow-up (LTFU) (average 11.4 (range 8–15) years) of patients who were randomized to either spinal fusion or non-operative treatment in three multicentre randomized controlled trials.

**Methods:** Participants were 473 patients with cLBP of at least 1 year’s duration who were all considered candidates for spinal fusion. Treatment comprised lumbar spine fusion (instrumented or non-instrumented) or non-operative treatment (multidisciplinary cognitive-behavioral and exercise rehabilitation program). The primary outcome was the Oswestry Disability Index (ODI). An ODI score of 10% was considered a meaningful improvement towards better results SF group could be show, due to the small sample number in the subgroups these findings should be interpreted carefully. The relevance of fixed-angled fixation of stand alone cages for the long-term outcome, as assessed before studies (1), should be evaluated in larger cohort studies.

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**ALIF L5/S1 with stand-alone-cages: long term follow up**

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**Introduction:** Anterior lumbar interbody fusion (ALIF) is associated with low approach-dependent morbidity and shows good mid-term results (1). Few long-term results have been published, especially for stand-alone cages.

**Material/Methods:** In a retrospective study, all patients who had undergone male-unionial ALIF L5/S1 from 2003–2008 were clinically and radiologically re-assessed. Two different cages with and without fixed angle (SynFix (SF)/ Synseal (SC) both Synthes, Switzerland) fixation were used as stand-alone implants. Radiological analysis concerning both fusion and adjacent segment degeneration (ASD) was assessed using standard radiographs including functional X-rays. For clinical outcome self-assessment questionnaires of the Spine Tango data bank (ODI, SF-12, EQ-5D, COMI) and a questionnaire based on Grob et al (2) was used.

**Results:** 54 patients could be included in the study (mean age 49.3 years ± 11.1, range 25 – 84, male 26: female 28). Mean follow-up time was 55.87 months (±18, range 28 – 102). Signs of stable bony fusion was observed in 92.3% (48/52) of the patients. In the functional X-rays 95.3% (47/49) were judged as stable. Radiological signs of ASD, in terms of decreasing disc height, was found in 17% (8/47). The revision rate during the FU period was 12.5% (7/54) (3x pseudarthrosis L5/S1, 1x persisting remaining disc protrusion L5/S1, 1 x unclear persisting radicular pain without radiological correlation). Symptomatic ASD caused intervention in 6 patients (2x decompression, 4x fusion), in follow up-back pain improved in 89%, leg pain in 93% of patients. 82% stated global subjective improvement. 93% would undergo the surgery again. In some sub-terms (SF-12: body pain; COMI: postoperative leg pain (VAS soxon = 0.037; quality of life (Fisher = 0.009)) the outcome in the SF group was significantly better compared to the SC group. There was no correlation between radiological and clinical outcome.

**Discussion:** Stand-alone monosegmental ALIF L5/S1 shows favorable long-term results. Fusion rate is high. The rate of re-operations, especially caused by symptomatic ASD, is low. No correlation between radiological fusion and clinical outcome could be shown. Results are good concerning postoperative development of pain, quality of life and function. Even the tendency towards better results SF group could be show, due to the small sample number in the subgroups these findings should be interpreted carefully. The relevance of fixed-angled fixation of stand alone cages for the long-term outcome, as assessed before studies (1), should be evaluated in larger cohort studies.

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**Results:** 140/242 patients randomized to receive surgery and 121/231 randomized to receive non-operative care were available for LT FU. The intention-to-treat analysis showed no statistically or clinically significant differences between treatment groups for ODI scores at LT FU (adjusted for age, sex, smoking habit, previous surgery, duration of LBP and baseline ODI): the mean adjusted treatment effect of fusion was –1.4 points on the 0–100 ODI scale (95% confidence interval, –5.8 to 4.5). There were no significant group differences for any of the adjusted values for the secondary outcomes.

**Discussion:** After an average of 11 years follow-up, there was no difference in patient self-assessment outcomes between fusion and non-operative treatment for cLBP. The results suggest that, given the increased risks of surgery and the lack of deterioration in non-operative outcomes over time, the use of lumbar fusion in cLBP patients should not be favored in healthcare systems where combined physical and psychological programs are available.
What score on the Oswestry disability index indicates a satisfactory symptom state?

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Introduction: The achievement of a given change-score, e.g. a 15-point reduction on a 0–100–scaled instrument, is often used to indicate clinically-relevant change after spine surgery. However, the achievement of such a change 1) depends on the initial preoperative score and 2) does not indicate whether a satisfactory symptom state is ultimately reached. The achievement of an absolute score equivalent to a satisfactory symptom state may be a more stringent measure of success; we quantified this score for the Oswestry Disability Index (v2.1).

Methods: 532 patients undergoing lumbar spine surgery completed the ODI and the Core Measures Outcome Index (COMI) at various times up to 4y after surgery. The COMI item “If you had to spend the rest of your life with the symptoms you have right now, how would you feel about it?” was responded to on a 5-point Likert scale from “very satisfied” to “very dissatisfied.” Two receiver operating characteristics (ROC) analyses were used to derive cut-off scores for ODI that best predicted being 1) at least “satisfied” and 2) “very satisfied” with the symptom state.

Results: 114/532 (21%) patients were ≥satisfied and 43 (8%) “very satisfied” with their symptom state. The ROC area under the curve was 0.69 (95% CI 0.65–0.73) for “satisfied” and 0.92 (95% CI 0.90–0.94) for “very satisfied” indicating the ODI discriminated well. The ODI-score cut-off predicting a ≥satisfied state was ≤29 points (sens, 88% and spec 75%) and a “very satisfied” state, ≥14 points (sens, 86% and spec 89%).

Discussion: Whilst change scores show the achievement of improvement after surgery, they may give a more optimistic view than when the proportion of patients achieving a satisfactory state is examined. In the absence of valid “norm values” for condition-specific questionnaires, the ODI-score requiring an ODI score equivalent to a satisfactory/very satisfactory state might represent a more appropriate criterion when assessing the success of surgery.

Perforations and Bacterial Contamination of Microscope Covers after Spine Surgery

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Background: Recent studies pointed out the possible role of bacterial shedding by surgical microscopes. The aim of the study was to determine the integrity of microscope covers after spinal surgery and to assess a possible correlation with the amount of bacterial contamination.

Methods: A prospective study of 25 consecutive spinal interventions with the use of a surgical microscope was performed. To assess for potential perforations of the microscope covers, these were filled with water after surgery and the presence of water leakage in three zones (objective, ocular, control panel) was documented. Microbiological smears were taken from each of the covers at the same locations before and after surgery. To determine our institution’s wound infection rate after decompressive spinal surgery with use of a microscope, we retrospectively identified 265 patients that had undergone these interventions during the two years preceding the aforementioned investigation.

Results: One small perforation in 1/25 covers was observed which did not lead to bacterial contamination; 3/25 smears from 25 covers showed postoperative bacterial contamination, two in the ocular cover and one in the optical zone, without proof of a cover perforation. The infection rate in our clinical series of 265 patients was 1.1%.

Conclusions: Both, the rate and quantity of contamination and especially the occurrence of cover perforation were rather low. Infections after decompressive spinal surgery with use of a microscope were rare. Thus, the use of a surgical microscope with a foil cover is associated with an acceptable risk of infection.

The lumbar Spines of Professional Beach Volleyball Players – High Incidence of Spondylolysis

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Background: Beach volleyball is an Olympic overhead sport since 1996. Many professional players suffer from low back pain. It is not much known which clinical and imaging findings are normal and which are associated with symptoms.

Hypothesis: Due to the high rate of low back pain in professional beach volleyball players there is a high incidence of pathological findings in the magnetic resonance tomography, such as degeneration of the intervertebral discs, injuries, pars fractures and spondylolysis compared to the normal population.

Study Design: Cross-sectional study.

Methods: During the Beach Volleyball Grand Slam 2012 Tournament in Klagenfurt, Austria, 29 professional male players underwent a questionnaire-based interview (Roland Morris, SF 36) and a complete physical and neurological examination of their spine, including a MRI of their lumbar spine.

Results: The mean age of the athletes was 28.2 years. 86.2% suffered low back pain, 62.1% during the last year, and 31% during the last 4 weeks. The intensity of pain, rated with the visual analog scale (VAS 0–10 points) was median 3 points, 25% of 29 (86%) players showed degeneration of intervertebral discs (Pfirrmann Grade >II). Spondylolysis was found in 6 of 29 (13.8%) players. 5 of these had a defect of the pars interartikularis in L5W 5. 6.9% showed a spondylolisthesis Meyerding Grade I. Only 21% used NSAIR on a regular basis, 50 % underwent medical treatment such as PT. All players were fully competitive at the time of examination.

Conclusion: The prevalence of spondylolysis and degeneration of the intervertebral disc in professional beach volleyball players is 13.8%, respectively 9.6%. This is significantly higher than in the normal age-matched population. Most of the examined, fully competitive players, have suffered low back pain but only few had to interrupt training or tournament caused by pain. Therefore, abnormal clinical and imaging findings in the lumbar spine of beach volleyball players should be interpreted with care.

Keywords: lumbar spine, degeneration, lower back pain, professional; sports injury; overuse; volleyball; beach volleyball;
Ponseti Treatment in older and previously treated child using below knee semi-rigid fiberglass cast (SoftCast®): efficiency and limits
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Introduction: Long leg casting is necessary in newborns for proper foot fixation and correction during treatment for clubfoot. The majority of Ponseti treatment since 2001 and did not appreciate any difference in terms of duration of treatment compared with regular plaster cast. SoftCast® is lighter and easier to remove. To improve compliance we also use fixation below the knee in children older than 2 years allowing the child to walk free during treatment. The purpose of this study is to evaluate the efficiency of Ponseti treatment in difficult situations such as relapsed or previously treated clubfeet in older children using fixation with below knee Soft Cast®.

Methods: 38 feet of 28 patients (23 boys, 5 girls) with residual clubfoot deformity were treated by Ponseti technique with fixation with below knee SoftCast® until full correction or no further progression of correction was achieved. In some cases in older children the goal of treatment was just improvement of foot position and joint mobility to reduce operative steps and complications.

Results: Mean age at onset of treatment was 4.6 years (2–15). Mean follow up was 3.1 years (0.4–9.7). 3–14 casts (average 7) were needed. Mean treatment duration was 10.4 weeks (5–20.1). Change of 21 patients (75%) full correction could be achieved after 8 casts needed further treatment. 11 feet (29%) in 7 patients (25%) needed further treatment. In some cases in older children the goal of treatment was just improvement of foot position and joint mobility to reduce operative steps and complications.

Conclusions: Ponseti Method is extremely efficient even in older children and particularly difficult situations. With only exception of feet which showed severe stiffness due to secondary joint deformity (all previously operated) Ponseti Method is powerful enough to reduce deformity completely reduce its severity and improve joint mobility allowing less invasive surgery. We believe that in children older than 2 years fixation below the knee joint, which is allowing free gait, can be as efficient as long leg cast fixation. Perfect modeling around the ankle joint is mandatory.

Quadricepsplasty for congenital dislocation of the knee and congenital contracture
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Introduction: We encountered problems with the Curtis & Fisher technique of quadricepsplasty for congenital quadriceps contracture including wound dehiscence, insufficient lengthening of the quadriceps and instability of the knee. We modified the operative technique to address these three problems. We undertook this study to evaluate the results of the modified technique of quadricepsplasty to determine if we succeeded in overcoming these limitations of the original technique.

Methods: Twenty children (33 knees) underwent the modified Curtis & Fisher quadricepsplasty through a lateral incision; a long tongue of the lateral retinaculae till the collateral ligaments. The children were followed up for a mean period of 63 months and evaluated. The healing of the wound, active and passive range of motion of the knee, the stability of the knee, quadriceps power and knee function were assessed.

Results: Primary wound healing occurred in 32 of 33 knees. Adequate lengthening of the quadriceps sufficient to facilitate knee flexion to 90 degrees was possible. Considerable improvement in the range of motion was noted. In non-syndromic congenital dislocation of the knee (CDK) the quadriceps power was Grade 5 but, minor degrees of extensor lag was noted. In a proportion of patients minor degrees of joint instability was present. The majority of children were community walkers. The overall results were better in non-syndromic CDK than in children with arthrogryposis but differences of some variables were not significant.

Discussion: The modifications to the original Curtis & Fisher technique overcame the specific problems they were expected to avoid.

3D gait assessment in children with cerebral palsy using foot-worn inertial sensors
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Introduction: A child’s natural gait pattern may be affected by the gait laboratory environment. The use of foot-worn sensors has been developed for 3D gait analysis. The purpose of this study was to validate and explore the use of foot-worn inertial sensors for 3D gait measurement in independently walking children with cerebral palsy (CP).

Method: We performed a case-control study. We analysed 14 children with CP old and 15 controls, aged 6 to 15 years old. Two U-shaped and two 8-shaped trial walks per subject were performed during which accuracy and precision of the foot-worn device were measured using an optical motion capture system (Vicon,Oxford Metrics) as the reference system. All subjects then performed a continuous 200-meter walk wearing the foot-worn inertial sensors (Physilog III, LMAM-EFPL, Switzerland). Limb-related spatio-temporal parameters were compared between paretic and control limbs while bilateral gait characteristics were compared between CP and control subjects, using nonparametric analyses.

Results: Mean accuracy + precision for both groups was 3.4 ± 4.6 cm for stride length, 4.3 ± 4.2 cm/s for speed and 0.5 ± 2.9° for strike angle. Gait spatio-temporal parameters showed longer stance and shorter swing phases with an increase in double support in children with CP (p = 0.001). Speed, peak angular velocity were decreased in paretic limbs, with significant differences in strike and lift-off angles. Children with cerebral palsy showed significantly higher intra-individual variability (measured by their coefficient of variation) for speed, stride length, swing and stance phases. During turning trajectories speed and stride length decreased significantly (p<0.01) for both groups, whereas stance increased significantly (p<0.01) in CP children only.

Conclusion: Foot-worn inertial sensors allowed us to analyze gait kinematics outside a laboratory environment with a good accuracy and precision. The case control comparison yielded results which were congruent with what is known of gait variations in children with cerebral palsy who walk independently. Participants found the system light weight and easy to wear and use. While not substituting for complete 3D gait analysis, portable sensors provide precise information about gait in conditions that are closer to the child’s habitual environment and motor behaviour, and could therefore prove to be a useful complement.

Analysis of osseous and cartilaginous acetabular angles on MRI in children
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CHUV/UPCOT

Introduction: In patients with developmental hip dysplasia (DDH) a plain radiography of the pelvis can show an insufficiency of osseous acetabular coverage of the femoral epiphysis but we are not able to quantify the quality of the coverage of the acetabulum. The MRI allows a good tissue differentiation between the bone, the cartilage and fibrous tissues. The measure of the cartilaginous angle of Hilgenreiner (HTE) appreciates the morphology of the cartilaginous borders of the acetabulum, which will gradually ossify with growth. This cartilaginous HTE appreciates the theoretical cover at the end of growth. We performed oxymetrical analysis of the cartilaginous and osseous limits of the acetabulum on frontal MRI imaging from healthy and dysplasic hips.

Material and Method: We included 30 children (mean age 5y) who had a MRI imagery of both hips. The diagnoses for the 60 hips were 22 healthy hips, 11 hips with Perthes disease and 27 hips with DDH. We measured the cartilaginous and osseous angles of Hip-Hilgenreiner (HTE) on both hips on T2 weighted frontal images where the centers of the femoral epiphysis were best seen. We calculated then the ratio of the square of cartilaginous HTE (C²) above the osseous HTE (O). This ratio C²/O expresses the residual cartilaginous growing-potential of the acetabulum.

Results: For the healthy hips, the ratio varies from 0.75 to 6.78. 81% of these hips show a ratio lower than 5. The hips with DDH show a ratio from 4.73 to 14.9 with 95% higher than 5, including 23% which have a ratio above 10. The hips with Perthes disease show a mean ratio of 2.75, with only one hip above 5.

Discussion: If we consider a hip at the end of growth, the value of the osseous angle tends towards that of the cartilaginous angle; the ratio C²/O is then equivalent or inferior to the osseous HTE. The mean value of this angle at the end of growth was evaluated by Bédouelle et al. at 12° at the age of 6–10 years and for younger children between 15–20°. The trial shows a theoretical “normal” value for this cartilaginous
HTE inferior to 10°. This angle is corroborated with the average values we obtained from the 22 healthy hips and the 11 hips with Perthes. The hips with DDH in our study have 88% cartilaginous HTE above 10° and a mean value of 14.2°.

Conclusion: The ratio C²/O enables us to classify the hips in 3 categories: Group A includes hips with a ratio inferior to 5. Group B includes hips with a ratio from 5 to 10 and group C includes hips with a ratio above 10. Group A represents the hips with a great potential of standardization with growth. Group B includes hips that have less optimal correction potential, but still have a chance of normalization with growth and Group C represents severely dysplastic hips in which the cartilaginous potential of growth is insufficient and where a surgery of reorientation of the acetabulum is indicated. In future, estimation of cartilaginous and osseous angles based on MRI imaging could help evaluate the indication of a pelvic osteotomy for acetabular reorientation in children with residual developmental hip dysplasia.

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**Loss of a condyle of the femur or tibia following septic arthritis in infancy: problems of management and testing of a hypothesis of pathogenesis**

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**Introduction:** The study was undertaken to i) describe the characteristic radiological features and problems of management of the loss of one condyle of the femur or tibia following septic arthritis of the knee in infancy and ii) to test a hypothesis of the cause of the loss of a single condyle.

**Methods:** Radiographs of eight children with loss of one condyle of the femur or the tibia following septic arthritis in infancy were reviewed. The course and outcome in two of these children who underwent reconstructive operations were studied. Knees of 35 stillborn foetuses were dissected to determine if presence of synovial septae could account for isolated loss of one condyle following infection.

**Results:** All eight cases showed characteristic features of loss of half the epiphysis, the underlying physis and part of the adjacent metaphysis; the other condyle was totally spared. The two children who underwent elaborate reconstructive procedures had poor outcomes at skeletal maturity despite a series of additional operations. The foetal cadaveric study showed that complete infrapatellar synovial septae are present in some foetuses approaching 40 weeks of gestation.

**Discussion:** The pattern of loss of a femoral or tibial condyle following septic arthritis is consistent with total preservation of the other condyle. The outcome of surgical reconstruction of the missing condyle is poor. The presence of a complete synovial septum could result in localisation of infection to one half of the joint with destruction of one condyle.
The Anterior Intermuscular Septum. A suitable guideline in the course of the superficial peroneal nerve

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Introduction: Variable location of the superficial peroneal nerve (SPN), either in the lateral or anterior compartment of the lower leg, and risk of its damage during surgery should be considered. However, we currently lack a clear strategy as to where and how the SPN can be dissected and risk of its damage during surgery should be considered. However, we currently lack a clear strategy as to where and how the SPN can be dissected. Thus, the aim of the present study was to view the SPN in relation to the AIS and to determine whether that would be of practical value for a safe technique for SPN dissection.

Methods: 164 SPNs were dissected in 137 cadaver legs of 72 specimens. The entire course of each SPN was recorded and described with respect to the AIS at two points on the fibula (x/3 and 2x/3, adjacent to the AIS, 2) the distance between the point x/3 and the point 2x/3 and where the SPN pierces the AIS were calculated.

Results:

- In 68.6% (94 cases) the SPN coursed in the lateral compartment (anterior leg-type), in 11.7% (16 cases) in the anterior compartment (anterior leg-type) and in 19.7% (27 cases) in both the anterior and lateral compartments (intermediate leg type).
- 80.5% of the 164 traced SNPs coursed in the lateral and 19.5% in the anterior compartment. SPNs, more than 53 of the SPN consistently found a close proximity or adjacent to the AIS; 0 to 10 mm and 0 to 18 mm respectively. At the point 2x/3 the SPNs coursed a distance of 0 to 26 mm from the AIS.

Conclusion: In the majority of patients the SPN can be localised 1/3 of the fibula length proximal to the lateral malleolus adjacent or very closely lateral to the AIS. In the remaining cases the SPN can be found medial to the AIS. The localization of the AIS is a simple procedure and can be achieved even under difficult conditions such as trauma, swelling, or after previous surgery with scarring. Therefore, the AIS can be used as a suitable landmark while performing a dissection of the SPN.

Visualization of the Talar Dome by Anterior versus Posterior Ankle Arthroscopy: A Cadaver Study

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Introduction: Arthroscopy has become a valuable and important diagnostic and therapeutic procedure for treatment of pathology of the tibiotalar and more recently the posterior subtalar joint. Although the safety of portal placement for posterior ankle and subtalar arthroscopy has been shown in anatomic studies, little is now about the visualization and accessibility of the talar dome by posterior ankle arthroscopy. Therefore, the objectives of this study were to (1) assess the visualization of the talar dome through anterior versus posterior arthroscopic approaches with the standard non-invasive distraction, and (2) assess the effect of the minimally invasive calcaneal distraction.

Methods: We used 14 matched fresh cadaveric thigh to foot specimens. The mean age of the cadavers was 54.3 ± 9.0 years (range, 38 to 63 years). The order of the arthroscopic procedure (anterior versus posterior) and use of a distraction method (non-invasive vs minimally invasive) has been randomly determined using a computerized random number generation. The visualized area has been marked using a ring curette (anterior ankle arthroscopy) or an electrocurette (posterior ankle arthroscopy). After the arthroscopies the tibiotalar joint was disarticulated and previously marked areas were analyzed.

Results:

- The mean talar sagittal length was 45 mm (range, 43 to 50 mm), the mean total talar area was 1220 mm² (range, 1043 to 1443 mm²). In specimens with non-invasive distraction the accessibility of the talar dome was greater using anterior approach than posterior approach (p = 0.007). The use of minimally invasive distraction did not change the accessibility of the talar dome in specimens with anterior and posterior arthroscopy with 743 ± 180 mm² vs. 716 ± 240 mm², respectively (p = 0.590). In specimens with posterior ankle arthroscopy the use of minimally invasive distraction significantly increased the talar dome accessibility with 480 ± 178 mm² vs. 703 ± 269 mm², respectively (p = 0.031).

Conclusion: Intraarticular pathology in the anterior 60% of the joint can be well addressed via anterior ankle arthroscopy using standard distraction technique. Lesion located more posterior are better addressed via posterior arthroscopy: calcaneal pin distraction may increase the articular visualization.

Foot biomechanics and muscle activation during walking after joint preserving realignment surgery for asymmetric ankle osteoarthritis

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Introduction: Osteoarthritis (OA) of the ankle is often asymmetric with a hindfoot malalignment into varus or valgus. Patients often have partially intact articular cartilage and can benefit from joint preserving realignment surgery with hindfoot and supramalleolar osteotomies.

The purpose of this study was to quantify bilateral biomechanical and neuromuscular adaptations during walking in patients with asymmetric ankle OA before and after realignment surgery.

Methods: A 3D gait analysis with bilateral electromyography (EMG) of gastrocnemius medialis, soleus, peroneus longus, and tibialis anterior was performed in: 7 patients with asymmetric ankle OA before (P1a) and 12 to 18 months after surgery (P1b), 7 other patients 8 to 9 years after surgery (P2), and 15 healthy subjects (O). For each subject 6 trials were recorded. EMG envelopes of each muscle were analyzed using principal component analysis (input: 101 time points x 432 trials). The first 2 principal components (PC) scores, kinematic, and kinetic parameters were assessed for each leg and subject and compared between the groups using ANOVA (P<0.05).

Results: The range of motion of the affected foot was significantly reduced in hindfoot dorsiflexion (C: 22.6 ± 4.1°; P1a: 15.3 ± 5.3°; P1b: 11.5 ± 7.6°; P2: 13.5 ± 7.5°) and forefoot supination (C: 12.4 ± 2.4°; P1a: 9.5 ± 3.1°; P1b: 7.5 ± 1.8°; P2: 8.7 ± 2.3°) in all patient groups. The peak ankle plantarflexion moment was significantly lower for both legs in P1a (OA ankle: 1.4 ± 0.3 Nm/kg; healthy ankle: 1.5 ± 0.2 Nm/kg) and P1b (1.1 ± 0.2 Nm/kg; 1.3 ± 0.2 Nm/kg) patients than in controls (1.7 ± 0.1 Nm/kg). The hindfoot and forefoot varus moment increased postoperatively (P2) and the peak activation and the PC scores were significantly lower than in controls in P1a (both legs) and P1b (affected leg) patients. For soleus, PC1 scores (peak activity) were lower for the affected leg in the P1a patients.

Conclusion: The biomechanical changes were likely related to a reduced mobility of the ankle joint. Long-term follow-up patients (P2) showed fewer changes in their gait pattern, especially for the temporal muscle activation. This could indicate that one year after surgery patients were still adjusting to the altered biomechanics. As clinical results already showed reduced pain and improved quality of life, the present study suggest that realignment surgery is a worthwhile alternative treatment option for patients with asymmetric ankle OA.

Acknowledgement: This study was supported by SNF grant 3200BO-120631.

Timed unilateral vs. simultaneous bilateral hallux valgus correction surgery: Prospective analysis of clinical outcome and socioeconomic considerations

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Introduction: Hallux valgus correction is one of the most commonly performed procedures in foot surgery. Recent surgical methods allow full weightbearing in postoperative follow-up, enabling surgeons to perform simultaneous bilateral surgery. The presented prospective case series aims to analyze short-term follow-ups after unilateral and bilateral bunion correction surgery with special regards to clinical outcome, patient acceptance and cost effectiveness.

Methods: Distal metatarsal ReveL-ostectomy combined with proximal phalanx Akin ostotomy was performed in 130 patients (Group 1: unilateral N = 65; Group 2: bilateral N = 65). Patients with additional corrective forefoot surgery were excluded from analysis. Preoperative AOFAS scores were compared to scores at 6/12 weeks and 1 year after surgery. In patients with AOFAS scores > 77, first and second metatarsal AOFAS (MAA) angles were measured pre- and postoperatively. A 2-years phone follow-up regarding patient satisfaction was performed. Direct and indirect costs were estimated by analyzing hospitalization parameters 743 ± 180 mm² and distal articular (DMAA) angles were measured pre- and postoperatively. A 2-years phone follow-up regarding patient satisfaction was performed. Direct and indirect costs were estimated by analyzing hospitalization parameters 743 ± 180 mm² and distal articular (DMAA) angles were measured pre- and postoperatively.
Laparoscopic assisted resection of an ileosacral chondrosarcoma

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Rationale: According to contributions of Yonamine we have begun to resect sacral tumors with video-laparoscopic exposure of the anterior structures.

Patient: A 53-year-old woman 6 weeks after her second normal vaginal delivery complained of lumbosacral dysesthesia. Imaging showed a mass off the sacrum crossing the ileosacral joint suggestive of a chondrosarcoma, after biopsy graded GI, calculated volume 700 cc.

Technique: The procedure was performed in an unstable lateral decubitus starting with the anterior laparoscopic exposure of the os sacrum and the right pelvic sidewall by passing through right pararectal space and full mobilization of the rectum from the promontorium downwards to the pectineal line. After transection of the sacral hypogastric fascia, the medial and caudal limits of the tumor and as well as the SNR were identified. While the sacral nerve roots L5 - S2 attached on the tumor, while S3 and S4 were free. Full exposure of the pelvic ureter followed by the coagulation and transection of the internal iliac and the lateral sacral vessels. All cardinal vessels below the tumor were also transected including the pudendal and inferior gluteal vessels. The dissection of the lumbosacral space enabled the exposure of the lateral limits of the tumor and identification of both the obturator nerve and the sciatic just before it entry through the great sciatic foramen. 2 Gigli saws were inserted from anterior to posteriorly, one through foramina L5 and S1, the other through S1 and S4 for transection of the sacrum under visual endoscopic control. The resection of the ilium was performed in analogy to a Judet approach externally.

For reconstruction the defect was replaced with a massive allograft and stabilisation performed by lumbo-ischial screw and rod fixation. The total blood loss was judged to be about 1000 cc; the total replacement were 2 units of blood.

Results: Pathologic examination showed unencapsulated benign cartilage tissue.

Conclusion: We have got the impression, that the anterior video-laparoscopic approach presents several advantages by giving a superior view, higher precision and decreased blood loss for tumors in this anatomical difficult location of tumors.

In vivo monitoring of osteosarcoma primary tumor growth using fluorescent and Luciferent imaging

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Introduction: In osteosarcoma (OS), monitoring of metastases is very important, as this is the most important prognostic determinant of patient death. In our laboratory, we study OS in several mouse models. Using our lacZ tagging technique (Artl et al., J Vis Exp 2012) we can monitor metastases formation, but only ex vivo. Also, necrosis inside the primary tumor can overestimate tumor volume and the true amount of living tumor cells. We therefore looked into additional techniques to monitor primary tumor growth and metastasis formation in vivo. Here we present recent results of an experiment where OS tumor cells were tagged with the light-producing enzyme Luciferase (Luc), or our lacZ tag.

Methods: Female SCID mice were intratrabecularly injected with either Luc/lacZ, dsRed/lacZ, or mCh/lacZ tagged osteolytic 143B OS cells. Mice were scanned every week in the IVIS Lumina XR to monitor Luc, dsRed and mCh presence, and primary tumor sizes were measured using caliper and micro-CT. To monitor Lac presence, mice were injected with substrate (Luciferin) immediately prior to measuring. For mCh and dsRed monitoring, excitation wavelengths were 557 nm for dsR, and 587 nm for mCh. Scans took between 10–15 min, with two mice scanned simultaneously. After 28 days the animals were sacrificed, lungs were excised, stained for lacZ presence, and both macro (>0.1 mm) and micro metastases (<0.1 mm) were counted.

Results: Already 24 hrs after injection of the Luc tagged tumor cells a clear Luc signal was obtained in the hind limb, which increased further over time and peaked 28 days after tumor cell injection, at which time point lung metastases could also be detected. The dsR signal could only be detected after 28 days due to a high unspecific autofluorescence signal of mCh tagged tumor cells in an internal reference only. Unexpectedly, tumor sizes were significantly smaller in Luc tagged tumors compared to dsR and mCh tagged tumors, and mice injected with dsR tagged tumor cells had a larger amount of macrometastases. We found a serious correlation between caliper-measured and micro-CT measured tumor volumes.

Conclusions: Luciferase tagging is a very sensitive technique to monitor living tumor cells. Fluorescent mCherry tagging yielded the most consistent signal during primary tumor growth, whereas dsRed tagging was found to be unsuitable. These techniques allow us to monitor primary tumor growth and metastasis formation in vivo.

Computer-aided matching of multimodal tomographic data for improved diagnostics and more accurate osteotomy planning in the oncological pelvic surgery

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Introduction: Planning of tumor resection in the oncological pelvic surgery involves usually multimodal tomographic imaging data. For pelvic osteotomy planning in case of pelvic bone tumors or soft tissue tumors infiltrating bones the computed tomography (CT) and the magnetic resonance imaging (MRI) data are principally used. In the context of diagnostics the nuclear medicine imaging techniques to monitor primary tumor growth and metastasis formation in vivo. Here we present results of an experiment where OS tumor cells were tagged with the light-producing enzyme Luciferase (Luc), or our lacZ tag.

Methods: For computer-based correlation of the multimodal tomographic data several numerical matching methods have been developed and implemented. Two main classes of 3D data matching procedures have been applied in our study: voxel-based methods (based on the mutual information function) and point-based methods (surfaces of anatomical structures have to be segmented in the data pre-processing phase). For an effective evaluation of the diagnostic-relevant matching results and an optimal osteotomy planning numerous advanced data visualization methods have been applied. A similar data processing pipeline has been performed in 8 oncological pelvic osteotomy planning cases.

Results: For each of these 8 cases at least one pair of multimodal tomographic data has been matched. In the majority of cases the multimodal data pair consisted of CT and MRI data. The matched datasets have been inspected and analyzed by the 2D and 3D visualization methods. For instance, 2D slice-view of one modality with free-movable small inspection window inside, showing the correlated grey-value information from the second modality. Other example is 3D volume rendering of one modality showing the tumor and the soft tissue information mixed with the 3D surface rendering of osseous structures segmented in the aligned second modality. In addition, the
implemented virtual cutting tools allow performing more accurate osteotomy planning on the segmented 3D surface models due to numerical, not mental, data correlation. All this can be controlled in a full interactive way. The advantages of the proposed osteotomy planning method over the traditional approach have been confirmed in all 8 cases.

Conclusion: In all tested cases the new system demonstrated significant superiority over the traditional pelvic osteotomy planning based on the mental tomographic data correlation and 2D slice viewing. The proposed oncoplastic pelvic osteotomy planning method has potential to become the method of choice for this class of surgery planning approaches.

Biomechanical comparison of five different external fixation configurations for pelvic ring instability
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Objective: External fixation is useful in the primary treatment of pelvic ring injuries. The present study compared the (lamechanical stability of five different configurations of an external pelvic ring fixation system.

Methods: Five configurations of the same anterior external pelvic ring fixation system were tested on pairs of Polyoxymethylene testing cylinders using a universal testing machine with 3 for each sample group. One single connecting rod was used in group SINGLE, two parallel connecting rods in groups DOUBLE, four rods in a rhomboid-like configuration in group RHOMBOID. Each specimen was subjected to a total of 2000 consecutive cyclic loadings at 1 Hz with sinusoidal lateral compression/distraction (+/-50 N) and torque (+/-0.5Nm) loading alternating every 300 cycles. The results of rotational stiffness were determined at 100, 300, 500, 700 and 900 cycles.

Results: The SINGLE TENT and RHOMBOID configurations already failed with a preloading of 50 N compression. The DOUBLE configuration had around twice the translational stability at 100, 300, 500, 700 and 900 cycles when compared with the SINGLE (p = .002,.003,.005, .000, and .000) and DOUBLE TENT (p = .001,.001,.001,000, and .000) configurations. Rotational stiffness observed for the DOUBLE and DOUBLE TENT configurations was about 50% higher when compared with the SIMPLE configuration at 100 (p = .024/.012), 300 (p = .019/.074), 500 (p = .031/.011), 700 (p = .003/.005) and 900 cycles (p = .004/.006).

Conclusion: Using two parallel connecting rods for external pelvic ring fixation provides the highest translational (lateral compression/distraction) and rotational (bending of the hip) stability.

Biomechanical comparison of five different external fixation configurations for pelvic ring instability

Biomechanical comparison of five different external fixation configurations for pelvic ring instability

The Fifth Muscle of the Quadriceps Muscle Group
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Introduction: The quadriceps femoris (Q) is traditionally described as a muscle group composed of the rectus femoris (R) and the three vasti (lateralis, intermedius and medialis). However, clinical observations of anatomical specimens are not consistent and do not reflect accurately the description of anatomy textbooks. Following cadaveric exposure of the vastus lateralis, we identified an intervening muscle belly (IM) between the vastus lateralis (VL) and the vastus intermedius (VI). The aim of this anatomical study was to clarify, with regards to muscle innervation, whether the intervening muscle we observed was a variation of the VL, the VI, or a separate head of the extensor apparatus.

Methods: Twenty-six cadaveric lower limbs from sixteen specimens were investigated using macro dissection techniques. The limbs of four specimens were cut transversely in the middle third of the thigh. With special attention to the innervation and vascularisation pattern, the architecture of the quadriiceps was examined to confirm its anatomy. Additional muscle bellies were sought; all muscle bellies of the Q were traced from their origin to their insertion, and their affiliation was determined.

Results: In all dissections, an intervening muscle (IM) was found between the muscle bellies of the VL and the VI. Similar to the VL and VI, the IM was innervated by independent muscular branches of the femoral nerve and vascularised through separate muscle branches of the lateral femoral circumflex artery. In the proximal aspect this muscle could always be separated easily from the VI. Further distally, at the junction into the tendinous portion, the A of the IM was adjacent to the lateral fascia of the VI. Before entering the quadriiceps tendon (QT), the layers of VL, VI and the IM could be clearly separated. Four morphological types of IM were divided: Independent Type, VI-Type, VL-Type and Combined Type.

Conclusion: This study demonstrated a different architecture of the Q as compared to previous descriptions. There is an additional muscle belly between the VI and VL, which cannot be clearly assigned to the former or the latter. Distal exposure shows that this muscle belly becomes its own aponoeurosis (A), which continues distally as part of the QT. To our knowledge, the IM has not been previously described or illustrated in any textbook of anatomy.

Range of Motion Analysis for the Design Optimization of a Bi-Directional Total Hip Endoprosthesis
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Introduction: After total hip arthroplasty, dislocation is one of the most frequent serious early complications. This occurs in part due to impingement (catching and leverage of the neck-cup on the inlay/cup border). Impingement may also negatively impact long-term outcomes.

Materials and Methods: A preliminary model for an optimized hip endoprosthesis system was developed to offer a mechanical solution to avoid impingement and dislocation. A computer-supported range of motion simulation using parameters of cup anteverision and inclination as well as torsion and CCD shaft angle was then performed to localize areas of anterior and posterior impingement of typical acetabular cups.

Results: Through isolation of the two main trajectories of motion, and modifications with corresponding gaps to the inlay/cup areas as well as opportunistic banking in the abduction/adduction plane, the combination of a snap-fit acetabular cup with reduced cup profile was the result: the "bidirectional total hip prosthesis."

Conclusion: Complications such as dislocation and impingement may possibly be avoided with the bidirectional total hip prosthesis. Typical implantation parameters yield an implant design with rotational asymmetry.
Muscle Imbalance of the Knee Extensors does not affect Patellar Tracking in the ACL Deficient Knee

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Introduction: Aberrant patellar tracking is known to be an important risk factor in the degenerative pain syndromes (PPFS) and patellofemoral osteoarthritis (OA). Although the etiology is still unclear and multifactorial, abnormal tracking of the patella caused by muscular imbalance of the quadriceps muscle is considered to be an important contributing factor [1]. Essentially, weakness and atrophy of the knee extensor muscles followed by altered patellar tracking are commonly seen [2]. Quadriceps strengthening exercises focusing on the vastus medialis muscle (VM) have been suggested as a therapeutic approach to retain knee patellar joint kinematics and muscle force are scarce. Therefore the purpose of this study was to evaluate the influence of the loss of the vastus medialis muscle force on patellar tracking in the intact and anterior cruciate ligament (ACL) deficient knee in vivo.

Methods: Eight skeletally mature New Zealand White Rabbits, weighing 6.0 kg ± 0.6 (mean ± SD) were used. The animals were placed in a custom built stereotactic frame rigidly fixed at the hips and active, concentric (con) and eccentric (ecc) movements of the knee joint, ranging from 30 to 90° of flexion (eleven limbs, n = 11). Measurements were first performed with the knee fully intact (intact control); then, the ACL was transected through a medial arthroscopy, and last, the VM was transected to produce a vastus muscle force imbalance. Knee extensor forces for all ACL and VM-transsected trials were matched (±5% difference of peak force) as force is known to affect patellar tracking [3]. For muscle stimulation, a custom made femoral nerve cuff electrode was used. Patellofemoral kinematics (slopes and angles) were quantified from high speed video (200 Hz, optical resolution 0.08 mm) which measured the displacement of bone pins imbedded rigidly in the patella relative to bone pins in the distal femur. Statistical analysis was performed using a one way repeated measures ANOVA and Fisher’s post hoc analysis. Statistical significance was set at p <0.05. Intraobserver repeatability was assessed by analyzing selected trials three times and calculating the associated variance. The study was approved by the Institutional Review Board for Animal Care at the University of Ottawa.

Results: VM transaction did not alter the patellar tracking, tilting or rotation significantly for any of the force-matched experimental conditions. After ACL transaction, patellar tracking occurred more laterally for the concentric and eccentric contractions (p <0.001, mean shift 0.3 mm (± 0.48 mm), and 0.3 mm (±0.51 mm), respectively (figure 1a,b), and caused a significant lateral rotation of the patella (p <0.001, mean rotation 1.8° (±2.2°) and 2.3° (±1.7°), respectively (table 1). No change in the eccentric tilt was observed. After VM-transcetion trials were matched (±5% difference of peak force) as force is known to affect patellar tracking [3]. For muscle stimulation, a custom made femoral nerve cuff electrode was used. Patellofemoral kinematics (slopes and angles) were quantified from high speed video (200 Hz, optical resolution 0.08 mm) which measured the displacement of bone pins imbedded rigidly in the patella relative to bone pins in the distal femur. Statistical analysis was performed using a one way repeated measures ANOVA and Fisher’s post hoc analysis. Statistical significance was set at p <0.05. Intraobserver repeatability was assessed by analyzing selected trials three times and calculating the associated variance. The study was approved by the Institutional Review Board for Animal Care at the University of Ottawa.

Discussion: Our results suggest that the isolated loss of vastus medialis muscle force does not affect patellar tracking, rotation or tilting compared to force-matched concentric and eccentric movements in the ACL deficient knee. These results concurred with previous findings where we analyzed patellar pressure distribution and patellar tracking in the intact and VM transected animal model, but contradict some results in the literature [3–5]. It is not clear if the results obtained here in a rabbit model can be directly translated to the human knee. However, the VM has a similar insertion into the human and rabbit patella, and the fiber direction of the distal VM is virtually the same (about 45° from the femoral axis) in humans and rabbits, suggesting that the current results should be considered fully in future interpretations of knee extensor imbalance in humans.

Significance: Our study is the first to investigate patellar tracking in vivo in the ACL deficient knee supinepressed with a selective and controlled muscle imbalance. The findings of this study suggest that muscle imbalance in the ACL-deficient knee does not affect patellar tracking, as has been found previously in the intact, stable knee of rabbits. Therefore, strengthening of the VM in patients with patellar mal-tracking might not restore normal tracking patterns, as has been suggested in the past.

Acknowledgements: AHFMR Team grant on Osteoarthritis, CIHR Canada Research Chair Program, Swiss Society of Orthopaedics and Traumatology, The Killam Foundation.

Increased macrophage infiltration and trap activity characterize subchondral bone sclerosis in knee osteoarthritis

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Objective: Single photon emission computed tomography (SPECT)-CT is an emerging diagnostic tool for osteoarthritis (OA). While subchondral bone sclerosis is a hallmark of end-stage OA, the cellular and molecular mechanisms of increased bone turnover in OA remain elusive. In this study, we investigated the cellular mechanisms of increased bone remodeling, defined by SPECT-CT, in patients suffering from end-stage ankle OA.

Methods: Pre-operative SPECT-CT imaging, using 99mTc-Technetium-dicarboxyphosphonate (99mTc-DPD), was performed in six consecutive OA patients (mean age 63, range 52–72) undergoing total ankle replacement. AOFAS score and VAS were used for clinical evaluation in this study group. Intra-operative distal tibial and talar...
resections were obtained and standardized samples (5 x 5 mm) were divided into four categories according to subchondral bone density (low or high) and 99mTc-DPD uptake (negative or positive). For histological analyses, tissue sections (10 mm) were stained with haematoxylin and eosin (H&E) and van Gieson’s stain to evaluate cellular morphology and extracellular connective tissue, respectively. Results: Preoperative AOFAS score and VAS were 40 ± 15 (range 20–56) and 7.5 ± 0.84 (range 7–9), respectively. The spatial distribution of SPECT-CT-positive lesions was heterogeneous, with hotspots located in four tibial and two talar resections. 99mTc-DPD uptake was found exclusively in areas of increased bone density (sclerotic) as defined by CT scans, while 99mTc-DPD tracer-negative areas were both of low and high bone density. H&E staining revealed marked infiltration of subchondral marrow spaces by a fibrovascular tissue in SPECT-CT-positive regions. Bone-lining osteoblasts were specifically present in these regions, while they were absent from SPECT-CT-negative subchondral bone. Van Gieson’s staining showed a massive increase of collagen deposition into randomly organized fibers, which is typical for formation of woven bone as a result of rapid osteoblast-mediated osteoid production. Conclusion: In end-stage ankle OA, increased 99mTc-DPD tracer uptake in subchondral bone tissue corresponds with fibrovascular marrow infiltration and osteoblast-mediated woven bone formation. These findings indicate that extensive subchondral bone remodeling plays an important role in the development and progression of OA in SPECT-CT positive areas of the ankle.

A comparative study of growth factor release from L-PRF and L-PRP and their effect on migration of mesenchymal stem cells and endothelial cells

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Objective: The aim of this in vitro study was to investigate the release of growth factors from L-PRP and L-PRF during 28 days of culture and their influence on the migration of MSC and endothelial cells, two cell types with an important role in the healing process.

Study design: Blood samples were collected from 11 young healthy male volunteers, and L-PRP and L-PRF were prepared using standard protocols. Platelet-rich concentrates were placed in culture media and incubated at 37 °C in CO2 incubator for 28 days. Media was collected with new media addition after 8h, 1, 3, 7, 14 and 28 days. The levels of vascular endothelial growth factor (VEGF), platelet derived growth factor AB (PDGF), insulin-like growth factor-1 (IGF-1), transforming growth factor β1 (TGF-β1), and interleukin 1β (IL-1β) were quantified using ELISA. A cell migration assay using MSC and endothelial cells in a Boyden Chamber was performed with media samples collected at all time points.

Results: When compared to L-PRF, L-PRP released higher amounts of VEGF, PDGF, IGF-1 and TGFβ1 within the first 8 hours. In contrast, L-PRF released significantly more PDGF and IGF-1 from 1 to 3 days, significantly more VEGF and TGFβ1 from 3 to 7 days while only release of TGFβ1 was significantly increased from 7 to 14 and from 14 to 28 days when compared to L-PRP. Release of VEGF and TGFβ1 from L-PRF was constant for the first 7 days, followed by a decrease until the end of the culturing period; in contrast, it peaked from 3 to 7 days from L-PRP. PDGF and IGF-1 release was continuous from L-PRF for the first 3 days, followed by a decrease, while it decreased already after 8 hours and remained low from L-PRF. IL-1β release was similarly low in both platelet concentrates. The chemoaesthactants released from L-PRF within the first 8 hours, and from 1 to 3, 3 to 7 and 7 to 14 days induced significant migration of endothelial cells in comparison to L-PRP. Similarly, L-PRF chemoaesthactants released from 1 to 3 and 7 to 14 days resulted in a significantly higher migration of MSC compared to L-PRP. Conclusion: The release of growth factors from the L-PRP peaked at the onset of culture, while being continuously release from L-PRF over a period of 28 days. Moreover, L-PRF demonstrated better chemoaesthactant properties with endothelial cells and MSC compared to L-PRP. Depending on whether a boost or a constant release of growth factors is desired for the healing process, L-PRP or L-PRF would be employed in clinics.

Gain of length – loss of strength? – Alteration in muscle strength after femoral leg lengthening with a motorized intramedullary nail

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Introduction: Intramedullary leg lengthening with a motorized nail can reduce the complications which are associated with leg lengthening by external fixation. The data on the recovery of muscle strength after lengthening is very limited. This prospective observational study was designed to investigate the alteration in muscle strength in patients with a femoral leg lengthening with a motorized intramedullary nail.

Methods: Thirty patients with a median leg length discrepancy of 3.0 cm (range 2.4–8.0 cm) underwent femoral limb-lengthening with an intramedullary motorized device. Maximum isometric, concentric muscle strength of the extensors and flexors of the knee as well as range of motion were measured before (n = 30) and a median of 2.0 years after the operation (n = 21). The investigated parameters were analyzed for any alterations before and after the procedure.

Results: Preoperatively there was a significant difference in median isokinetic muscle strength between the shorter and the normal leg in the extensor muscles (15%, p = 0.01)). There was no significant difference in the flexors (3%). With increasing leg length discrepancy this effect also increased in the extensors. The etiology of the LLD had no effect on muscle strength. Postoperatively there remained a difference of muscle force of the extensors (22%) between the lengthened and the normal leg. There was no alteration in the flexors. There was no significant loss of muscle force in the lengthened leg.

Conclusion: There is no significant loss of muscle strength in the treated leg after the lengthening procedure with a tendency to a loss of strength in the extensors (7%). However we think that the remaining postoperative difference of muscle strength has no clinical significance. We infer that physical therapy should especially focus on the training of the extensors to diminish this effect.

Treatment options in tendon healing following natural growth factor expression

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Introduction: Tendon ruptures recover slowly and the healing of injuries can be devastating. Growth factors are known to influence tendon healing. However, only little is understood about growth factors in a healing tendon. Aim of this study was to investigate the influence of growth factors on tendon healing of rats following their natural expression.

Methods: The Achilles tendon of rats were transected and resutured. First the expression of bFGF, BMP-12, VEGF and TGF-β1 was assessed by immunohistochemical analysis 1 to 8 weeks after surgery. Second the maximal failure load of healed Achilles tendons was measured dependent on the external application of bFGF, TGF-b1 and BMP-12.

Results: The natural expression of bFGF, BMP-12 and VEGF was highest 1 week after transection. VEGF expression persisted during the remaining period whereas bFGF and BMP-12 declined. TGF-b1 expression peaked again after 8 weeks. A combined application of bFGF, TGF-b1 and BMP-12 resulted in a 4fold greater load to failure after 1 week, whereas a sequential treatment of these growth factors increased the load to failure even 5fold.

Conclusion: During tendon healing, bFGF, BMP-12, VEGF and TGF-b1 are differentially expressed. Additional administration of growth factors can improve the load to failure in the early healing phase of rat Achilles tendons.

nociception of pain in osteoarthritis may be triggered through intrathecal nerve fibers

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Background: The mechanism causing pain in osteoarthritis is not well understood. A connection between the presence of intrathecal sensory nerves and pain in osteoarthritis has not yet been established. We hypothesized, that in patients with severe joint pain and radiographically isolated, focal osteoarthritic cartilage degeneration, the source of pain may be exclusively localized within the subchondral bone.

Methods: This retrospective analysis includes five patients with isolated patelofemoral osteoarthritis confirmed by X-ray and MRI, with typical pain provocation upon compression of the patella against the femur. During a diagnostic knee arthroscopy two (lateral and medial) temporary intrathecal catheters were inserted under fluoroscopy into
the patella through drill holes from anteroinferiorly. On the first
NaCl followed with up to 5 ml of local anesthetic (ropivacain 0.5%).
Bone, the pain at rest shortly bursts from a mean of VAS 1.7 (range 0
100% in 3 patients, 75% in two patients and 50% in one patient during
the effect of local anesthesia intraosseously.
Conclusion: The instillation of liquid volume (0.5 ml saline) into bone
provores a short burst of severe pain, which resembles the pain felt
preoperatively and the intraosseous local anesthetic did eliminate all
pain upon patellar compression and was associated with a pain relief
during ambulation. Therefore, we conclude that osteoarthritic pain may
at least in part be sensed and transmitted through intraosseous
nerves. The mechanism of pain triggering is most likely not a direct
provocation of nerves, but something that elicited through an increase
intraosseous pressure, either through deformation of bone or through
infusion of joint fluid. These new findings may allow to explore new
surgical or pharmacological approaches to understand, diagnose or
treat osteoarthritic pain.

Impact of a Co-managed Hip Fracture Program on Treatment Process and Patient’s Outcome. A Prospective Quality Assurance Survey
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Objective: Dedicated hip fracture programs are increasingly
implemented because of the impact of these fractures. Our objective
was to quantify the impact of such a program in multiple dimensions
and on different time scales by comparing it with usual care.
Design: Prospective longitudinal cohort quality assurance survey with two
observation periods.
Patients: Included were hip fracture patients aged 65 years or older
who were treated by our trauma service because of a hip fracture. The
first “usual care” group corresponded to the patients who were treated
prior to the start of the hip fracture program. The second “co-managed” group
covers 229 patients admitted subsequent to full implementation of the
program.
Variables: Quality of treatment process was measured: Time to
surgery, length of hospital stay, completeness of documentation.
Patient’s outcomes were measured: Mortality rates (in-hospital,
30-days, and 1-year), readmission rates (30-days and 1-year) as well
as prefracture ambulatory status and on different time scales by comparing it with usual care.

Proximal femoral fractures: a new concept of implant,
stress and interfragmentary compression analysis
Rémi Billard1, Pierre Vacher2, Eric Vittecoq3, Franck Toussaint4, Laure Devun5, Christian Bonjour6, Yvan Arlet7, P. Vacher8, E. Vittecoq9, F. Toussaint10, L. Devurt11, C. Bonjour12, R. Billard13
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Introduction: This paper concerns a new concept of implant for fixing proximal femoral fractures. The solution lies in the adaptability of the
implant to different morphologies. The implant has intramedullary and
extramedullary parts. These elements are linked with a thin curved
blade, allowing the deformation of the implant during insertion. An
deployable device allows the adjustment of the relative position of these
two parts leading to a possible adjustment of the angular orientation of
the cephalic screw ranging from 115° to 135°. The support points of the
cephalic screw on the two rigid parts are spaced apart, thereby limiting
stress in implant. Moreover, the blade partially protects the greater
trochanter and maintains the gluteus medius muscles.
Method: A finite element analysis was carried out to study implant
behaviour in cases of stable intertrochanteric and unstable reverse
obliquity fractures. A digital model of femur (Digital 3D Femur, ref.
3908) corresponding to the medium left composite Sawbone is used in
this study. Geometries of femur and implant are discretized in Abaqus
software. A vertical load of 3000 N is progressively applied to the
femoral head through a ball joint. Elastic behaviour laws are
implemented for cortical bone (E = 16.35 GPa, υ = 0.26), trabecular
bone (E = 0.155 GPa, v = 0.3) and stainless steel implant (E = 200
GPa, v = 0.3).
Results: Stress distributions in bone and implant are calculated.
Interfragmentary motions are described by normal and tangential
components. Stresses in the new implant are of lower values (400
MPa) compared to yield stress material (800 MPa). Data are finally
compared to those obtained by the numerical analysis of
intramedullary nail and compression hip screw (similar to Gamma nail
and DHS). Results show that the new implant is more suitable in terms
of stress state. Data show a decrease of relative motions of fracture
lips in the case of fractured femur fitted with the new implant
regardless of fracture type.
Conclusion: A new implant for treating proximal femoral fractures is
proposed in this study. The angulation of the cephalic screw can be
adjusted by the surgeon covering the fracture gap in anatomy. The implant
of the femur is completely stiffened allowing the bone to follow its natural
development. This type of implant could significantly reduce implants
stucks in hospitals.

Does the Gamma 3 need to be distally locked for stable
intertrochanteric fracture? A Finite Element Analysis
Rémi Billard1, Pierre Vacher1, Eric Vittecoq2, Franck Toussaint1, Laure Devun3, Christian Bonjour4, Yvan Arlet5
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Introduction: We could observe sometime a lack of the distal locking
for Gamma 3 short nail. This fact is mainly due to technical error.
Nevertheless, some stable fracture heals without any displacement or
complacation. The aim of our study is to simulate such cases based on
finite element analysis.
Method: A finite element analysis was carried out to study implant
behaviour in cases of stable intertrochanteric fractures. A digital model
of femur (Digital 3D Femur, ref. Sawbone 3908) corresponding to the
medium left composite 4th generation Sawbone was used. Geometries of
femur and implant are discretized in Abaqus software. A vertical
load of 3000 N is progressively applied to the femoral head through
a ball joint. Elastic behaviour laws are implemented for cortical bone
(E = 16.35 GPa, υ = 0.26), trabecular bone (E = 0.155 GPa et v = 0.3)
and stainless steel implant (E = 200 GPa, v = 0.3). Stress distributions
in bone and implant are calculated. Interfragmentary motions are
described by normal an tangential components.
Result: The forces are transmitted to the fracture mainly through the
cephalic screw. They are no traction or distraction on the distal locking screw.
Conclusion: Probably no mechanical effect for stable intertrochanteric fracture
treated by intramedullary short nail. Few clinical cases corresponding
to such technical mistakes seem to confirm this fact. One could ask if
the Gamma 3 need to be distally locked for stable intertrochanteric fracture?
In Situ Fixation and Arthroscopic Osteochondroplasty for mild Slipped Capital Femoral Epiphysis: Can the \( \alpha \)-angle be normalized? Eric Frey\(^1\), Patrick Zingg\(^1\), Leonhard Ramseier\(^1\), Claudio Dora\(^1\)
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**Introduction:** In situ fixation of mild (epiphyseal–shaft angle <30°) slipped capital femoral epiphysis (SCFE) is a well accepted treatment method. However, the remaining retrotroit morphology represents a CAM type deformity suspected to favour early osteoarthrits by femoroacetabular impingement. Arthroscopic osteochondroplasty during in situ fixation has disadvantages with limited additional invasiveness. The aim of the present study was to test the hypothesis that \( \alpha \)-angles could be improved to normal by arthroscopic osteochondroplasty in addition to in situ fixation.

**Methods:** Between April 2010 and November 2011, nine patients (6 female, 3 male; range 10–15y; BMI 17–32 kg/m\(^2\)) presented with mild SCFE (mean epiphyseal–shaft angle 26 ± 5°) and received arthroscopic osteochondroplasty in addition to in situ fixation. An \( \alpha \)-angle [1] less than 55° was considered normal.

**Results:** \( \alpha \)-angles improved from 57.6° (range 45–74°, SD 8.6) to 38.2° (range 30–51°, SD 7.1). No complications were encountered.

**Conclusion:** Hip arthroscopy in addition to in situ fixation can restore physiological \( \alpha \)-angle in mild SCFE.

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Joint Degeneration Pattern in Severe Pincer Impingement and its Implications for Surgical Therapy Emanuel F. Liechti\(^1\), Stephen J. Ferguson\(^1\), Moritz Tannast\(^1\)
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**Introduction:** Severe pincer impingement (acetabular protrusio) is an established cause of hip pain and osteoarthritis. The pain is considered to be due to an early dynamic pathological contact of the excessive acetabular rim with the femoral head-neck junction. However, according to the literature, the radiographic joint degeneration in severe pincer impingement typically occurs in the superomedial aspect of the hip socket, which is not explained by the femoroacetabular impingement concept. We therefore asked the following questions: (1) is there a static overload in the medial aspect of the protrusio joint? (2) Does acetabular rim trimming lead to an increased static overload in protrusio hips?

**Methods:** Four hip morphologies derived from patient data were used [1–4]. In contrast to these results achieved in highly selected studies involving professional and semi-professional hockeyplayers: a case series of 5 athletes after open surgical decompression of the hip, Am J Sports Med. 2007:35:1955–1959.

**Results:** acetabular protrusio in a protrusio hip even increased the static overload at the medial aspect of the femoral head-neck junction up to 28%. During walking, the dysplastic configuration, compared with protrusio, resulted in opposite patterns of stress and contact pressure having its peak values located at the anterolateral acetabular rim.

**Conclusion:** The findings substantiate the hypothesis that severe pincer impingement (protrusio) represents a unique pathology which involves a dynamic impingement problem at the lateral edge of the acetabulum, and – similar to a “medial dysplasia” – a static overload at the medial edge of the acetabular lunate surface. Based on these findings, the curative joint-preserving treatment of this pathomorphology would consist of a reorientation of the acetabulum rather than isolated rim trimming alone.

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Effect of CCD-angle on impingement free hip range of motion Faustine Vallon\(^1\), Claudio Dora\(^1\), Philipp Fürnstahl\(^2\), Jess Gerit Snedeker\(^3\)
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**Introduction:** Several aberrations of hip morphology can reduce hip range of motion (ROM) and limit the treatment of femoroacetabular impingement (FAI). Among them asphericity of the head-neck junction and regional or global acetabular overcoverage are extensively discussed in the literature. Other aberrations such as valgus and varus deformities of the proximal femur are not.

The aim of the study was to explore the effect of varying centrum-collum-diaphyseal (CCD) angles on impingement free ROM.

**Methods:** A CAD-based 3D simulation model of the hip was installed to gradually deform the femur to create CCD-angles from 90°–160°. To improve estimates of normal ROM two additional hip models based on MRI pictures of a volunteer were used. FAI was defined as bone to bone contact within physiological hip ROM defined from literature.

**Results:** With decreasing CCD angles of less than 110°, range of abduction and internal rotation at 90° of flexion were reduced and led to FAI. No impingement was seen with flexion and extension. With increasing CCD angles, the range of adduction and extension got reduced and resulted in FAI for adduction and extension at 135° and 145°, respectively. No impingement was seen with external rotation at 90° of flexion. Zones of impingement on the acetabular side were located at the superior rim with coxa vara and at the posteroinferior rim with coxa valga. Acetabular rim trimming could not compensate for CCD angles outside the range of 110–135° since combined movements remained impinged. Zones of impingement on the femoral side were found to be distal to the head neck junction at the mid-cervical region showing the smallest cross sectional area.

**Conclusion:** In the investigate model, variations of the CCD angle shows a marked influence on impingement free hip ROM. Outside CCD angles of 110–135° FAI occurs. Typical rim trimming and/or neck osteochondroplasty does not allow for adequate bony correction to solve FAI.
Proportions of Iliocapsularis and Rectus Femoris Muscle Predict DDH

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Introduction: The iliocapsularis muscle is a little known, but uniformly present muscle of the hip. It originates from the anteromedial hip capsule and anterior-inferior iliac spine. Its insertion is located just distal to the lesser trochanter. The iliocapsularis muscle has a postulated function as a hip stabilizer. In a previously MR-based study a hypertrophied iliocapsularis was found in developmental dysplasia of the hip (DDH). Therefore, we asked whether the proportions of the iliocapsularis muscle in relation to the rectus femoris muscle predict a deficient acetabular coverage (DDH).

Patients and Methods: The anatomical dimensions of the iliocapsularis and rectus femoris muscle were compared between 45 hips with DDH (Group I) and 40 hips with excessive acetabular coverage (Group II). DDH (Group I) was defined as an LCE angle of less than 25° with a minimal acetabular index of 14° on anteroposterior AP pelvic radiographs. Group II with excessive acetabular coverage was defined as an LCE angle exceeding 39°. The anatomical dimensions of both muscles were evaluated in axial arthro-MRI slices at the height of the femoral head using the following parameters: thickness, width, circumference, and cross-sectional area (CSA). For all four parameters ratios were calculated comparing the iliocapsularis (ROC) curves for each parameter used to diagnose DDH.

Results: The iliocapsularis to rectus femoris ratio was increased for thickness, width, circumference, and CSA. At a one-to-one ratio all parameters had a high positive predictive value ranging from 77 to 89%. From all four parameters the highest positive predictive value had the CSA with 89% (95% confidence interval, 74–97%).

Conclusion: The anatomic dimensions of the iliocapsularis muscle in comparison to the rectus femoris muscle are associated with acetabular morphology. All parameters are indicators for DDH with the CSA having the highest positive predictive value. These results suggest that the iliocapsularis muscle is a stabilizer of the hip. Additionally, preoperative evaluation of this muscle can be used as an adjunct for decision making when treating patients with borderline DDH.

Hip Range of Motion in Everyday Life

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Introduction: To date, there is no clear consensus as to the amplitude of movement of the "normal hip." Knowing the necessary joint mobility for everyday life is also important to understand different pathologies and to better plan their treatments (correct implant positioning in total hip arthroplasty, amount of bone loss in the treatment of femoroacetabular impingement, planning of reorientation osteotomies, etc.). To address these questions, we performed a preliminary study that aims at defining in a precise way the necessary hip joint mobility for everyday tasks based on the coupling of MR imaging and optical motion capture.

Methods: Motion capture and MRI was carried out on 4 healthy volunteers (mean age, 28 years). A morphological analysis (alpha angle, acetabular depth and version, etc.) was performed to assess any bony abnormalities. Motion from the subjects were acquired during routine activities (stand-to-sit, lie down, the shoes while seated, pick an object on the floor while seated or standing) known to be painful or prone to implant failure (dislocation, impingements). The hip joint kinematics was computed from the recorded markers trajectories using a validated optimized fitting algorithm which accounted for skin motion artifacts (accuracy: translational error <0.5 mm, rotational error <3°). The resulting computed motions were applied to patient-specific hip joint 3D models reconstructed from their MRI data.

Results: The hip range of motion was quantified for each subject and for all motions, thanks to two bone coordinate systems (1 for the femur and 1 for the pelvis). The hip joint kinematics was computed based on the computed bone poses from motion capture data, hip angles were determined at each point of the motion independently of the major anatomical planes, thanks to two bone coordinate systems (1 for the femur and 1 for the pelvis).

Conclusion: To our knowledge this is the first study of this kind assessing the accuracy of the hip clinical exam. The results seem to indicate that the clinical exam is a precise method for determining hip passive motion, if extra care is taken to stabilize the pelvis during flexion and abduction to prevent overestimation of the ROM. The examiner’s experience was not found to be a determining factor. Further studies including more subjects are required before validating the values of hip clinical exam as a gold standard.

Validity, reproducibility and responsiveness of the Oxford Hip Score in patients with femoroacetabular impingement

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Introduction: With the gradual acceptance of femoroacetabular impingement (FAI) as a disease mechanism of the hip, the scientific interest in the syndrome has increased and it has been described more frequently in the literature. The use of patient-reported outcome measures (PROMs) in the assessment of treatment success is now commonplace. However, with the exception of the Hip Outcome Score (HOS), the hip-scanic PROMs used in previous studies on FAI patients or in patients with other hip disorders have been not externally validated for use in FAI patients. One such instrument is the Oxford Hip Score (OHS). The OHS is quick and easy to complete. It was developed to assess patients with total hip arthroplasty (THA), in terms of their pain, mobility, and function during routine clinical practice. The aim of this study was to examine whether the psychometric properties (validity, reproducibility and responsiveness) of the OHS were acceptable enough to extend its use to patients with FAI.

Methods: 165 consecutive patients with FAI undergoing either arthroscopic surgery with labral preservation or limited anterolateral open surgery with labral resection completed the OHS and HOS before the operation. Six and 12 months postoperatively they were asked to complete the questionnaires again. 126 (76%) patients returned completed questionnaires at all three time-points. Over the
same period, 613 consecutive patients undergoing THA completed the OHS at baseline, and 550 (89%), at all three time-points At 6 and 12 months’ follow-up, the patients also rated the global treatment outcome (“how much did the operation help your hip problem?”) on a 5-point Likert scale with responses ranging from “helped a lot” to “made things worse.”

Results: The reproducibility of OHS was good and was similar for both the THA and FAI groups (SEM of 5.6% for THA and 6.2% for FAI, and ICC 0.97 for both FAI and THA). The responsiveness (Cohen’s d) of the HOS in FAI patients was high and similar to the HOS (d from 1.32 to 1.61 for the OHS and from 0.99 to 1.64 for the HOS). The correlation coefficients between HOS subscales (activity of daily living and sport) and OHS were large (r = 0.67 to 0.85). Similarly, high correlations were found between the changes scores of the two instruments (r = 0.60 to 0.76) and between changes scores and the transition question (r = 0.52 to 0.59). In the FAI patients, floor and ceiling effects ranged from 0 to 7.6% for OHS and from 0 to 16.8% for HOS.

Conclusions: The OHS showed sufficiently good psychometric attributes to support its use in FAI patients. When compared with the HOS (an instrument specifically developed for FAI patients), the measurement properties were similar. In conclusion, the study showed that the OHS, although originally developed for patients undergoing THA, can also be used for assessing pain and function in FAI patients.

Intraoperative monitoring of periacetabular osteotomy using 3-D custom made cutting and repositioning guides: a cadaver study

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Introduction: The goal of periacetabular osteotomy (PAO) is to reorient the acetabulum in a more physiological position: the limited correction is challenging because 1) osteotomy planes should keep the pelvic ring intact while staying extra-articular and 2) the final position of the acetabular fragment lies within a narrow three-dimensional range. Assistance with custom cutting- and reorientation-guides would thus be very helpful and save intraoperative x-ray time. Our purpose is to present a pilot study on such guides.

Methods: 8 cadaveric (6 female and 2 male) hemipelvis, (mean age 65.25 years, range 56–100) were scanned using Siemens CT with voxel size 0.65*0.65*1.25 mm. After segmentation of the images using Mimics® software, 3D models of each specimen were created. A PAO was performed on the 3D models and reorientation of the acetabulum was defined. Using 3-matic® software, an anatomy-specific guide was designed aimed to assist in iliac, posterior column and superior pubic ramus cuts as well as in acetabulum reorientation. Also position and length of fixation screws were planned. Regarding guidance and fixation of reposition 2 concepts of custom made guides were developed. Concept 1 was tested on 6 cadavers and concept 2 on two cadavers Laser-sintered guides were used to perform PAO on respective specimens. PAO was performed using original instruments by two surgeons (one experienced, one novice). CT images were acquired postoperatively and virtually planned acetabulum reorientation were compared.

Results: Application of the guides through the standard modified Smith Peterson approach and performance of the osteotomies, reorientation and fixation went uneventfully. Two cadavers showed very low bone quality with insufficient stability of fixation and were excluded from further analysis. The postoperative analyses showed that the cutting planes were completely extra-articular and the posterior column intact in all 8 specimens. Correlation between planning and postoperative result in terms of the acetabular index (AC), centre edge angle (CE), acetabular anteversion angle (AcetAV) and the position of centre of rotation (COR) revealed following differences: COR preoperatively compared to postoperatively showed a deviation of 720 mm (stdev 1.86 mm) on all performed PAOs (n = 6). Deviation of COR of concept 1 (n = 4) showed 7.82 mm (stdev = 2.04). Deviation of COR of concept 2 (n = 2) showed 5.96 mm (stdev = 0.49). Both concepts (n = 6) showed differences from of the CE angle of 5.78° (stdev 4.04°), AcetAV angle of 5.11° (stdev 3.27°), AcetAV angle of 14.98° (stdev 11.09°).

Conclusion: Concept 1 (n = 4) showed differences from of the CE angle of 4.61° (stdev 4.49°), AcetAV angle of 3.98° (stdev 3.96°), AcetAV angle of 13.61° (stdev 9.66°).

The use of 3D guides was possible through a standard approach without extension and revealed reliable fit of the guides to bone, reliable positioning of the osteotomies and planned corrections.
Positioning of sacroiliac screws using an intraoperative 3D CT (O-Arm®) guided navigation in posterior pelvic ring fractures
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Objective: Sacro-iliac (SI) screw fixation for sacroiliac joint disruption and fractures of the pelvic ring is an accepted method of treatment. Aberrant screw or wire placement can lead to significant neurovascular complications, including injury to the fifth lumbar nerve root, sacral venous plexus, iliac vessels, or cauda equina. Incorrect positioning of the SI-screws has been reported in up to 16% and in 7% this lead to neurovascular complications. In order to avoid such complications some authors suggest an intraoperative 3D CT guided navigation for screw positioning. We report our experience in the use of an intraoperative 3D CT guided navigation for the positioning of SI screws using the mobile O-Arm scanner.

Methods: From August 2008 to December 2012, we performed 23 O-ArmØ navigated SI-transfixations in 20 patients. Indications were unstable posterior ring fractures and painful SI-joint disruption. The operations were performed either in a prone position, when solely a dorsal fixation was performed, or supine, when associated with anterior pelvic ring stabilization. The reference pin was positioned for scan was then performed for screw position control. Using this scan, 1 or 2 percutaneous 6 to 8 mm diameter screws were inserted using the Medtronic® navigation system. A final scan was then performed for screw position control.

Results: 16 SI-transfixations were performed in females and 4 were males. Median age was 45.5 (18–84). 3 patients were operated bilaterally, 7 underwent an exclusive SI-transfixation. 13 also had an anterior pelvic ring or acetabulum osteosynthesis. 6 were SI joint disruptions, 16 were sacrum fractures and 1 was combined. The second intraoperative control scan showed that all screws were correctly positioned. The patients showed no intraoperative or postoperative complications.

Discussion: In our experience, navigation guided SI screw positioning using the O-Arm™ is a safe method, that enables correct screw placement and a low radiation dose for the operator. The advantages of the O-Arm compared to other devices are its mobility that allows intraoperative use and the image quality, which is comparable to standard CT-scan. Advantages of a mobile CT imaging combined with navigation include the ability to use a lower dose of radiation for the surgeon and the staff, the lack of patient transport and the precision and reproducibility of the screw positioning. The downside is the high acquisition cost.

Mid-term outcome following fixation of anterior pelvic ring injuries using the modified Stoppa approach
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Introduction: The modified Stoppa approach was introduced for less invasive open reduction and internal fixation of anterior pelvic ring injuries. The aim of the present study was to focus on the elderly after treatment of pelvic ring injuries using this approach.

Methods: A consecutive series of 46 patients (50 yrs, 19-79; 27/46 C-type fractures) treated operatively using the modified Stoppa approach between 07/2004 and 08/2011 was assessed in accordance to age (group A: <60 yrs (n = 33), group B: ≥60 yrs (n = 13)). Surgical data, accuracy of reduction according to the Rommens classifications respectively. Failures were defined as total hip arthroplasty, a Merle d'Aubigné score of less than 14 points, a Harris Hip Score of less than 90 points, and/or a neurological progression of osteoarthritis (Tönnis grade 2 or 3). The clinical and radiographic outcome was rated according to Matta.

Results: Initially, the reduction was noted to be "anatomical" in 19 and "improved" in one patient. At follow-up, 32 patients were evaluated. 12 patients were not available for follow-up, 2 patients refused consultation 24 months postoperatively as they were doing well (two patients suffering from dementia and one elderly patient). Two patients had to be excluded from further evaluation as they required a total joint replacement four and five months, respectively, after the index procedure. In the further 12 patients, no failures were observed, the clinical outcome was rated according to Matta as "excellent" or "good" in seven and five patients, respectively whereas the radiographic outcome showed "excellent" results in ten cases, "good" or "fair" results in one patient in each case two years after surgery.

Conclusion: In the treatment of complex acetabular fractures in patients the Pararectus approach allowed for anatomic restoration with minimal access morbidity and providing promising outcomes at the short-term. At our department in Pararectus approach has become the standard approach in the presented fracture patterns.

One stage revision of infected hip arthroplasty with and without cement
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Introduction: According to a treatment algorithm (N Engl J Med 2004;351:1645–54) well selected patients with infected hip replacement qualify for one-stage revision. Eradication of infection is achieved by implant exchange and antibiotics administration without additional local antibiotics, thus permitting fixation without antibiotic-loaded cement. The outcome of our one-stage revisions is presented.

Methods: After joint aspiration and identification of the microorganisms all patients qualifying for one-stage exchange were included. Thorough debridement and cemented or uncemented reimplantations were performed according to the preference of the surgeon. In case of cementation Palacos® R+G was used. At least 3 additional intraoperative biopsies for bacteriological and histological analyses were sampled. Antibiotic treatment was administered intravenously for two weeks, followed by oral therapy for a total duration of 3 months. Patients had a standardised clinical and radiological follow-up.

Results: Between 1998 and 2011, 40 patients (41 hips) were treated with a one-stage procedure. In 26 cases an uncemented revision stem (Wagner or Revitan, both Zimmer®) was implanted and 38 cases received an acetabular ring (Müller or Burch Schneider). Coagulase-negative staphylococci were the most frequent pathogens (44%), followed by S. aureus (22%), streptococci (19%), and gram-negatives (10%). Polymicrobial infection was present in 4 cases. Mean follow-up was 4.7 (2.3 to 15.2) years. Three patients had died before 2 years follow-up, not related to treatment. No patient had persistence of infection or reinfection. However, there were 4 revisions for aseptic

Short-term outcome after management of acetabular fractures using the Pararectus approach
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Introduction: The Pararectus approach was introduced previously as a new anterior intrapelvic approach for treatment of displaced acetabular fractures. The aim was to present the short-term outcome data after its clinical implementation.

Patients: A consecutive series of 20 patients (mean age 59 years, range: 17–90; 17 male) with displaced acetabular fractures involving predominantly the anterior column and the quadrilateral plate was treated between 12/2009 and 02/2010 using the Pararectus approach. Initially, the accuracy of reduction using CT scans and the occurrence of intraoperative complications were assessed. Enrolled in a prospective evaluation protocol, patients were evaluated 12 and 24 months postoperatively. Clinically, the Harris Hip Score, the Western Ontario McMasters (WOMAC) Score and the Merle d’Aubigné and Postel grading adapted by Matta were used. Radiographically, conventional radiographs were analyzed for occurrence of osteoarthritis (OA), acetabular head necrosis (AVN) according to Tönnis-, Brooker- and Ficat classifications respectively. Failures were defined as total hip arthroplasty, a Merle d’Aubigné score of less than 14 points, a Harris Hip Score of less than 90 points, and/or a neurological progression of osteoarthritis (Tönnis grade 2 or 3). The clinical and radiographic outcome was rated according to Matta.

Results: Initially, the reduction was noted to be "anatomical" in 19 and "improved" in one patient. At follow-up, 20 patients died 12 and 24 months postoperatively. Clinically, the Harris Hip Score, the Western Ontario McMasters (WOMAC) Score and the Merle d’Aubigné and Postel grading adapted by Matta were used. Radiographically, conventional radiographs were analyzed for occurrence of osteoarthritis (OA), acetabular head necrosis (AVN) according to Tönnis-, Brooker- and Ficat classifications respectively. Failures were defined as total hip arthroplasty, a Merle d’Aubigné score of less than 14 points, a Harris Hip Score of less than 90 points, and/or a neurological progression of osteoarthritis (Tönnis grade 2 or 3). The clinical and radiographic outcome was rated according to Matta.
loosening of cemented stems. The mean HHS was 81 (26 to 99) at final follow-up.

Discussion: One-stage revision of established hip infection has an excellent clinical and microbiological success rate even in fixation without antibiotic-loaded cement. A careful selection of suitable patients according to well-defined criteria and a three-month treatment with appropriate antibiotics that are active against biofilm are a prerequisite for this strategy. For correct treatment stratification an interdisciplinary approach including orthopedic surgeons and infectious diseases specialists is necessary.

Radiological short term results after total hip arthroplasty using the Fitmore® hip stem

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Introduction: The purpose of this retrospective multicenter case series was to evaluate the radiological outcome after implantation of the un cemented Fitmore® Hip Stem (Zimmer GmbH, Switzerland).

Methods: From April 2007 to December 2008, the first 145 consecutive patients (mf = 1:1.23; median age 57 years, range 21–87 yrs) treated with the Fitmore® hip stem as part of a total hip arthroplasty (THA) were included in this study. The indication for the THA was mostly primary degenerative arthritis (n = 99), dysplasia (n = 17), but included other indications (n = 20). The typical approach used was the antero-lateral (n = 125). Clinical and radiological controls took place postoperatively, after 6 weeks, 12 months and 24 months.

Changes to the primary position of the stem including varus/valgus as well as subsidence were measured. Furthermore, changes in the femoral bone including cortical resorption and hypertrophy, cancellous condensation or radiolucencies and signs of oscillation in the interface between stem and surrounding bone adapted to the Gruen zones were evaluated.

Results: In the first 6 weeks an increase of 0.5° to a varus position of 3.1° was detectable. An average stem subsumption of 2.4 mm after 1 year with no changes in the following year is not significant. After 1 year, 35% of all patients show some calcar resorption at the wedge-shaped portion of the prosthesis (no significant changes at the direct stem-bone-interface) and 59% show cortical hypertrophy at the level of the stem tip, mostly at the lateral side. A radiolucent line was present in 16% at the greater trochanter and in 14% at the tip. After 2 years, bone adaptation in the calcar region can be seen in 44%, Cortical hypertrophy in the distal part of the stem is visible in 64%, but also a significant decrease of stem oscillation signs (6% at the greater trochanter; 10% at the tip) is notable.

Conclusion: The Fitmore® stem shows in the first 2 years a stable position in the proximal femur with no significant subsidence of 2.4 mm and a non significant increase of varus of 0.5°. Between 1 and 2 years no further changes in position are measurable. The changes in bony appearance will be discussed.

Dual mobility socket to prevent instability in primary total hip replacements: results at 10 years minimal follow-up

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Introduction: Total hip arthroplasty (THA) instability is well documented to be more common in specific demographic groups. We report a retrospective analysis of the use of a dual mobility implant for primary hip replacements in selected patients at risk for dislocation. The aim of this study was to assess the long-term clinical and radiologic features associated with the dual mobility cup in case of primary THA.

Materials and Methods: At our institution 119 primary THA were performed in 114 patients (74 females and 40 males) at high risk of instability between January 2000 and December 2002. 84% of the patients had at least two risk factors for dislocation. The mean age was 71 years old (range, 21.4 to 93.2 years) at the time of the arthroplasty. A dual mobility socket was used in all cases. Clinical result was assessed using Harris Hip Score, and complications were determined by detailed review of the patient’s records. Radiographs of the involved joint were reviewed to assess the position of the prosthesis and to look for osteolysis and signs of loosening of the implant.

Results: During the study period, 56 patients (47%) died of unrelated causes. 17 patients (15%) were lost to follow-up. For the remaining 41 patients (46 hips, 38%), the minimal follow-up was 10 years (119 to 154 months, mean 133 months). Harris hip score improved from 39.6 to 82.4 (p <0.05). Only one dislocation (1%) occurred, 7 years after the surgery, in a 35-year-old female with Mannosidosis. Two hips were revised at latest follow-up, for deep infections. No aseptic loosening of the cup or osteolysis was observed at latest follow-up.

Conclusion: The dual mobility system was extremely successful in achieving stability in this continuous series of patients with increased risk for dislocation. In addition, no mechanical failure, and no osteolysis or aseptic loosening of the cup has been reported. The use of dual mobility cup to prevent instability in selected patients is a reliable option at long term follow-up.
Revision of unstable THA using a dual mobility socket: 3.5 to 11.1 year follow up
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Introduction: Revision procedures for unstable total hip arthroplasty have been reported. High failure rates and complications have been proposed in such challenging cases, including dual mobility. The purpose of this retrospective study was to assess the clinical and radiologic features associated with the dual mobility cup in case of revisions for instability.

Materials and Methods: Sixty four total hip arthroplasties (62 patients) were revised for THA instability using a dual mobility cup at our institution between March 2000 and April 2008. Mean age at reoperation was 67.3 year old (range, 35 to 98). The outcome of the revision procedure was assessed using the Harris Hip Score, and complications were determined by detailed review of the patient’s records. Anteroposterior and lateral radiographs of the involved joint were reviewed to assess the position of the prosthesis and to look for osteolysis and signs of loosening of the implant.

Results: Mean follow-up was 7.5 years (range, 3.5 to 11.1). At last review 11 patients had died and one was lost to follow up. Postoperatively there was a significant improvement of the Harris Hip Score. Sixty-three patients (98.4%) had no further episodes of dislocation. There were 3 revisions for deep infection, and 4 for mechanical failures including 2 dissociation of the bipolar component, one head-trunion dissociation, and one aseptic loosening of the acetabular construct. For the remaining patients, no radiolucent lines around the components and no osteolysis were observed at latest follow up.

Conclusion: The dual mobility cup is a highly effective option to manage unstable total hip arthroplasty. Unlike constrained devices, such implants provide encouraging radiologic results regarding the potential for loosening and osteolysis at mid- to long-term.

Constrained implants for total hip arthroplasty instability: analysis of failures
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Introduction: Recurrent instability after total hip arthroplasty remains a serious and somewhat frequent problem. Constrained implants have proven effective to manage instability. This has led to a liberal utilization of these devices. However, sporadic mechanical failures have been reported. This report analyzes the failures of a single constrained device at our institution.

Materials and Methods: Forty-three constrained implants (Stryker Constrained Liner™) in 34 patients were revised out of total 390 similar implants performed at our institution. There were 24 females and 10 males. Constrained implant was inserted at the first revision in 6 hips and after an average of three surgeries (1–6) in 37 hips. Seven different methods of constrained liner fixation were observed. Eight different theoretical failure mechanisms were identified: six are mechanical device failures at each of the implant interfaces, infection and catastrophic polyethylene wear being the other two.

Results: Average time to failure was 28.4 months (1–78). Several failure mechanisms were operating in most cases. The predominant mechanism was infection in 12 (28%), type I (failure of fixation to bone) in 11 (26%), type II (failure of mechanism holding the liner to shell) in 6 (14%), type III (failure of the bipolar holding mechanism) in one (2%), type IV (dislocation of bipolar) in 9 (21%), type V (dislocation of femoral component from head of bipolar) in 3 (7%), and in 1 hip we could not identify the failure mechanism; There were no instances found of type VI failure (disengagement of the prosthetic head from trunion) or catastrophic polyethylene wear.

Conclusion: Constrained bipolar implants are complex devices with multiple interfaces. We have shown multiple mechanisms of failure of these devices, and we therefore advocate restricting their use to salvage situations. As an alternative to constraining systems, dual mobility sockets have also proven effective on stability, with decreased risk for mechanical failure because of a simple design involving a limited number of parts. For these reasons, the current use of constrained implants has decreased, and the dual mobility sockets are becoming the most popular options.

Effect of cup-medialization on flexion and abduction moment arms in total hip arthroplasty
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Introduction: The classic technique of total hip replacement described by Charnley and Müller includes a medialization of the acetabular cup towards the ilioschial line with a compensatory increase of the femoral offset in order to keep the global offset anatomical. This concept is based on a 2D analysis of moment arms, which lead to the conclusion that the more medial the center of rotation is, the more favorable the moment arms would be. However, medialization is associated with significant bone loss. In addition, the working length of muscle fibers is altered. The purpose of this study was to compare moment arms of the hip abductors after an anatomical reconstruction with those of a reconstruction with cup medialization in a numerical 3D model of the hip during the gait cycle.

Methods: A 3D numerical model of a patient with "normal" hip anatomy was developed (using FE software Abaqus, Dassault Systemes). The model is based on a CT scan, including the gluteus medius, minimus and maximus. A total hip prosthesis was virtually implanted with and without cup medialization (5 mm), keeping the global offset constant in both cases. Bone and prosthesis were assumed rigid, while a hyperelastic deformation law was used for the muscles. Passive flexion-extension and abduction-adduction were simulated. The range of motion corresponded to gait cycle. The gluteus medius (middle fiber) moment arm was calculated for these two (planar) movements separately.

Results: During flexion-extension, the minimum, average and maximum moment arms of the gluteus medius were 9.0, 10.6 and 11.2 mm without cup medialization, and 10.4, 11.7 and 12.2 mm with medialization. Respective values for abduction-adduction were 38.2, 40.5 and 41.8 mm without and 40.2, 43.1, 44.7 mm with medialization. A cup medialization of 5 mm leads to an increase of the gluteus medius moment arm of (minimal, average and maximal values) 15, 10 and 9% for flexion-extension and 5, 6 and 7% for abduction – adduction, respectively.

The change in length of the middle muscle fiber, with or without offset, was less than 1 mm.

Conclusion: A cup medialization of 5 mm resulted in an increase of 5–15% of the lever arm of the gluteus medius throughout the gait cycle, while a minimal effect on the fiber length was observed.
Micromotion, subsidence and gap at the stem-femur

Valérie Malfroy Camine, Hannes Rüdiger, Pierrick Bauduin, Dominique Pioletti, Alexandre Terrier

Introduction: Excessive interfacial micromotions around the femoral stem affect the primary stability of hip implants, and may promote aseptic loosening. Physical activities such as stair climbing induce primary stability than compressive loads. The aim of this study was to extend a technique based on microcomputed tomography (µCT) to measure simultaneously and at multiple sites the relative interfacial micromotions and gap during compression and torsion on a cadaveric femur.

Methods: Torsional and compressive load cases were studied on the femur (SPS, Symbolis, Yverdon) while stainless steel beads were press-fitted onto the endosteal bone surface of a human cadaveric femur. The cementless stem was implanted according to the technique recommended by the manufacturer. Compression (2000 N) and torsional (13 Nm) loads were successively applied with a custom-made loading device. µCT scans were performed at 3 steps: before, during and after loading.

A custom-made image-processing algorithm was used to detect bone and stem markers from µCT images. The third unloaded µCT was used as a reference and the first two µCT were rigidly transformed so as to have the stem beads overlapping. The 3D micromotions were the difference of bone markers position between the loaded and reference µCT, while subsidence was derived from the first and last µCT. Gap was the closest distance between the bone markers and stem surface in the reference µCT.

Results: Micromotions, subsidence and gap were simultaneously measured for 384 steel beads, spread within a 40-mm region of interest. Maximum micromotions were 95 µm in compression and 170 µm in torsion. Mean subsidence was 2190 µm in compression and 630 µm in torsion. For both load cases, gap was small against the bearing faces of the implant.

Conclusion: During compression, maximal micromotions measured were below the critical value of 150 µm reported to induce aseptic loosening of the prosthesis. During torsion, local micromotions exceeded this threshold. This result underlines the importance of a simultaneous and multisite measurement of micromotions, for different load cases.

To conclude, we developed a technique to get a quasi-continuous distribution of interfacial micromotions, subsidence and gap around the femoral stem during compression and torsion. This method could be used to test implant design, surgical techniques, or validate numerical models.

Diagnosis and management of failed metal-on-metal total hip arthroplasty

Jérôme Fasmeyer, Alexandre Lunebourg, Jean-François Fischer, Olivier Husmann, Bertrand Vuilleumier

Introduction: Large head metal-on-metal (MoM) total hip arthroplasty (THA) has been considered as particularly interesting in young and active patients. This type of total hip replacement has several advantages, such as less wear, lower risk of dislocation and better range of motion. Unfortunately, revision rate is significantly higher. The purpose of this study is to review our recent cases and to define clinical, biological and radiological criteria helping us to decide if revision surgery of a large head MoM THA is necessary (flow chart). Technical and surgical aspects are discussed.

Materials and methods: Between 2005 and 2012 we implanted 352 large head MoM THA. We reviewed all patients with large head MoM THA operated in our department during this period. 17 (5%) patients with a mean age of 67 years (+/- 9) have been revised. Patients' complaint were noted. They all had blood test analysis (FBC, PCR, chrome/cobalt serum concentration) and standard x-ray. Sometimes CT and hip aspiration were necessary to obtain a better assessment. Anatomopathological and microbiological analysis were obtained systematically.

Results: With a mean follow-up of 5 years (+/- 2) after THA, 13 patients presented pain associated with a decreased range of motion, 2 patients a periprosthetic fracture, 1 patient with a swelling around the thigh and 1 infection. Serum chrome/cobalt level was elevated (maximum Chrome/Cobalt: 2203/2344 nm/l). No superficial signs of inflammation were reported but blood test showed increased inflammatory parameters, which needed complementary investigation by hip aspiration. On the x-ray analysis, implants were in an adequate position except in 2 cases, where the cup was too vertical (>45° of inclination). Osteolysis was rarely obvious on standard X-ray, but was uncovered by CT scan, particularly on the acetabular side. In 14 cases, revision included cup and femoral head exchange and in 3 cases cup and stem were revised. Aggressive synovitis with local invasion of muscles (gluteus medius and psosas) and metallosis were observed and confirmed by anatopathological analysis.

Conclusion: Large head MoM THA represents a serious concern because of a high rate of revision. Pain and decreased range of motion with a high blood level of chrome/cobalt were routinely found. Revision of MoM THA involved most of the time an exchange of the cup and the femoral head. Surgery could be complicated by severe cancellous bone resorption on the acetabular side and/or lysis of tendon attachment.

Patients with large head MoM THA should be closely followed-up. In case of clinical complains, elevated Chrome/Cobalt serum concentration or radiological (standard X-rays, CT) abnormalities, early revision should be proposed.

Assessment of Congruence and Impingement of Prosthetic Hips during Everyday Tasks

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Introduction: Conventional pre-operative planning for total hip arthroplasty mostly relies on the patient anatomy for the positioning and choice of implants. This kind of planning essentially remains a static approach since dynamic aspects such as the joint kinematics are not taken into account, and is hence not able to fully consider the evolving behavior of the prosthetic joint that may lead to implant failures. In fact, knowledge of the prosthesis endo-cup and the joint kinematics plays an important role since some movement can create conflicts within the articulation and yielding possible dislocations. The goal of our study was to assess the relationship between acetabular implant positioning variations and resultant impingements and loss of joint congruence during daily activities.

Methods: 3D models of prosthetic hip joints (pelvis, proximal femur, cup, stem, head) were developed based on variations of acetabular cup’s inclination (40°, 45°, 40°) and anteversion (0°, 15°, 30°) parameters, resulting in a total of 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 daily tasks were applied to all implant configurations. The motions were obtained from 4 healthy volunteers (mean age, 28 years) during routine (stand-to-sit, lie down) and specific activities (lace the shoes while seated, pick an object on the floor while seated or standing) known to be prone to implant dislocation and impingement.

One-stage bilateral total hip replacement using the direct anterior approach is safe and effective

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Background: The direct anterior approach without using a fracture table is suitable for patients who require bilateral total hip replacement (THR) and this can be performed during a single operative session. The potential benefits of single stage THA include a single episode of anesthesia, more efficient use of resources, reduced overall hospitalization and shorter rehabilitation periods. Some studies have, however, reported a higher incidence of medical and surgical complications after single stage bilateral THA compared to a staged procedure.

Purpose: The aim of this study is to determine whether single stage bilateral THA using the direct anterior approach is as safe and effective as the unilateral procedure regarding complications, radiographic and diagnostical assessment, and patient-reported clinical outcomes.

Patients and Methods: We retrospectively compared 14 patients who had single stage bilateral THA with a matched group of 28 patients who underwent unilateral THA with a minimum 2 years follow-up for both groups. Duration of anesthesia, operative time, blood loss, length of hospital stay, and any intraoperative or postoperative complications were recorded. Cup inclination and heteroetic ossification were analyzed on postoperative radiographs. Generic (EQ-VAS and EuroQoL-5D index) and condition-specific (Oxford Hip Score) instruments were used to assess patient-reported outcomes.

Results: No significant differences between the two groups were found for complications, radiographic assessment, or patient-reported outcomes. In the single stage THA group, blood loss, anesthesia, and operative times were less than double that of the unilateral group.

Conclusions: Single stage bilateral THA using the direct anterior approach seems to be as safe and effective as a unilateral THA, with favorable short-term clinical and radiological outcomes and similar complication rates.

One-stage bilateral total hip replacement using the direct anterior approach is as safe and effective as the unilateral procedure regarding complications, radiographic and diagnostical assessment, and patient-reported clinical outcomes.

Assessment of Congruence and Impingement of Prosthetic Hips during Everyday Tasks

Caecilia Charbonniere 1, Sylvain Chaguel 2, Matteo Ponzon 2, Massimiliano Bernardoni 3, Pierre Hoffmeyer 3, Panayiotis Christofiliopoulos 4

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Methods: 3D models of prosthetic hip joints (pelvis, proximal femur, cup, stem, head) were developed based on variations of acetabular cup’s inclination (40°, 45°, 40°) and anteversion (0°, 15°, 30°) parameters, resulting in a total of 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 daily tasks were applied to all implant configurations. The motions were obtained from 4 healthy volunteers (mean age, 28 years) during routine (stand-to-sit, lie down) and specific activities (lace the shoes while seated, pick an object on the floor while seated or standing) known to be prone to implant dislocation and impingement.
While visualizing the prosthetic models in motion, a collision detection algorithm was used to locate abnormal contacts between both bone and prosthetic components. Moreover, femoral head translations (subluxation) were computed to evaluate the joint congruence.

**Results:** The simulations showed that collisions occurred at maximal ranges of motion in the anterosuperior part of the acetabulum. The more the inclination and anteversion were important, the lower the frequency of impingements was noted (e.g. 23% at 40°/0°, 13% at 45°/15°, 5% at 60°/30°). Subluxations followed the same trend (e.g. 4.0 mm at 40°/0°, 1.5 mm at 45°/15°, 0.2 mm at 60°/30°) and were observed as a consequence of impingements.

**Conclusion:** Daily tasks could expose the prosthetic hip to subluxation and impingement located in the anterosuperior position. This location could be explained by the high hip flexion required to execute the motions (≈95°). Considering the kinematics solely, increasing inclination and anteversion seems to decrease possible conflicts, but mechanical aspects (stress, wear) should also be considered in the definition of ideal cup positioning.

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**MoM articulation Metasul versus contemporary Polyethylene. A long time follow up, 14±15 yrs. after primary implantation**

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**Objectives:** Between 1992 and 2003 we used the same uncemented Zweymüller titan hip implant 690-times with the articulation ceramic-polyethylene (UHWMP) and in 663 hips the metal-on-metal articulation Metasul with a forged high carbon alloy. In both articulations the same head diameter 28mm.

In 2003 we reported in cooperation with H.G Willert new findings of a metal-sensitivity reaction type ALVAL detected in 5 Metasul-hips (0.8%) at the 5 yrs. follow up. (Aspecific Lymphocytic Vasculitis Associated Lesion)

**Methods:** Therefore continuous clinical and radiological follow-up examinations of all articulations 10 and 15 years after the primary implantation with a special regard to radiological wear associated alterations, such as radiolucous lines, osteolysis and MoM-signs of a hypersensitivity like fibrosis were performed. The follow-up time now 202 hips had a 15-years follow-up with an additional clinical and radiological examination.

**Results:** At 14/15 years follow up: 36 hips, 2.6% lost to follow-up. Ceramic-PE: All revisions 20 (2.9%), two of them with a ceramic-to-MoM-Metasul. All revisions 28 (4.2%), wear related 12 (1.8%), aspecific loosening 5 (0.8%), late infections 5 (0.8%), others 7 (1.1%). Ten of all wear related revision (N12) were probably MoM-induced (1.5%) with seven (1.1%) histological confirmed perivascular lympho-plasmacellular infiltrations like ALVAL. Two cases needed a full stem and cup exchange, all other revisions "only" an inlay exchange to PE or PX-PE with later good functional results and new re-ossifications of the MoM-induced osteolyses.

**Conclusion:** In the contrary in the first years detected MoM-cases, at the 14/15 years follow-up only a slight increase of the metal-induced revisions from 0.8% to 1.5%. No worrying progression, but compared to the low revision rate of Ceramic-PE no better Metasul-wear behaviour. In contrary to recently reported bad to concerning results of large MoM Bearings no unacceptable high failures rate as ARMD or Pseudotumors. (adverse reaction to metal debris). As a result of the regular performed 5, 10 and 15 yrs. follow-up all revisions were detected early and carried out in time. Only 1 extended osteolysis.

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**Ten-year comparative effectiveness of metal-on-metal vs ceramic-on-polyethylene THAs with a small diameter head**

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**Introduction:** Large metal-on-metal (MoM) total hip arthroplasties (THA) have given rise to serious concerns. Studies comparing smaller head MoM to ceramic-on-polyethylene (CoP) THAs over a longer follow-up period are lacking.

**Objectives:** Our objective was to evaluate complications, radiographic and clinical outcomes in MoM vs. conventional CoP THAs during the first 10 years postoperatively.

**Methods:** Prospective cohort study including all MoM (group 1) and CoP (group 2) THAs with an uncemented press-fit cup and 28 mm head. The following outcomes were compared: (1) Complication rates (infection, dislocation, revision) and all-cause mortality for patients operated upon between 3/1996 and 6/2011 (mean F/U 109 months, range 12–199); (2) Incidence of osteolysis; and (3) Clinical outcomes at 5 and 10 years postoperative. Evaluation was performed by an independent assessor. Cox regression was used to compare incidence rates of complications and mortality and multivariable linear regression to compare clinical scores.

**Results:** 3,341 THAs were included, 883 with MoM and 2,458 with CoP bearing. Crude incidence rates for complications were: 14 vs 0.9 cases/1000 person-years (p < 0.05) for infection; 4.3 vs 2.4 /1000 p-y for dislocation; and 4.3 vs 2.4 /1000 p-y for all-cause revision. Adjustment for baseline differences substantially attenuated the higher rates for infection (adjusted hazard ratio (HR) 1.3, 95% CI 0.5; 3.0) and revision (adjusted HR 1.2, 95% CI 0.7; 2.2). Mortality was similar in both groups (adjusted HR 1.0, 95% CI 0.7; 1.3). Only in the MoM group 6 (0.7%) patients developed adverse local tissue reaction and required revision at a mean F/U of 73 months (range 17–139). No substantial difference in osteolysis at 5 and 10 years was observed between both groups. At 5 years, 449 MoM and 1,444 CoP THAs were seen; at 10 years, 75 MoM and 653 CoP THAs. Clinical outcomes were similar both at 5 and 10 year F/U after adjusting for baseline differences.

**Conclusion:** Mid-term results did not substantially differ with respect to complications, radiographic and clinical outcomes between MoM and conventional CoP THAs, suggesting no major advantage for use of a small head MoM bearing in the first 10 years postoperative.

However, the potential advantage of metal wear debris remains a concern even with smaller head sizes as evidenced by an adverse local tissue reaction in 6 patients in the MoM group.

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**Recovery of hip muscle strength after hip arthroscopy in patients with symptomatic femoroacetabular impingement**

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**Introduction:** Patients with symptomatic femoroacetabular impingement (FAI) present with hip muscle weakness. The restoration of hip muscle strength after hip arthroscopy to address FAI is therefore a major concern in this cohort of young and active patients. Aim of this study was to prospectively evaluate hip muscle strength of patients with symptomatic FAI 2.5 years after hip arthroscopy.

**Methods:** Hip muscle strength of 8 patients with symptomatic FAI (age: 29 ± 10 years) was evaluated preoperatively and 2.5 years after hip arthroscopy, and was compared to 8 healthy matched controls.

Maximal voluntary contraction (MVC) strength was measured for all hip muscle groups (adductors, abductors, internal rotators, external rotators, flexors, extensors) using hand-held and isokinetic dynamometry. At follow-up, we also used (1) the Hip Outcome Score (HOS) to evaluate hip pain and function during activities of daily living (ADL) and sports activities (sport), (2) the symptom-specific well-being outcome to assess the acceptability of the current health state related to the hip, and (3) the global treatment outcome to evaluate hip arthroscopy.

**Results:** Patients showed significant increases in MVC strength for all hip muscles (9 to 59%, p < 0.05). At follow-up, only hip flexor MVC strength was lower for patients than controls (–18%, p = 0.03), and strength was lower for patients than controls (–18%, p = 0.03), and all hip muscles (9 to 59%, p <0.05). At follow-up, only hip flexor MVC strength was lower for patients than controls (–18%, p = 0.03), and strength was lower for patients than controls (–18%, p = 0.03), and all hip muscles (9 to 59%, p <0.05). At follow-up, only hip flexor MVC strength was lower for patients than controls (–18%, p = 0.03), and strength was lower for patients than controls (–18%, p = 0.03), and all hip muscles (9% to 59%, p <0.05). At follow-up, only hip flexor MVC strength was lower for patients than controls (–18%, p = 0.03), and strength was lower for patients than controls (–18%, p = 0.03), and all hip muscles (9% to 59%, p <0.05). At follow-up, only hip flexor MVC strength was lower for patients than controls (–18%, p = 0.03), and strength was lower for patients than controls (–18%, p = 0.03), and all hip muscles (9% to 59%, p <0.05). At follow-up, only hip flexor MVC strength was lower for patients than controls (–18%, p = 0.03), and strength was lower for patients than controls (–18%, p = 0.03), and all hip muscles (9% to 59%, p <0.05).

**Conclusion:** Patients with symptomatic FAI recovered their hip muscle strength to normal levels 2.5 years after hip arthroscopy, except for hip flexors. Although hip muscle strength was restored, clinical outcomes were good-to-excellent, and general positive evaluation of surgery at follow-up, half of the patients were not completely satisfied with their postoperative health state related to the hip.

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**Enlargement of the anterior approach to the hip joint: Potential risk to neurovascular structures**

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**Introduction:** Many studies favour the anterior approach (AA) for total hip arthroplasty. However, some report high complication rates, especially when using the mini-incision technique. In cases of intraoperative complications, the surgeon may need to enlarge the approach distally by splitting the interval between the rectus femoris (R) and vastus lateralis (VL). This extension endangers neurovascular structures, namely the branches of the femoral nerve (F) and of the lateral femoral circumflex artery (LCA). The purpose of this study was 1) to demonstrate the proximity of neurovascular structures with...
regards to AA at the hip joint and 2) to investigate if the AA could be safely enlarged distally.

**Methods:** Seventeen cadaveric hemipelvis with legs from twelve specimens were dissected. All nerve branches to the VL, vastus intermedius (VI), vastus medialis (VM), vastus lateralis (VL) and the S and R as well as vessels arising from the LCA were traced. The entrance of each nerve branch into its specific muscle belly was recorded and the distances to two reference lines were measured: 1) the horizontal line through the middle of the neck of the femur proximal to the intertrochanteric line (X1) and 2) the horizontal line through the lower margin of the lesser trochanter (X2). A Cerglage hook was inserted between X1 and X2 and damage to neurovascular structures was recorded.

**Results:** The VL was innervated proximally and distally, the VI medially and laterally by branches of F. The proximal part of VL, lateral part of VI, the S and R received branches mainly from between X1 and X2; In contrast, the S and R received nerve branches more anteriorly and superficially, a safe distance from the enlarged AA. The LCA always divided into its branches between X1 and X2. The distal part of the VL and medial part of the VI were innervated distal to X2. The insertion of the Cerclage hook regularly led to damage or tearing of muscle branches to the VL, VI and branches of LCA while branches to the S and R remained untouched.

**Conclusions:** The distal enlargement of the AA to the hip joint results in direct denervation of proximal lateral parts of the quadriceps muscle. Additionally damage to branches of the LCA is very likely. The enlargement of the AA distal to the intertrochanteric line as well as the placement of instruments over the AA should be avoided.

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**Conclusions:** The distal enlargement of the AA to the hip joint results in direct denervation of proximal lateral parts of the quadriceps muscle. Additionally damage to branches of the LCA is very likely. The enlargement of the AA distal to the intertrochanteric line as well as the placement of instruments over the AA should be avoided.
Public rami fractures in the elderly – an underestimated injury
Patrick Studer, Norbert Suhm, Marcel Jakob, Nicolas Bless
Universitätsspital Basel

Objective: To evaluate patient characteristics and natural history of public rami fractures in elderly people with a special focus on the frequency of concomitant posterior pelvic ring lesions and the percentage of secondary operated patients due to conservative treatment failure.

Study Design: Retrospective cohort study. Patients were treated in university hospital which is equivalent with a level I Trauma center.

Introduction: Many surgical approaches to the posterior shoulder joint have been utilised. Deep dissection generally includes the development of the intermuscular plane between the infraspinatus and teres minor muscles (IS/TMI). Identifying this interval is crucial, as a dissection carried out more proximal leads to denervation of parts of the quadrilateral and triangular space. To our knowledge, there are no reports detailing anatomical landmarks relative to the IS/TMI.

Methods: Twenty-five, formalin fixed, human cadaveric shoulders were dissected. The IS/TMI, the inferior border of the glenoid (IBG), T and the humeral insertion of IS and TMI were identified. Structures were dissected. The (IS/TMI), the inferior border of the glenoid (IBG), T and the humeral insertion of IS and TMI were identified. Structures were dissected. The (IS/TMI), the inferior border of the glenoid (IBG), T and the humeral insertion of IS and TMI were identified. Structures were dissected.

Results: In all except one specimen the IS/TMI was located immediately proximal to T. The mean distance between T and IS/TMI was recorded 4.6 mm (range 0 to 10, SD +/- 3.3). In all shoulders T was found proximal to the IBG (mean distance 8.1 mm, range 4 to 15, SD +/- 3.1).

Conclusion: Detailed anatomical knowledge is imperative to avoid surgical complications during the approach to the posterior shoulder joint. Our study reveals that the interval IS/TMI constantly corresponds to the posterior pelvic ring. In contrast to other landmarks T is independent of gender, body size and position of the shoulder joint as the T moves with the position of the humeral head.

Tuberolateral of the Greater Tuberosity. A suitable landmark for the posterior approach to the shoulder joint
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Methods: 53 OA shoulders were analyzed using regular CT’s. A 3D geometric model and a coordinate system were defined using accurate bony landmarks. VERSION angle (Va) is the angle between the glenoid surface and the scapular axis. Va was divided in V1 when Va less 10deg, V2 when Va between 10 and 20deg, and V3 when Va more than 20deg. Version ORIENTATION (Vo) is the angle between the axial (horizontal) plane and the direction of the maximal glenoid deformation. Vo is identified posterior (P), postero-superior (PS), postero-inferior (PI) or anterior (A). Glenoid MEDIALIZATION (M) is the medio-lateral position of the glenoid center. EXCENTRICITY (E) is a measure of the humeral head subluxation relative to the scapular plane. OA shoulders were classified with V, O, M, E parameters.

Results: OA shoulders were 20.8% V1, 52.8% V2, and 26.4% V3. Some (27%) V1 shoulders were medialized, but none was eccentric. V2 shoulders were mainly P (39.3%) and PS (39.3%), but also PI (14.3%) and even A (7.1%). V2 shoulders were essentially E (43.3%), or M (42.9%), but never M and E V3 shoulders were essentially P (85.8%), with a few PI (7.1%) and PS (7.1%). V3 shoulders were sometimes (28.6%) E, sometimes (42.9%) E and M, but never only M.

Discussion: This study confirms that glenoid wear and humeral subluxation of OA shoulders occur not only in the axial (horizontal) plane. A 3D objective method allows measuring accurately the deformations. We propose a new classification of AO shoulder, based on 3D measures taking into account the version, orientation, medialization and eccentricity (VOME). The better recognition of the glenoid morphology of OA shoulders should help to plan the surgery before TSA.

A 3D classification of Glenoid Version and Humeral head Subluxation of Osteoarthritic Shoulders
Alain Faron1, Julien Storn2, Aalexandre Terrier1
1CHUV, EPFL, Laboratoire de biomécanique en orthopédie

Methods: We analysed 132 consecutive patients, >65-year old, presenting with low energy-trauma pubic rami fractures at our emergency department from January 2009 to December 2011. Results: Mean age of patients was 84 years (range 66–100). Women were affected 6 times more frequently than men. 15 per cent of patients lost their previous independency permanently due to the injury. 98 per cent of previously independent patients (community dwellers) required temporary hospital care for a median duration of 39 days (IQR 28–52). One-year mortality was 20 per cent. A concomitant posterior pelvic ring lesion was identified by CT-Scan in 54 per cent of patients. In 4 per cent of the patients secondary operative fracture stabilisation was performed.

Discussion: Pubic rami fractures are frequently associated with concomitant posterior pelvic ring injuries making these injuries more unstable than generally assumed. Based on this fact and the long duration of acute hospital stay, more aggressive management of these injuries may be considered. Principle aims in this patient population are satisfying pain management, quicker mobilisation, less dependency and return to previous place of residence.

Conversion of Hemi- or Total- to Reverse Total Shoulder Arthroplasty:
Karl Wieser, Paul Borbas, Dominik C. Meyer, Christian Gerber
Uniklinik Balgrist

Background: After failed hemi- (HA) or total shoulder arthroplasty (TSA) conversion to a reverse total shoulder arthroplasty (RTSA) has shown to be a reliable option, as the more constrained prosthetic design allows to compensate for muscular imbalance and addresses the glenoid bone loss and erosion. The aim of this study was to evaluate the clinical and radiological outcome of AO shoulders following conversion of HA to RTSO with or without humeral stem removal.

Methods: Between 2005 and 2011, 48 HA and 8 TSA were converted to an Anatomical reverse shoulder arthroplasty system (Zimmer, Winterthur, Switzerland). Mean age at conversion was 67 (range: 44–87) years and mean time between index surgery and conversion was 38 (range: 0–147) months. 11 patients had to be excluded leaving 45 patients (32 with and 13 without stem exchange) with a complete clinical and radiological follow up of at least 12 months.

Results: Mean blood loss (485 vs 831 ml; p = 0.001) and surgical time (118 vs 176 minutes; p = 0.0001) was significantly lower in patients without stem exchange. We identified 13 intra- and 9 post-operative complications leading to 9 re-interventions (in 6 patients (14%)) in the 43 cases were the stem had to be exchanged compared to one intra- and 2 post-operative complications with only 3% re-intervention in the 13 cases the stem could be left in place.

The mean improvements of the relative and absolute Constant scores were 28 (range: -15–100) % and 21 (range: -11–64) points (p = 0.0001).
There were however, no significant differences between the groups with or without stem removal.

**Conclusion:** Conversion from HA or TSA to RTSA without stem removal reduces the length of surgery of about one hour, and the intraoperative blood loss of about 350 ml. Furthermore it minimizes the risk of sustaining an intraoperative complication by the factor 5 and the risk of undergoing a conversion related revision by half.

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**Clinical and Radiographical Mid- and Long-term Evolution in the Throwing Shoulder 6.8 resp. 21 Years after Completion of a Professional Handball Career**

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**Introduction:** The shoulders of overhead throwing athletes are highly stressed. Structural abnormalities are found in 93% of the throwing shoulders (TS) of professional handball players. What happens with respect to these pathological changes after completion of the professional career is not well-known. Jost et al. examined the shoulders of thirty fully competitive professional handball players in 2005. In the here presented study, we were able to reevaluate 20 of these 30 players, which had terminated their career on average 6.8 years ago. None of these had received any shoulder surgery. To compare these mid- and long-term evolution of the pathological changes after completion of the professional handball career, we included also 17 former professional handball players, that terminated their career on average 21 years ago.

**Methods:** The Constant Score increased from 88.1 during their career to 97.3 at the 6.8 year follow-up (FU) and 96.7 at the 21 year FU. External rotation remained significantly increased in the TS when compared to the non-throwing shoulder (NTS) at the 6.8 year FU. The amount of subjects with abnormalities in the TS increased not significantly from 93% during the professional career to 95% at the 6.8 year FU and 100% at the 21 year FU. Interestingly was the fact, that the players had significant more pathological changes in their TS (93%) compared to the NTS during their professional time, but there was no difference between the TS and NTS in both FU time points. Looking at the pathological changes in the supraspinatus tendon, we found a significant decrease in tendinopathies from the initial examination to the 6.8 FU (9 vs 3 subjects) and a significant increase of the partial tears (8 to 14 shoulders). No full thickness tears were found in all three time-points.

**Results:** Osseous changes were recognized in 70% of the players during their career. This number is decreased to 18% at the 21 year FU. Also the size of ganglions decreased significantly over time and the amount of postero-superior impingements decreased from 40% during the career to 5% at the 6.8 year FU and 0% at last FU.

**Conclusion:** The majority of shoulders show osseous and soft tissue lesions, which are not changeable after termination of professional career. The best combination of two was: apER/ax30 (90% sens), of three: apIR/apER/ax30 (96% sens) and of four: apIR/ap0/apER/ax30 (100% sens and 100% spec even for screw position).

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**Glenoid erosion in patients with shoulder hemiarthroplasty: an analysis of 118 cases**

Ramin Herschei¹, Dominik Meyer¹, Mark Morrey², Carlos H. Ramos³, C. Gerber¹, K. Wieser¹

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**Glenoid erosion in patients with shoulder hemiarthroplasty:**

**an analysis of 118 cases.**

**Background:** Glenoid erosion is an important and frequent, but poorly predictable finding after hemiarthroplasty of the shoulder. The purpose of this study was to analyse the degree of glenoid erosion after hemiarthroplasty of the shoulder and to determine predisposing preoperative factors for advanced glenoid erosion. Our hypothesis was that very horizontal positioning of the prothetic head may result in a gouging mechanism against the glenoid and therefore promote excessive glenoid erosion.

**Methods:** We retrospectively reviewed radiological data and clinical charts of all patients that had hemiarthroplasty of the shoulder between 2002 and 2011 at our institution. Minimum followup was 12 months (only if massive erosion occurred earlier than one year postop, patient data were included in the analysis). 118 prostheses in 113 patients were included. Evaluation was performed by two independent observers. Glenoid erosion was graded as none (0°), mild (1°), moderate (2°) and severe (3°). Positions of the prothetic components in relation to the bony architecture of the shoulder were analyzed over the course of follow up. Preoperative CT-scans were reviewed for condition of the glenoid. Clinical charts were reviewed for possibly predisposing factors such as rheumatoid arthritis and chondrocalcinosis.

**Results:** Mean FU was 31 months (range, 5 to 86 months). Erosion was absent in 31 (26%), mild in 30 (25%), moderate in 30 (25%) and severe in 27 (24%) of 118 shoulders. Out of 15 patients with a humeral head angle to the glenoid (in addition) >50°, 13 developed moderate or severe erosion. However, these observations were not statistically significant. Preoperatively existing cystic alterations of the glenoid were found in 36 (31%) of 118 shoulders. 17 of these developed severe, 13 moderate glenoid erosion. Of 11 shoulders of patients with rheumatoid arthritis, 6 developed severe, 5 developed moderate erosion.

**Conclusions:** An angle of the humeral head to the glenoid above 50° degrees appears to be detrimental to the survival of the glenoid. However, also preoperatively existing cystic alterations of the glenoid as well as rheumatoid arthritis seem to be a possible predisposing factor for glenoid erosion. In these subgroups of patients, total shoulder arthroplasty instead of hemiarthroplasty should be considered.

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**The Single Best and The Best Combination of Radiographic Projections to Detect Head Screw Perforations of the PHILOS Plate – A Cadaver Study**

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**Introduction:** The PHILOS plate is a frequently used implant for open reduction and internal fixation of fractures of the proximal humerus. Head screw cut outs may be missed. The single best radiographic projections to detect screw cut outs were examined in a cadaver study.

**Material and methods:** The PHILOS plate was fixed to 6 proximal humeri of 3 whole-body human cadavers. The correct, subchondral head screw placement was controlled using fluoroscopic control. Six radiographic projections were performed: anteroposterior (ap) in internal rotation (apIR); ap in neutral rotation (ap0); in 30° external rotation (apER); axial in 30° (ax30) and 60° (ax60) abduction in neutral rotation and the outlet view. Each head screw (n = 9) was sequentially exchanged to perforate the humeral head with the tip and all six rx combinations were examined again for cut out and identification of screw position. Inter-rater reliability was calculated and, in case of disagreement, a consensus reading was appended. Based on sensitivity (sens) and specificity (spec) the best projections were assessed.

**Results:** All readings had substantial to excellent inter-rater agreement (kappa >0.72). The best single projection was ax30 (sens 76%) and the worst was the outlet view (sens 17%). Standard combination of apIR/ap0/apER/ax30 reached a sens of 54% and 81% in combination with ax60. The best combination of two was: apER/ax30 (90% sens), of three: apIR/apER/ax30 (96% sens) and of four: apIR/ap0/apER/ax30 (100% sens and 100% spec even for screw position).

**Conclusion:** With the use of standard radiographs (ap/outlet), especially with the arm in internal rotation (e.g. in a sling), up to 46% of screw cut outs may be missed. The single best radiographic projection was an axial with 30° abduction, which projected screw tips in the inferior humeral head hemisphere better than a standard axial view. To account for all cut outs and their correct screw position a combination of 4 projections was needed. These clinically feasible radiographs help to detect screw perforations of the PHILOS plate.
of patients undergoing RC surgery, we hypothesized that CSA can be reproducibly determined on MRI.

**Method:** 33 high quality true ap view of the shoulder and an corresponding MRI were selected. On the X-ray the CSA was determined according to Moor. On the MRI the CSA was measured on three consecutive coronal T1 images. The first image to be measured was defined with help of the scout axial view showing the anterolateral border of the acromion; the level to be considered was determined as the first anterior image representing the lateral border of the acromion and the glenoid simultaneously. The second and third level of measurement were performed on the two consecutive images posteriorly to the first one. Each record was evaluated three times by two attending orthopedic surgeons and one intern respectively.

**Results:** Both techniques showed excellent intra- and inter-observer reliability (intra ICC, inter ICC >0.9). The average CSA was 34.1° (SD +/- 3.6°) on X-ray, 35.2 (SD +/- 3.9°) on MRI level 1, 36.6° (SD +/- 4.0°) on level 2 and 38.1° (SD +/- 4.0°) on level 3. Correlation between X-Ray CSA and MRI CSA was good (Pearson r >0.6) for all levels. The best correlation was measured at level 2 (Pearson r = 0.689). However the absolute value of the critical shoulder angle differed significantly from X-ray compared to level 2 measurements (p = 0.0001).

**Conclusion:** The CSA can be reproducibly determined on MRI tomography and can offer an alternative technique of measurement when conventional CT or PET/CT are not available. Although correlation between X-ray and MRI measurements were found to be good, the absolute CSA value on X-ray cannot be directly compared to MRI. Correspondingly a clinical recommendation based on MRI cannot be done yet. As MRI is obtained in a reliable standardized manner, further investigations should be considered to determine which CSA in MRI is clinically relevant.

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**Analysis of muscular properties after ACL reconstruction: Comparison BTB versus pedunculated hamstring grafts – an analysis of 111 patients**

Christophe Baur1, Samuel Christian Blatter2, Olivier Siegrist3, Nicolas Mathieu4, Simone Delamorac5, Sarah FOURIER6

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**Introduction:** Main objective of ACL reconstruction is to re-establish kinematics and function of the injured knee. Several operative techniques have been described. A widely used technique is the bone-patellar tendon-bone graft (BPTB). Due to less invasive technique and less anterior knee pain postoperatively, a trend towards hamstring grafts is noted in the last few years in our clinic. Clinical experience with hamstring grafts is positive. The aim of this cohort study is to assess objectively this perception and to compare both techniques regarding functional outcomes.

**Material and Methods:** Between 2007 and 2010 205 patients underwent primary ACL reconstruction by one single, experienced orthopaedic surgeon. Data of these patients were collected in a retrospective manner. Patients with previous surgery (ipsi- and contralateral knee), complex ligamentous reconstruction, contralateral knee problems and age >50 years were excluded as well as meniscal suture and re-reconstructions. 145 patients meet inclusion criteria. 111 (77%) patient were accessible to follow-up (48 women, 63 men), thereby 43 BTB and 68 pedunculated hamstring grafts, with mean duration of follow-up of 45 months (range 24–71 months). At follow-up, quadriceps and hamstring strength, power and acceleration were measured with handheld dynamometer (WOMAT®). Static and dynamic balance was measured with accelerometer.

Differences between both groups were calculated considering side differences (operated versus non-operated side). Data were analyzed with linear regression methods adjusting for age and sex.

**Results:** Deficit between operated and non-operated side was statistically significant smaller in the BPTB group by 78% (95% CI 3.3 to 12.3) for quadriceps movement velocity and by 9.7% (95% CI 3.8 to 15.7) for quadripload power as in the hamstring group. There was no difference in quadriceps strength (5.7% (95% CI –8.5 to 19.8) between both groups BPTB vs. hamstring. The data were adjusted for age and sex.

Absolute values (i.e. not comparing to non-operated side) showed no differences between the BPTB and hamstring group. For example, the difference in hamstring strength was 0.49 Nm (95% CI 1–6.49) in favor (but non-significant) of the BPTB, for quadriceps strength the difference was 0.08 Nm (95% CI 1–2.4). There was no significant difference between both groups concerning dynamic balance (0.12 sec, 95% CI –0.10 to 0.42) and the KOOS –0.93 points, 95% CI 2.7 to 0.83).

**Conclusion:** Interestingly we observed that patients operated with a BPTB showed significant less deficits (power and velocity) between operated and non-operated side compared with the hamstring group. Otherwise no significant differences in the different muscular tests could be objectified, especially no statistically significant weakness of the knee flexors in the hamstring group. Results of static and dynamic balance were comparable in both groups.

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**Physial-sparing anterior cruciate ligament reconstruction in children – a retrospective analysis of 12 patients**

Samuel Christian Blatter, Peter Koch

**Introduction:** Due to strenuous activities in sportive children, injuries of the anterior cruciate ligament (ACL) are increasing. In case of instability and/or additional meniscal tears it is generally accepted to reconstruct mid substance ACL tears even in immature patients to prevent meniscal and chondral structure from secondary damage. Controversy regarding operating technique (physial sparing vs. transphysal) in young athletes with widely open physes remains unsolved. This study claims the results of a physial-sparing ACL reconstruction technique in skeletally immature patients.

**Methods:** Between 2006 and 2010 12 patients (2 girls, 10 boys, aged 10–13, CI 11.6 years) underwent physial-sparing primary ACL reconstruction (1 bilateral intervention) by one single, experienced orthopaedic surgeon. In two patients concomitant bucket handle tears were sutured, in one patient a partial medial meniscectomy was performed. Femoral and tibial tunnels were drilled entirely in the femoral and tibial epiphysis under image-intensifier control to prevent injury of the open physis. Data of these patients were collected retrospectively. All patients were accessible to follow-up with a mean duration of follow-up of 59 months (range 39–80 months) and assessed by clinical examination (ROM, KT-1000) and radiological analysis (knee status and long leg radiographs). Functional status was assessed with use of Lysholm knee score, Tegner activity scale and IKDC-2000 questionnaire.

**Results:** In 2 patients reoperation was necessary due to graft failure (one traumatic and one non-traumatic; 13 month and 49 month after primary operation). Two patients developed overlength of affected limb; one with 20 mm overlength and slight varus malalignment after re-physeal-sparing ACL reconstruction, the second developed arthrofibrosis and overlength of 12 mm. The former was treated by temporary epiphysodesis, the latter conservatively. No early closure of epiphysal plate occurred. One patient with intact but slightly elongated graft required meniscal suture 34 month after ACL reconstruction after traumatic medial meniscal lesion. Instrumented arthrometer (KT-1000) testing showed significant side-difference compared with unaffected knee. IKDC subjective evaluation form score was in between 90 and 100.

**Discussion:** This study demonstrates that arthropscopic ACL reconstruction sparing the physis in immature children results in patient satisfaction and good clinical results although hyperstimulation of the physis with overgrowth and limb malalignment as well as graft failure in this highly active children remains a concern.

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**Clinical outcome of bone-patellar tendon-bone versus pedunculated hamstring grafts for ACL reconstruction – a retrospective analysis of 111 patients**

Samuel Christian Blatter1, Christophe Baur2, Olivier Siegrist3

1Uniklinik Balgrist, Zürich, 2Chcv’s hôpital Martigny, 3Chcv’s hôpital Martigny

**Introduction:** The reconstruction of anterior cruciate ligament (ACL) is considered as a standard procedure in orthopaedic surgery. Several techniques have been described and different graft choices are possible. Due to morbidity at the site of harvesting in BTB a trend towards hamstring-tendon is noted in the last few years in our clinic. Aim

Free communications IX – Shoulder

Free communications IX – Knee

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of this study is to compare clinical outcome after ACL reconstruction with BTB and pedunculated hamstring-grafts by a two-incision technique.

**Methods:** Between 2007 and 2010 205 patients underwent primary ACL reconstruction by one single, experienced orthopaedic surgeon. Femoral and tibial tunnels were drilled in an outside-in two-incision technique guided by Phusis® drill-sleeves, BTB grafts were implanted upside-down and fixed articular sided by interference screws. In the hamstring grafts, semimembranosus and gracilis tendons were harvested without detachment at the tibial insertion. The four stranded graft was implanted retrograd and fixed on both side with interference screws. Data of these patients were collected in a retrospective manner. Patients with primary ACL surgery (ipsi- and contralateral knee), complex ligamentous reconstruction, contralateral knee problems and age >50 years were excluded as well as meniscal suture and reconstructions. 145 patients meet inclusion criteria. 111 (77%) patients were accessible to follow-up, thereby 43 BTB and 68 pedunculated hamstring grafts, with mean duration of follow-up of 45 months (range 24–71 months). All patients were assessed by clinical examination (ROM, KT-1000) by one orthopaedic surgeon and radiological analysis was performed. Functional status was assessed with use of Lysholm knee score, Tegner activity scale, KOSS and IKDC-2000 questionnaire.

**Results:** Overall revision rate was 12.5% (19 of 152 patients). In 7 patients revision surgery was necessary due to graft failure (5 patients BTB group, 2 patient hamstrings group). Meniscal lesions (4 patients), lavage of hemarthrosis (2 patients) and cyclops formation (5 patients) were other indications for reoperation. One patient with cartilage lesion occurred. Anterior drawer measured by KT-1000 Arthrometer was 5.9 mm (range 2.0–12.5) and 4.1 mm in opposite knees (range 1.0–10.0), no difference was noted between the two groups. IKDC subjective evaluation form score was 91 (range 69–100; 90.1 BTB group, 90.7 hamstring group).

**Discussion:** Acceptance after ACL-reconstruction in both groups (BTB vs. pedunculated Hamstring graft) is high with satisfying subjective results without significant differences in IKDC evaluation in both groups. Instrumented arthrometer testing in our patients showed no significant difference between BTB and soft-tissue grafts, contrary to previous reports. No correlation between elevated anterior laxity after ACL-reconstruction (KT-1000 >3 mm) and functional status was noted.

**Evaluation of intra-ligamentary radiodensity marker after ACL reconstruction**

Paul Borbas, Karl Wieser, Stefan Rahm, Sandro F. Fucentese, Peter P. Koch, Dominik C. Meyer, Uniklinik Balgrist

**Introduction:** The success rate of primary ACL reconstruction varies from 69% to 95%. Early clinical and radiographic diagnosis of failure or loosening can be difficult. The aim of the present study is to retrospectively evaluate the use of radiologically visible markers in the ACL, serving as a new potential diagnostic tool in early diagnosis of ACL graft rupture and insufficiency.

**Methods:** Twenty-five patients were included in the study. ACL reconstruction was performed with use of a hamstring autograft in hybrid fixation technique. During surgery the hamstring graft was marked with two radiodense sutures, one at the tibial and one at the femoral tunnel opening. X-rays were performed postoperatively, after 6 weeks and at 12 months. Additionally, at a minimum follow-up of 12-months measurement of ap-translantion in 30° knee flexion by using a Rolimeter device and clinical examination with IKDC score was performed. Four marker distances were measured in antero-posterior as well as in lateral x-ray views and the positional change between the measurement times was calculated.

**Results:** In two measured antero-posterior distances statistically significant changes could be detected between 6 weeks and 12 months postoperatively in case of one MRI-documented ACL rupture and in six patients with ACL elongation (p = 0.04 and p = 0.025). Significant relationships could be detected between the time from 6 weeks to 12 months of two measured distal distances on ap-x-rays and clinical ACL insufficiency (p = 0.021 and p = 0.01). In lateral x-rays, changes of the marker distances were highly variable depending on the projection and did not correlate with clinical ACL insufficiency. One failure (extra-ligamentary marker migration) was seen 12 months postoperatively. Measurements of the marker distances on x-rays showed an excellent interobserver reliability (κ = 0.968).

**Conclusion:** The application of radiologic imaging marker seems to be a useful diagnostic tool for diagnosis of ACL graft rupture and insufficiency. However, several limitations such as reproducible radiologic imaging have to be addressed in further studies.
A union rate of 74% (17/23 patients) was found in group SA after a mean time of 51 weeks (range 8 to 115) while three patients had painfree fibrotic nonunion and four needed revision surgery and all but one had a good to very good result. The overall reoperation rate (hardware removal not included) was 48% (11 patients with 35 operations) in group SA and 30% (7 patients with 12 operations) in group PA.

Conclusion: When compared with primary ankle arthrodesis salvage arthrodesis after TAR shows similar union rates but significantly higher reoperation rates and a lower overall clinical outcomes. In the light of the results obtained with the current study the opinion that failed TAR can always be salvaged easily by means of arthrodesis must be questioned.

Hintegra Total Ankle Contact Pressures are Sensitive to Misalignment in Version
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Introduction: Mobile bearing total ankle replacement (TAR) can reduce the sensitivity of joint contact pressures to implant position. This is of high importance, since surgical misalignment may be a major cause in premature ankle implant failures. While numerous TAR designs have been suggested, objective comparisons of the various designs in an appropriate way lacking. In this study we investigated the highly congruent prismatic design of the Hintegra TAR and compared it against results from our previous study of the DePuy Mobility, which features a condylar shaped joint surface. Sensitivity of joint contact pressures to component misalignment in version was quantified using both experiments and finite element methods.

Methods: A comprehensive parametric study was performed by successively varying implant positioning parameters within a finite element model of the Hintegra prosthesis. Static load cases were simulated for ankle positions seen at heel strike, mid-stance and toe-off, under an axial force of 800N. The results of the computer models were validated experimentally using actual implants loaded in a uniaxial testing machine to reproduce the simulated positions. Here, pressure distributions at the implant contact surfaces were measured using interfacial contact pressure sensors.

Results: In the manufacture recommended position for implantation, average Hintegra joint contact pressures were lower than thresholds associated with premature polyethylene wear. In contrast to the Mobility TAR, Hintegra joint contact pressures exceeded these thresholds with one degree of version misalignment. Differences between the two systems were more pronounced (more than 50% difference in average joint contact pressures to implant position). Thus, while the Hintegra implant system yielded smaller contact pressures than the Mobility TAR in a neutral position, edge loading of the Hintegra design was more severe than the Mobility, leading to higher contact pressures to joint contact pressures to implant position.

Conclusions: Although both considered prostheses represent three component, mobile bearing total ankle designs, they nonetheless responded differently to misalignment in version. The Hintegra total ankle joint contact pressures showed higher sensitivity to version than the Mobility. This implies that the design plays a key role in terms of contact pressure sensitivity to misalignment. As a consequence, special care must be given to the positioning of the implant independent of the design.

Effects of Unilateral Ankle Arthrodesis and Total Ankle Replacement on Gait Mechanics of the Contralateral Foot
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Introduction: Gait analysis is used to assess the outcome of ankle arthrodesis (AA) versus total ankle replacement (TAR) and several studies reported better outcome in TAR. The method of assessment often compared the operated foot with the control population, hence focusing only on the operated foot. In this study the outcome of AA and TAR is compared based on the achievement of gait symmetry.

Methods: Intra-subject gait analysis was performed to assess the symmetry between the operated and unoperated foot. In this study the outcome of AA and TAR is compared based on the achievement of gait symmetry.

Results: Temporal-distance parameters: Operated side of AA showed significant difference with their unoperated side in stance (% gait cycle) and maximal load (% stance), compared to the other 2 groups. Kinematics: The AA group showed significantly lower range of motion (ROM) in all 3 planes at the ankle joint, sagittal and transverse planes of mid tarsal (MTL) joints and sagittal and coronal planes of metatarsophalangeal (MTP) joint. The TAR group presented almost symmetrical MTL ROM but significantly lower coronal motion was observed at ankle and sagittal motion at the MTP joint. The general tendency in both groups is a reduced ROM of all joints in the operated side compared to the unaffected side. Plantar pressure parameters: Significant asymmetry was seen in the unoperated side of the AA group in total contact duration (To), maximum pressure (Max P) and maximum force (Max F) in almost all foot regions. The TAR group showed a better symmetry, however the values were low compared with the controls.

Conclusion: AA patients retained a permanent residual effect from having an adaptive gait pattern, whereas TAR patients almost fully recovered, having similar results than the controls.
The influence of shoewear on functional outcome after Total ankle replacement and ankle-arthrodesis

Victor Valderrabano

Introduction: Total ankle replacement (TAR) is endorsed in many studies because of possible superior subjective and functional outcomes over ankle fusion. However, due to cost (TAR ~ $5000, ankle fusion with 3–5 screws ~ $200), bone loss after trauma and indications (patient’s age and co-morbidities), many ankle fusions are still being performed at the author’s institution as well as in most countries around the world.

The functional outcome of total ankle replacement (TAR) or ankle arthrodesis (AA) is usually measured barefoot. However, this does not reflect the clinical reality, as we usually wear shoes. The purpose of this study was to evaluate the influence of sport shoes and rocker bottom shoes on the functional outcome after TAR and AA.

Materials and Methods: We assessed 84 patients (TAR 28, AA 56) and 35 healthy volunteers with dynamic pedobarography (Novel emed m/E, St. Paul, MN, USA) in three conditions: barefoot, sport shoes, rocker bottom shoes. Furthermore, AOFAS and SF36 scores, radiographs, comorbidities and postoperative complications were recorded after a minimum follow up of 2 years (average: 4.1, range: 2–6 years).

Results: The AOFAS- and all components of the SF-36-score were equal in both groups as was ASA and Charlson co-morbidity score. PE wear and osteolysis 1) and 16% for ankle fusions (symptomatic subtalar osteoarthritis 3, nonunion 3, chronic osteomyelitis 1, peroneal tendon tear 1, chronic pain 1, malunion 1). Walking speed and total contact time were consistent either bare feet or with shoes. However, there was a significantly decreased contact time in the forefoot from 84% in bare feet to 77% wearing shoes and COP velocity increased from 0.3 m/s to 0.37 m/s. Maximum pressures and forces as well as pressure-/force-time-integrals in the forefoot did not differ. However ambulating in rocker-bottom shoes resulted in a significantly stronger push-off (~715 kPa) than wearing running shoes (~500kPa). Operated patients excluded 20% increase in walking speed or contact times compared to healthy subjects.

Conclusion: In shoes TAR and AA have the same functional results. The inferiority of AA compared to TAR is not measurable. We conclude that ankle arthrodesis and Total Ankle Replacement are equal operations regarding functional outcome.

Stress fracture of the malleolar medialis after implantation of an ankle prosthesis

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Background: Stress fracture of the malleolar medialis is a complication, which can occur after implantation of an ankle prosthesis. Purpose: This study was to evaluate the recurrence in a consecutive series of total ankle arthroplasty (TAA).

Methods: A consecutive series of TAA using one single design (Mobility™*) in one single center has been reviewed retrospectively regarding any radiological evidence for fracture of the malleolar medialis on standardized X-rays (weight bearing, dp and lateral views) routinely performed intraoperatively, 6 weeks, 12 and 24 months postoperatively or in case of clinical suspicion for a stress fracture.

Results: Between 2003 and 2009, 323 TAA have been implanted in 323 patients. Mean age at the time of surgery was 62 (27–87) years, 160 (49.5%) patients were females, 163 (50.5%) males. 199 (61.6%) TAA were implanted on the right side, 124 (38.4%) on the left side. Stress fractures were detected in 19 (5.9%) ankles at an average postoperative time of 24 (5–104) weeks. None of those fracture showed a serious displacement. The fracture lines were in 12 (63%) vertical, in 5 (32%) cases horizontal and in 1 (5%) case diagonal. The shortest distance between the anterior and posterior malleoli was 19 mm (5.7–29). Average postoperative ROM was 80° (50–100). Postoperative weight bearing was not possible in 1 (5%) case.

Conclusion: Stress fractures of the malleolar medialis can occur after TAA implantation. Since those fractures were found more frequently in females, heavier patients, and with small bridge TC-MMC in our serie, so less aggressive postoperative regime for this population might reduce their incidence. Stress fractures can heal without specific treatment. ORIF of this medial malleolar fracture does not seem to improve the ankle ROM.

Bone Augmentation for Revision Total Ankle Arthroplasty with Large Bone Defects: Treatment Algorithm and Outcome

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Introduction: Revision surgery after a failed total ankle arthroplasty (TAA) may become challenging due to extensive bone loss, poor soft tissues, and hindfoot deformities. Revision TAR may result in substantial shortening of the lower extremity and impaired functional results. With the availability of a wide spectrum of implants, however, revision arthroplasty may become a viable alternative. The study presents a treatment algorithm for revision TAA with bone augmentation, and revision implants in patients with aseptic loosening of ankle prosthesis associated with large bone defects.

Methods: There were 4 male and 6 female patients with a mean age of 51.7 years (range, 29–71 years) who underwent revision TAA due to aseptic loosening of TAA associated with extensive bone loss. We used iliac crest autographs depending on size, localisation, and configuration of bone loss. Pre- and postoperatively, x-rays and or CT-scans of the involved ankles were evaluated clinically including the AOFAS ankle score, visual analogue scale for pain (VAS, 0–10), range of motion (ROM), ankle stability, and ability of daily life activities. Intra- and postoperative complications were recorded.

Results: One ankle in a patient with chronic pain syndrome had to be converted into an arthrodesis. The AOFAS ankle score for the remaining patients significantly increased from 39 points (range, 18–56) to 83 points (range, 70–97); p < 0.05. The mean postoperative pain significantly improved from 6.0 (range, 1–5) to 1.0 (range, 0–3; p < 0.05). The postoperative ROM of the ankle joint was in average 24° for flexion (range, 10–30°) and 4.4° for extension (range, 10–15°). Two patients underwent arthrolysis and ossification removal. Postoperative radiographs showed stable integration of iliac bone blocks and no loosening signs around prosthesis components.

Discussion: Revision TAA with structural bone augmentation according to the proposed treatment algorithm shows to be a viable treatment option in the treatment of failed TAA with aseptic loosening associated with large bone defects. Cases have to be carefully selected and preoperative planning is crucial. Further clinical studies are needed to address the long-term results of this procedure.

Isolated Tension-Bending Fusion for Stage 3 and 4 Muller-Weiss Syndrome

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Summary: With this prospective study we illustrate that an isolated talonavicular fusion is a highly effective solution in the treatment of stage 3 to 4 of Muller-Weiss syndrome (MWS).

Introduction: In MWS there is evidence of progressive avascular necrosis of lateral aspect of navicular. MWS is a progressive destruction of the navicular that starts with a collapse (stage 2), to get fractured (stage 3) and later on fragmented with expulsion of its dorsolateral-flake (stage 4). Complete collapse occurs in stage 5.

Most patients seen by orthopedic surgeons suffer from a MWS stage 3 or 4. There are still controversies with regard to the surgical approach for reconstruction. Most authors advocate fusion of the subtalar (ST) and naviculo-cuneiform (NC) joints in order to achieve reliable healing. As by this procedure delayed or non-unions of the NC joint are observed, we started to perform isolated talonavicular (TN) fusion. The purpose of this study was to assess 1) the effectiveness of the strategy and 2) to assess the radiological and clinical deformity stabilization.

Method: There were 2 male and 8 female patients with a mean age of 63.5 years. All patients presented with a painful deformity with its apex at TN joint. The standard X-rays showed a talar head that was externally rotated and impacted into the collapsed navicular, a medialized navicular and bony fragmentation at dorso-lateral aspect of navicular. The TN joint was exposed through a medial approach. After debridement, a second incision at lateral aspect of TN joint was done to remove the avascular fragments and to assess the bony aspect. The navicular was reduced with regard to talar head and an Uni-CP staple was used to fix the TN joint on its lateral part first, acting as a tension bending. Two other screws were used to accomplish further stability. A scotch plaster was used to immobilize the foot for 8 weeks. Weight-bearing was permitted after 2 weeks.
Results: At 8 weeks, solid fusion at arthrodesis site was found in all but 2 cases. In those 2 cases, fusion was achieved after 12 weeks, as confirmed by CT scan. All patients were satisfied with the obtained result.

Conclusion: The tension bending technique from lateral side is an efficient and successful method to get a stable construct for a TN arthrodesis in MWS. With the obtained results in this preliminary series of 10 feet, we continue to consider this isolated TN fusion technique as sufficient for treatment of patients with stage 3 and stage 4 MWS.

Arthroscopically assisted mini-invasive fracture treatment of Hawkins Type I talar fractures

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Kantonsspital Baselland, Standort Liestal

Summary: Arthroscopically assisted mini-invasive reduction and internal fixation (ORIF) of Hawkins Type I fractures of the talus is a safe technique that allows anatomic reduction of the fracture and early mobilisation thus Hawkins Type I fractures result in an excellent functional outcome.

Introduction: Important challenge with Hawkins Type I fractures of the talus is ensuring that anatomic reduction is obtained without varus rotation. Surgical treatment is often conflicting with regard to exposure and ORIF. Extended approach or an additional second approach may result in damages of the surrounding soft tissues which may compromise the functional outcome and increase the risk of avascular necrosis (AVN) of the talus. We thus started to use an arthroscopically assisted mini-invasive approach. The purpose of this preliminary work is to describe the technique to assess the obtained result by CT scan and 3) to determine the clinical outcome.

Methods: A consecutive series of 4 patients (females, 2; males, 2; mean age 41.5 [24–61] years) were included. The mean time between diagnosis and treatment was 21 days. A 4 mm arthroscope was used through an anterior central portal. A 2.5 mm K-wire was inserted percutaneously from medially into the talar head and a second one into the talar body just along the anterior border of the medial malleolus. A Hintermann distractor was mounted and then carefully distracted to open the fracture under arthroscopic visualization. The fracture was then reduced while using the K-wires as joy-sticks. A 1.5 mm K-wire was inserted under fluoroscopic control from the supero-lateral edge of the talar head, and a second one from the supero-medial edge of the talus head into the talar body, aiming to reach its posterior part just above the subtalar joint. A 5.5 mm screw was inserted over each of the two K-wires. In the case of intermediate fragments a fully threaded screw was used; otherwise, a compression screw was inserted. Final reduction was checked arthroscopically at the tibiotalar joint and, using an additional portal through sinus tarsi, at the subtalar joint. If an additional fracture of the processus lateralis tali was present, reduction was obtained by manual manipulation or using a hook and fixation was achieved by a cannulated 3.0 mm screw. CT scan was performed as postoperative control. The foot was protected by a walker during 8 weeks, starting with partial weight-bearing for the first 4 weeks and full weight-bearing thereafter. Continuous passive motion was used during the first 8 weeks. Fracture healing was assessed radiographically after 8 weeks, 4 months and 12 months.

Results: Anatomic reduction and stable fixation was obtained in all four cases. All fractures healed within 8 weeks and there were no signs of AVN in any case. All patients were highly satisfied with the results obtained and showed functional outcome similar to the contralateral foot.

Conclusion: Arthroscopically assisted, mini-invasive reduction and fixation of Hawkins Type I fractures yielded in excellent early results. As we see a main benefit in minimizing additional damages to the soft tissues, thereby also minimizing the risk of AVN, we continue to use this technique in the future.
supramalleolar osteotomy of the tibia and the fibula. The fracture type B in 5 cases. The mean time interval between the trauma and the corrective surgery was 20.2 (3–98) months. The correction of the tibia oblique osteotomy that was fixed by a 6-hole-plate with locking screws. During a postoperative period of 8 weeks an immobilization of the ankle in a splinting vacuum boot with only partial weight bearing was arranged. The patients were reassessed in regular clinical and radiological follow up-examinations including a survey of the range of motion and of the stability of the joint. In addition the AOFAS-Score was assessed. The radiological examinations were evaluated according to Takakura’s classification. Results: A medial closing wedge osteotomy was conducted in 45 cases, and an in-harmonic lateral opening osteotomy in 39 cases to correct the tibia. To achieve a neutral position of the hindfoot there was additionally performed a corrective procedure of the calcaneus in 19 cases (16 medial sliding osteotomies and 3 lateral lacing osteotomies). The talar surface of the distal tibia was 5.2°, which resulted in a postoperative valgus position of 2.8°. A complete osseous consolidation of the tibia was seen after a mean of 2.4 months, in 2 cases a delayed consolidation occurred after 6 respectively 7 months. After 7.1 (2–15) years of the patients were satisfied or very satisfied. 41 patients were completely free of complaints. The mean value of the AOFAS-Score was 86 (64–100) points. In 1 case a total ankle replacement was implanted after 26 months due to persisting pain and progressive osteoarthrosis. Postoperatively there was no increase of the degenerative changes in 30 cases, moderate increase of the degenerative changes in 14 cases and advanced increase of the degenerative changes in 3 cases.

Discussion: The results show that malunited pronation and external rotation fractures can successfully be treated by a corrective supramalleolar osteotomy. Osseous balancing of the hindfoot is essential to prevent degenerative changes of the ankle joint.

Conclusions: Typically the case for stage IV PTT dysfunction. The inefficient peritalar ligaments may not be able to withstand the increased mechanical load. This may be particularly true for the fused tibiotalar joint in valgus, e.g. where the talar position was not corrected to neutral position. This may increase the translational forces, with slipping of talus on calcaneus towards mediolaterally. Tibiotalar fusion should thus be indicated with caution in the valgus unstable osteoarthritic ankle; if so, special attention should be paid to achieve fusion of talus within the ankle mortise in a neutral position.

Safe Zones for Percutaneous Pin Placement in the Calcaneus
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Introduction: Placement of a percutaneous pin in the calcaneus is indicated in various conditions. Electively, these include ankle and subtalar distraction, ankle arthrodesis and correction of deformities. Transcalcaneal pins are used in cases of pin fixation with external fixation to stabilise dislocated ankle fractures or pilon fractures. Depending on the indication, one or more pins may be used. Neural structures are at risk during this procedure, medially the tibial nerve and laterally the sural nerve and their branches in the calcaneus. There is no consensus in the literature as to how or where the pins should be placed. The purpose of the following study was to reveal if there is a safe zone for transcalcaneal pin placement with special emphasis on neural structures. If a safe zone was identified a further goal was to develop a visual tool to be used during surgery to reliably identify safe pin direction.

Methods: Eighteen Thiel-fixed cadaveric below knee lower extremities were used for the study. Dissection was performed to identify and measure all neural structures in relation to the calcaneus. All dissected nerve branches were labelled with radiological colour and fixed. A lateral radiograph of each calcaneus with overlying nerves was obtained. All radiographs were printed from both the medial and lateral sides. The images were scanned and zoomed to a uniform size. In each section of the calcaneus the frequency of nerve strikes were counted and marked on a scaled ‘Map of Neural Frequency’. The results from this map have been used as a basis to generate a three-dimensional model of the calcaneus with marked safe zones for calcaneal pinning.

Results: The area for safe pin placement at the calcaneus is restricted to a narrow band dorsal of the calcaneal tuberosity. Medially this band widens proximally (are of the achieved calcaneal inclination), and laterally it widens distally until the lateral calcaneal process. Consequently these results indicate a direction of pin placement that differs from previous investigations, whereby the insertion of the achilles tendon and the lateral calcaneal process corresponds to a reliable landmark.
Conclusion: AMIC-repair in the ankle yields repair tissue with GAG content differing from healthy hyaline cartilage. However, cartilage quality is comparable to other established cartilage repair techniques.

Materials and Methods: Between 2006 and 2012, 55 consecutive patients (age 54 years, range 27–74) with a varus-tilted ankle of more than 5° underwent a correcting osteotomy. Patients with neurological disorders, or additional procedures as proximal to the ankle (subtalar fusion), the calcaneum osteotomy) were excluded. 50 cases were corrected with a medial opening wedge and 5 cases with a lateral closing wedge. The congruency of the ankle joint was restored with fibula shortening osteotomies in 14 cases. Radiographs were analysed pre- and postoperatively to measure the alignment and the 3D position of the talus with the talar tilt (TT) (according to the difference between the talar dome and the tibial-ankle surface angle (TAS)) on the mortise view. The position of the talus on the lateral view was determined measuring the sagittal talocalcaneal inclination angle (TCI). In the horizontal plane the rotation of the talus was assessed with the talometatarsal 1 angle (TMT1). Calcaneum offset was assessed using the saltzmann view; Sagittal and horizontal data were compared with a normal cohort. The neutral position was defined within two standard deviations of the mean of the control group (30.5° (SD = 4.5) for TCI and 3.7° (SD = 7.9) for TMT1).

Results: The mean preoperative measurement was TTA = 74.9° (SD = 5.7°), TT = 11.5° (5.9) on the frontal view; TLS = 81.9° (4.1), TCI = 178° (74) on the lateral view; TMT1 = 8.8° (14.1°) on the dorsoplanar view; calcaneum offset = 26.1 mm (11.1). At one year a statistical difference was found between the preoperative and postoperative results for the calcaneum offset, the TTA, TCI (<0.05). The mean postoperative measurement was TTA = 82.5° (6.9); TCI = 214° (71); Calcaneum offset = 11.8 mm (10.6). No statistical differences were found for the TT and TMT1 between pre and postoperative. The mean postoperative functional outcome was TT = 9.7° (5.1); TMT1 = 8.5° (11.6).

Discussion: In this study the 3D position of the talus preoperatively in varus tilted ankle was also malaligned in additional planes, it was more dorsiflexed and endorotated than the normal cohort. The correction of the varus tilted ankle deformity by a supramalleolar osteotomy induces also a modification of the talus position on the lateral view but no statistical difference on the dorsoplanar view. The lack of correction of the coronal orientation of the talus could be explained by a poor correction of the calcaneus osteotomy. In conclusion the talus position in a varus-tilted ankle is also dorsiflexed and endorotated. Realignment correction of a varus deformity change also the coronal position of the talus, but the patients with a talar tilt still present have also a lack of correction of the talus position in the horizontal plane. Further studies are necessary to elucidate if a complete correction of talar position is needed to have a balanced and congruent ankle joint.

**Summary:**
- **The radiological position of the talus after a supramalleolar osteotomy in varus tilted ankle**
- **Anterior correction and fusion of the lumbar spine:**
  - **Posters**
  - **Introduction:**
  - **Clinical outcome with a minimal one year follow up**
  - **Material and Methods:**
  - **Results:**
  - **Discussion:**

**FM147**

**Twenty-year outcome after surgical treatment of midtarsal joint injuries**

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Introduction: Complex midtarsal (Lisfranc) fracture-dislocation is a challenging injury characterized by loss of contact of the midfoot bones as well as fracture of one or more bones surrounding the Lisfranc ligament. The principle of treatment of such injuries involves stable fixation of fractures, anatomical reduction of the displaced midtarsal bones with temporary or permanent arthrodesis to maintain their position. The aim of our study was to evaluate the functional, clinical and radiological outcome of patients managed surgically during the last twenty years at our institution.

**Materials and Methods:** Medical charts were analyzed retrospectively of all patients operated upon between 1988 and 2009. Clinical outcomes were assessed with the American Orthopaedic Foot and Ankle Society (AOFAS) midfoot score, Musculoskeletal Function Assessment (MFA) score, Foot Function Index (FFI) score, the Short Form-12 Health survey. We also recorded concomitant/additional surgical procedures, and performed radiological evaluation.

**Results:** Of the 144 patients operated upon, 62 (mean age 51 years, 75% men) were available for FU. Patients underwent in general an open reduction and internal fixation (ORIF) with temporally/permanent arthrodesis. Mean follow-up was 132 months (range 30–292). Mean functional outcome scores were: 79.7 (47 to 100) on the (AOFAS) midfoot score, 18 on MFA score, 16.8 (range 8.3 to 40.0) on FFI score revealed good alignment on anteroposterior and lateral weight-bearing radiographs in 55 patients (84.6%). Symptomatic posttraumatic arthritis was present at FU in 44 patients (70.97%). Patients who had undergone permanent arthrodesis either as primary or as additional surgery showed better clinical results.

**Conclusions:** According to the scientific literature, an acceptable outcome depends on achieving and maintaining a well-aligned and well-reduced joint. Primary arthrodesis may lead to better short term functional outcome.

**Summary:**Summary:
- **Supramalleolar osteotomy of the 3D Talar position in 55 varus tilted ankle**
- **Anterior correction and fusion of the lumbar spine:**
  - **Posters**
  - **Introduction:**
  - **Clinical outcome with a minimal one year follow up**
  - **Material and Methods:**
  - **Results:**
  - **Discussion:**

**FM148**

**The radiological position of the talus after a supramalleolar osteotomy in varus tilted ankle**

Fabrice Colin1, Liliana Bolliger2, Zwicky Lukas3, Beat Hintermann1, 2, 3

1, 2, Kantonsspital St. Gallen, 3 Kantonsspital Liestal

**Summary:** This radiological study present the results after a supramalleolar osteotomy of the 3D Talar position in 55 varus tilted ankle.

**Introduction:** The goal of supramalleolar osteotomy in varus ankle is to realign the hindfoot and to unload the overstressed medial part of the ankle joint. This surgery has already shown to improve clinical outcomes.

**Results:** The lateral approach with stand-alone cage interposition.

**Discussion:** Of the 144 patients operated upon, 62 (mean age 51 years, 75% men) were available for FU. Patients underwent in general an open reduction and internal fixation (ORIF) with temporally/permanent arthrodesis. Mean follow-up was 132 months (range 30–292). Mean functional outcome scores were: 79.7 (47 to 100) on the (AOFAS) midfoot score, 18 on MFA score, 16.8 (range 8.3 to 40.0) on FFI score and a relative good quality of life (49 on SF-12). Radiographic analysis revealed good alignment on anteroposterior and lateral weight-bearing radiographs in 55 patients (84.6%). Symptomatic posttraumatic arthritis was present at FU in 44 patients (70.97%). Patients who had undergone permanent arthrodesis either as primary or as additional surgery showed better clinical results.

**Conclusions:** According to the scientific literature, an acceptable outcome depends on achieving and maintaining a well-aligned and well-reduced joint. Primary arthrodesis may lead to better short term functional outcome.

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**P1**

**Anterior correction and fusion of the lumbar spine:**

The lateral approach with stand-alone cage interposition.

**Clinical outcome with a minimal one year follow up**

Paul Ferdinand Heinl, Regula Teuscher, Mark Kleinschmidt

Klinik Sonnenhof

**Introduction:** The lateral approach to the lumbar spine offers an improved approach related symptoms subsided after six months. Two patients did show a paraesthesia of the obturator N during the index procedure. One remained permanent. A severe paraesthesia of the obturator N did occur in one patient that recovered incompletely after one year. 10 patients underwent a secondary posterior stabilization within the first three months after the index intervention. 7 patients got a follow up controls at one, three, and six months. In addition the radiological parameters were assessed (deformity correction – loss of correction / subidence, fusion).

**Results:** The study includes 95 patients (25 male, 70 female). Average age is 68 y (42–84). Overall 179 levels have been treated, in average 1.9 levels per patient (1–5). The distribution of levels was L1-L2 = 26; L2-L3 = 58; L3-L4 = 61; L4-L5 = 40. The indication was a spinal deformity in 36 and a deformity in 59 patients. For fusion the DBM was used in first patient in 63 and BMPII in 21 patients. Transient psoas weakness was present in 74% of patients one month postop and in 20% at three months – all approach related symptoms subsided after six months. Two patients did show a paraesthesia of the obturator N during the index procedure. One remained permanent. A severe paraesthesia of the obturator N did occur in one patient that recovered incompletely after one year. 10 patients underwent a secondary posterior stabilization within the first three months after the index intervention. 7 patients got a
vertebroplasty within the first three weeks after the intervention due to a vertebral fracture and a cage subsidence. The back pain scale improved by 5.4 points at the one year FU, leg pain by 4.8 points; the COMI score improvement was 6.1 at one year (p <0.05).

**Conclusion:** This approach offers a very short mean for the treatment of degenerative instabilities and deformities of the lumbar spine. The stand alone technique is working in 90% of cases – the routine use of an additional posterior stabilization is not required. The approach related morbidity is important in the early phase but is self-limiting within 6 months.

**Pedicle height to vertebral height ratio: an anatomical predisposition to symptomatic lumbar foraminal stenosis?**

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**Introduction:** Symptomatic foraminal stenosis has been observed in patients with degenerative disc disease, scoliosis, asymmetrical disc degeneration and spondylolisthesis. Nevertheless not all patients with the above pathologies will develop symptomatic foraminal stenosis. We hypothesised that symptomatic patients have anatomical predisposition to foraminal stenosis, namely a larger pedicle height (PH) to vertebral height (VH) ratio, leaving less room below the pedicle for the exiting nerve root compared to asymptomatic patients.

**Material and Methods:** A total of 88 patients devided in two groups were included in this study: the surgical group was comprised of 58 patients (average age of 62 years) presenting with low back pain (LP) but with no radicular symptoms and who were treated conservatively. On both groups we measured vertebral body height (VH) at the level of the posterior wall as well as pedicile height (PH) on parasagittal images (CT or MRI) of the lumbar spine using the Osirix imaging software. Measurements were performed on all lumbar levels from L1 to L5 and on both sides for each patient. Statistical analysis was performed using Student's t-test.

**Results:** The PH/VH ratio was larger in the symptomatic group treated surgically by the mean in the LBP control group for all lumbar levels analysed together (p <0.001). The mean value for the ratio in L1 in the surgical group was 0.51 (SD 0.06), compared to 0.46 (SD 0.05) in the control group (p <0.001). At the L3 level, the ratio was of 0.49 (SD 0.04) and 0.47 (SD 0.06) for the surgical and LBP groups respectively (p <0.005). Although for L4 this ratio was similar (0.46, p = 1), for L5 the ratio was of 0.48 (SD 0.08) in the surgical group and 0.46 in the LBP group (p <0.05).

**Discussion:** We found that symptomatic patients with foraminal stenosis have larger pediciles in the cranio-caudal direction in at least four of the lumbar levels studied when compared with asymptomatic patients normalised to the vertebral height. This is translated by a smaller space beneath the pedicle leaving the exiting nerve root more vulnerable to compression in case of spondylolisthesis or disc degeneration. Thus some patients with PH/VH ratio less than 0.5 are more prone to become symptomatic even in the presence of severe degeneration of the disc. In conclusion we believe that there are anatomical differences which predispose some patients to symptomatic foraminal stenosis.

**Cement-augmented anterior screw fixation of type II odontoid fractures. Description of a new technique to reduce the risk of secondary dislocation in elderly pa**

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**Introduction:** Closed reduction and internal fixation by an anterior approach is an established option for operative treatment of displaced type II odontoid fractures. In elderly patients, however, inadequate screw purchase in osteoporotic bone can result in severe procedure-related complications. The purpose of this study was to improve the stability of odontoid fracture screw fixation in the elderly employing a new technique that includes injection of PMMA cement into the C2 body.

**Methods:** This study is a retrospective review of hospital and outpatient records as well as radiographs of twenty-four elderly patients (8 males, 16 females; mean age 81 years, range 62–98 years) with type II fractures of the dens. Post- and perioperative complications, cement leakage (symptomatic/asymptomatic), operation time, loss of reduction, pseudarthrosis and revision surgery, patient complaints, return to normal activities, and signs of neurological complications were documented.

After closed reduction and anterior approach to the inferior border of C2, a guide wire is advanced to the tip of the odontoid under fluoroscopic control. An incision of the anterior capsule, self drilling, short thread screws, a 12 gauge Yamashidi cannula is inserted from anterior and 1–3 ml of high viscosity PMMA cement is injected into the anteroinferior portion of the C2 body. During polymerization of the cement, the screws are further inserted using a lag-screw compression technique. The cervical spine then is immobilized with a soft collar for 8 weeks postoperatively.

**Results:** Anatomical reduction of the dens was achieved in all 24 patients. Mean operative time was 54 minutes (range 90–90 min). Early loss of reduction occurred in 3 patients, but revision surgery was indicated in only one patient 2 days after primary surgery. One patient died within the first 8 postoperative weeks, one within 3 months after surgery. In 5 patients asymptomatic cement leakage was observed (into the C1-2 joint in 3 patients, into the fracture in 2). Conventional radiologic follow-up at 2 and 6 months confirmed anatomical healing in 16 of the 19 patients with complete follow up. In 2 patients the fractures healed in slight dorsal angulation. One patient developed a symptomatic pseudarthrosis. All patients were able to resume their pre-trauma level of activity.

**Conclusion:** Cement augmentation of the screw in type II odontoid fractures in elderly patients reduces the risk of secondary dislocation without an increased relevant complication rate. This technique improves screw purchase, especially in the osteoporotic C2 body.

**Intra-abdominal migration of a gamma nail lag screw: A rare complication**

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CHUV

**Introduction:** Fractures of the proximal femur are common in the elderly population. Extra-medullary nailing has become the standard treatment for fractures in the hip joint region. However there are a number of associated complications.

**Case report:** We report the case of a 69 year old female who presented medial migration of the lag screw into the pelvis at five and a half weeks postoperatively following the concepts in the literature. For that reason the nail was removed and replaced by THA after embolisation of one branch of the left internal iliac artery.

**Discussion:** A frequent complication of proximal femoral nailing is lag screw cut-out from the femoral head which is believed to occurs in 2–8% of cases. The main causes are varus position of the femoral neck and eccentric position of the lag screw. Cut-out with intra-abdominal migration of the lag screw is very rare. There are only a few papers in the literature describing such cases. We carried out a thorough review of the literature and present this with analysis and discussion of our case. The contributing factors in this case are the fracture pattern, poor peroperative fracture reduction, a ‘Tip Apex Distance’ higher than 20 mm, an incorrectly placed anti-rotational screw and all of this compounded by osteoporotic bone. The literature reminds us the importance of ruling out intra-abdominal visceral and/ or vascular injury as well as infective process. In this case, implant removal and prosthetic joint replacement after embolisation of one branch of the left internal iliac artery were carried out with a good clinical and radiological evolution.

**Conclusion:** Intra-abdominal migration of a gamma nail lag screw is a rare but serious complication. The rate of intertrochanteric fractures continues to rise dramatically, in an increasingly elderly population, and the number of complications is expected to rise as a result. It is the surgeon’s responsibility to be aware of, and to avoid the potential pitfalls which can lead to cut-out of the lag screw. Our poster clearly sets out the risks, how to avoid them and how to manage this type of complication. Our poster should be essential reading for anyone who carries out proximal femoral nailing. This will obviously be of interest to almost all orthopaedic and trauma surgeons.

**Bibliography:**

Does mechanically measured bone strength within the proximal femur predict hip screw migration in vivo? Results from a multicenter trial
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Introduction: While the primary implant position is a known predictor of the stability of proximal femoral fractures, the role of trabecular bone strength within the femoral head to prevent hip screw migration is unknown. DensiProbe™ Hip is a mechanical probe for quantification of trabecular bone strength during the fixation of proximal fractures using a dynamic hip screw (DHS). The goal of this study was to assess if DensiProbe™ Hip measured bone strength is an independent predictor of cranial DHS migration (DHSM) as signs of impending fixation failure.

Methods: 107 patients with 52 femoral neck and 54 perecotrochanteric fragility fractures were included in this multicenter study. Intraoperatively, DensiProbe™ Hip was inserted at the site of subsequent DHS tip and rotated around its longitudinal axis. Peak torque to breakaway the cancellous bone between the blades of the propeller like probe tip was registerd. Postoperatively, patients underwent plain radiography to quantify the primary DHS position and peak torque (R² = 0.16, p = 0.000). The mean value for PI on CT scans ranges around 50.8°. PI is neither significantly correlated with age nor gender. However, PI is significantly and linearly correlated with LL and the lateral Parker ratio TAD. Peak torque was not an independent predictor of DHSM. There was a significant non linear correlation between the lateral Parker ratio and peak torque (R² = 0.16, p = 0.000).

Conclusion: Screw position as measured by the distance from CNFA and the lateral Parker ratio and TAD, but not DensiProbe measured bone strength are independent predictors of DHSM. The lateral Parker ratio may indicate strength of the adjacent trabecular bone.

Comparisons of preoperative three-dimensional planning and surgical reconstruction in primary cementless total HIP Arthroplasty: A cohort of case series of 50
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Introduction: Classically, templating for total hip replacements (THR) is performed using a plain antero-posterior x-ray of the pelvis. However, measurements of important parameters such as true femoral offset and torsion or evaluation of intramedullary anatomy are inaccurate. Preoperative three-dimensional (3D) CT-based templating tools have recently become available. We evaluate intraoperative reproducibility of 3D templating using HIPPLAN software (Symbios, Yverdon/ Switzerland).

Methods: 50 consecutive patients undergoing primary cementless THR were included. All patients were operated by a single surgeon using a direct anterior approach. Pre-operative CT-based three-dimensional planning was performed using HIPPLAN software. Postoperatively, a second CT scan was performed in all patients. The difference between the planning and the real postoperative implant position was calculated using the postoperative CT with the pre-operative planning-CT.

Results: The implant size prediction was correct in all cases for the stem size, in 47/50 cases (94%) for the cup size and 44/50 cases (88%) for the head length. The mean difference between the planned and the real (i.e. postoperative) leg length was 0.3 ± 2.3 mm (min –5, max 6). The mean difference between the planned and the real femoral lateralization was 14 mm ± 3.3 mm (min –7 to max 8). The precision of the anteversion of the stem was 0.6 ± 3.9° (min –7 to max 8). The mean differences in regards to cup inclination and anteversion were –0.4 ± 5° (min –9 to max 10) and 6.9± 11° (min –14 to max 33), respectively.

Conclusion: Three-dimensional planning of primary THR using HIPPLAN software allows accurate prediction of implant size. The planned three-dimensional stem position and cup inclination are intra-operatively reproducible with an excellent accuracy. The planned anteversion of the cup has not been well reproduced in this series.

Increased Pelvic Incidence May Lead to Facet Joint Arthritis and Their Sagittal Orientation At The Lower Lumbar Spine
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Objective: Correct sagittal alignment with a balanced pelvis and spine is crucial in the management of spinal disorders. The pelvic incidence (PI) describes the sagittal pelvic alignment and is position-independent. (1) If No studies have focused on the association between PI and facet joint (FJ) arthritis, orientation and tropism. Recently, increased pelvic lordosis has been linked to FJ arthritis at L5/S1. Therefore, our goal was to clarify the relationship between PI, LL and FJ arthritis using CT scans.

Materials and Methods: We retrospectively analyzed CT scans of 620 individuals with a mean age of 58 (range 14 –94) years, who presented to our traumatology department and underwent a whole body CT scan, between 2008 and 2010. PI was measured by the angle between the hip axis to an orthogonal line the center of a line along the femoral canal. The first four factors were selected and evaluated on median sagittal slides by measuring the angle between the superior endplates of L1 and S1. FJs of the lumbar spine were evaluated for arthritis, orientation and tropism between the second lumbar and the first sacral level on axial planes.

Results: (1) 596 individuals yielded results for PI. There was no significant difference for PI and age (p = 0.07), nor (3) gender (p = 0.28). (4) PI was significantly and linearly correlated with LL (p < 0.0001). The mean value for LL was 48.3°. (5) PI and FJ arthritis displayed a significant and linear correlation (r = 0.0062, OR 1.020 (95%-CI 1.005, 1.034)). An increased PI was significantly associated with sagittally oriented FJs at LS/S1 (p = 0.01). There was no significant difference for PI and FJ orientation at the upper lumbar spine nor PI and FJ tropism.

Conclusion: The mean value for PI on CT scans ranges around 50.8°. PI is neither significantly correlated with age nor gender. However, PI is significantly and linearly associated with LL, FJ arthritis and sagittal FJ orientation at the lower lumbar spine. Increased PI may lead to higher contact force on the lower lumbar FJs and cause FJ arthritis along with more sagittal FJ orientation. Individuals with increased PI and (increased LL) may therefore be at high risk for FJ arthritis at the lower lumbar spine. People with increased LL and increased PI (and increased LL) could benefit from corrective surgery and spondylosis, once symptomatic or in the event of trauma.

Trial Head Navigation and Leg Length Control in minimal-invasive Stem-first –Total Hip Arthroplasty: Operative Technique and Clinical Results
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Introduction: Dislocation and leg length inequality are among the most embarrassing factors for patient satisfaction after total hip arthroplasty (THA). In order to reduce the risk for dislocation due to prosthetic impingement and to prevent edge loading and probably to minimize squeaking it is important to maximize the intended range of movement (iROM), which is accomplished by positioning both components according to the combined safe-zone for correct combined version and combined inclination. Leg length equality is required not only for the patient’s comfort but also for normal gait. This study shows how to control the combined orientation of both components intraoperatively using trial head navigation in minimal-invasive stem-first THA technique.

Material and Methods: 779 minimal-invasive total hip arthroplasties have been performed from 2007 to 2012 in our institution using the minimal-invasive direct anterior approach (DAA). In 152 of these cases the trial head navigation was applied allowing accurate control of combined version and inclination intraoperatively according to the
specific combined safe-zone of the prosthesis system. All patients were positioned supine on an orthopedic table that is functioning as a leg positioner mainly. Leg length was measured within the surgical field using a caliper.

**Results:** Overall 94% of the patients received a ceramic-on-ceramic articulation. In the trial head navigation group an anatomic stem with stem first technique was used. No squeaking or any sign of impingement did occur in these patients and component orientation of cup and stem was in the combined safe-zone in 92% of these cases. In total we observed three dislocations during the six years period. Leg length did not differ more than +/- 5 mm.

**Conclusion:** Stem-first technique with trial head navigation does assist the surgeon intraoperatively in a straightforward way to ensure optimal orientation of total hip components in the combined safe-zone in minimal-invasive direct anterior approach for total hip arthroplasty. It yields excellent functional results and reduces the rate of dislocations substantially.

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**Biologic reactions at ACL graft insertion sites measured by 99mTc-HDP-SPECT/CT tracer uptake**

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**Introduction:** Not much is known about biologic reactions at ACL graft insertion sites. SPECT/CT is a hybrid imaging modality, which combines a single photon emission computed tomography and a conventional computerized tomography. It allows accurate anatomical localization of metabolic tracer activity and allows therefore the correlation of surgical factors such as tunnel position and orientation with mechanical alignment, clinical outcome and biological factors.

The purpose of this study is to investigate the correlation between SPECT/CT tracer uptake (intensity and distribution) and the stability and laxity of the knee joint and also the position and orientation of the tibial and femoral tunnels in patients after ACL reconstruction.

**Methods:** A consecutive group of patients (n = 60), which were complaining about pain and/or instability after ACL reconstruction were prospectively evaluated using clinical examination and 99mTc-HDP-SPECT/CT. Clinical laxity testing was performed including Lachman's test (0–2 mm, 3–5 mm, 6–10 mm, >10 mm), anterior drawer test (0–2 mm, 3–5 mm, 6–10 mm, >10 mm), pivot shift test (positive/negative) and patient-based subjective instability (yes/no). For analysis of SPECT/CT tracer uptake a previously validated SPECT/CT localization scheme consisting of 17 tibial, 9 femoral and 4 patellar regions on standardized axial, coronal, and sagittal slices, was used. The tracer activity on SPECT/CT was localized and recorded using a 3D volumetric and quantitative analysis software. Mean, standard deviation, minimum and maximum of grading for each area of the localization scheme were recorded. The position and orientation of the tibial and femoral tunnel was assessed using a previously published method on 3D-CT.

**Results:** Characteristics of instability, pivot shift as well as clinical laxity testing with 99mTc-HDP-SPECT/CTtracer uptake intensity and distribution showed no significant correlation. The tracer uptake correlated significantly with the position and orientation of the ACL graft. A more homogenous graft showed significantly more increased tracer uptake within the superior and posterior femoral regions. A more posterior placed femoral insertion site showed significantly more tracer uptake within the femoral and tibial tunnel regions. A more vertical or a less medial tunnel orientation showed significant increased uptake within the tibial and femoral tunnel regions. A more anterior tibial tunnel position showed significant more tracer uptake in the femoral and tibial tunnel regions as well as the entire tibiofemoral joint.

**Conclusions:** SPECT/CT tracer uptake intensity and distribution showed a significant correlation with the femoral and tibial tunnel position and orientation in patients with symptomatic knees after ACL reconstruction. No correlation was found with stability or clinical laxity. SPECT/CT tracer uptake distribution has the potential to give us important information on joint homeostasis and remodeling after ACL reconstruction. It might help to improve our surgical ACL reconstruction technique by directing us to find the optimal tunnel position based on the results of biological activity with the achievement of joint homeostasis being our goal.

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**Assessment of in vivo loading history of the patellofemoral joint- a study combining patellar position, tilt, alignment and bone SPECT/CT tracer uptake/distribution**

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SPECT/CT could be used to evaluate the in vivo loading pattern of the patellofemoral joint before and after realignment surgery. The purpose of this study is to investigate whether the patella position (height and tilt) influences the intensity as well as the distribution pattern of SPECT/CT tracer uptake in the patellofemoral joint.

99mTc-HDP-SPECT/CT and conventional radiographs of consecutive 84 knees were prospectively obtained. Lateral radiographs were then analysed in terms of tunnel length, the Insall-Salvati index and the modified Insall-Salvati index. Skyline views were analysed measuring the lateral patellar variance and leg alignment measurements with the intensity of tracer uptake in each area of interest. Chi square statistics were used for categorical data. The level of statistical significance was p < 0.05.

16 (19%) knees showed valgus, 34 (40.5%) varus and 34 (40.5%) neutral mechanical alignment. A lower patella position correlated significantly with higher 99mTc-HDP SPECT/CT tracer uptake in all patellar and lateral femoral regions (p < 0.001). A higher lateral patellar angle correlated significantly with higher 99mTc-HDP tracer uptake in the superior lateral femoral parts and the tibial tubercle. The intensity of 99mTc-HDP-SPECT/CT tracer uptake on the medial part of the patellofemoral joint significantly correlated with mechanical varus alignment of the knee (p < 0.05). The intensity of 99mTc-HDP tracer uptake on the lateral part of the patellofemoral joint significantly correlated with mechanical varus alignment of the knee (p < 0.05). The intensity and distribution of the SPECT/CT significantly correlated with patella infera and patellar tilt angle, measured in conventional radiographs. Hence, SPECT/CT should be considered as imaging modality for evaluating patients with patellofemoral disorders and for follow-up of patients after patellofemoral realignment procedures.

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**Surgical treatment of anteromedial rotatory instability with injury of anterior cruciate ligament and second degree lesion of medial collateral ligament**

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**Introduction:** Anteromedial rotatory instability (AMRI) is a common Problem in athletes with injury of anterior cruciate ligament (ACL). Due to degree of lesion of medial collateral ligament (MCL) different therapy-strategies are described in the literature. Conservative treatment in combined ACL-injury and first degree MCL-injury, as well as reconstructive surgery in combined ACL-injury and third degree MCL-injury is well-established. However treatment regime of ACL rupture and second degree MCL-Lesion is discussed controversial in literature. Clinical results of conservative treatment are indifferent; a common surgical technique is not described.

In this study we want to suggest a surgical technique to treat this kind of knee joint injuries.

**Methods:** From 21 Patients with ACL-injury we diagnosed 5 Patients with acute ACL rupture, second degree MCL-tear and anteromedial rotatory instability. All Patients were treated with the same surgical technique by the same surgeon. Postoperative treatments were standardized. We evaluated standardized knee examination according to international knee documentation committee (IKDC), anteromedial rotatory instability (AMRI), excessive medial knee opening (EMKO) and Lysholm score both preoperative and after 2, 6 and 16 weeks postoperative.

**Results:** All Patients showed good to excellent clinical results at the follow-up examinations. The incidence of AMRI was significantly reduced to 0% (0 patients) compared with 100% (5 patients) preoperatively. An Evidence of EMKO was in none of the patients verifiable postoperative. Most patients had normal range of motion of the knee joint, whereas 1 patient (20%) lost 5° of range of motion in extension and 1 patient (20%) lost 15° in flexion. However in all 5 patients (100%) the findings...
were graded as normal or nearly normal according to IKDC knee examination form. All patients showed improvement of Lysholm score in the follow-up examination 16 weeks postoperative.

**Conclusion:** We presented a new surgical technique for treatment of ACL rupture and grade III MCL injuries. The technique improved both, valgus and rotatory stability on short term outcome. In our opinion surgical treatment in this kind of injuries, and especially in athletes, is recommended.

**Gait and clinical outcomes in patients with severe knee osteoarthritis: a multivariate approach**

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**Introduction:** Joint malalignment and gait deviations have been identified as important outcomes related to knee OA [1]. The relation between these outcomes and their evolution may be different between patients and healthy volunteers. To interpret [2], To us, gait of patients with knee OA, a multivariate approach could be used. The aims of this study are to determine which gait parameters are best adapted to discriminate patients with knee OA, to discover if different gait profiles exist, to determine associations among gait outcomes and joint malalignment.

**Patients/Materials and Methods:** Ninety patients with knee OA and scheduled for a total knee arthroplasty (TKA) were included in this study. Twenty-six elderly subjects were recruited as the control group. The hip-knee-ankle (HKA) angle, as an outcome of knee alignment, was assessed by full-limb radiography. The gait analysis was performed using a motion analysis system and force plates. Seventeen parameters were coded according to the literature in knee OA. The gait parameters were coded and normalized using fuzzy functions related to low, average and high modalities. The multiple correspondence analysis (MCA), a multivariate technique, was used to produce a simplified representation of the dataset information [3]. When relevant information was obtained from MCA, analysis of variances were performed to confirm differences.

**Results:** MCA highlighted a correspondence among 4 parameters: stride length, speed, knee flexion and hip flexion. MCA also highlighted a correspondence with other parameters: thorax obliquity and knee adductor moment. Four knee OA gait profiles were highlighted: A, B, C and D. Comparing A with control group, excepted for the knee flexion range, there is no significant difference for all gait parameters. Comparing B with control group, excepted for the knee flexion range there is no significant difference for the spatial-temporal and sagittal parameters. However, B has significant more thorax obliquity and knee adductor moment than the control group. Compared to the control group, C presents significant reductions of the spatio-temporal and sagittal parameters. C has no significant thorax obliquity, but it has a significant less knee adductor moment compared to the control group. Compared to the control group, D has significant reductions of the spatio-temporal and sagittal parameters. D has a more important thorax obliquity, but no significant difference for the knee adductor moment compared to the control group. For the HKA angle, there is a significant difference between the A-C profiles (patients with normal to valgus alignments) and the B-D profiles (patients with varus alignments).

**Discussion & Conclusions:** We highlighted 6 gait parameters which most contribute to the variance of our MCA and their main corresponding parameters. These parameters will be considered for the discrimination of gait deviations in patients with knee OA. They could be used to simplify gait interpretation of this population. Despite patients have severe knee OA and will be submitted to TKA, 4 gait profiles were observed and associated with knee malalignment. Patients with varus profiles increase thorax obliquity and reduce forward displacement whereas valgus profiles may only reduce forward displacement to manage knee OA evolution.

**References:**

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**P12**

**Development and Validation of a Numerical Model for Total Ankle Replacement**

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**Introduction:** Total ankle replacement (TAR) is an alternative to arthrodesis (AA) for surgical treatment of end-stage arthritis, with the main advantage to preserve a more physiological biomechanics of the ankle-foot complex. However, there are still major concerns regarding implants survival and complications at the bone-implant interface.

**Methods:** The tibial component of the Salto prosthesis (Tornier, Inc., Edina, MN) was implanted into 7 cadaveric tibias, which were then fixed to a testing machine (Instron E3000). An axial compression test (2000 N) was performed at varying positions of the mobile polyethylene insert. Bone strain was measured in 5 regions of interest (ROI) using a 3D stereo-photogrammetric system. The 7 cadaveric experiments were replicated numerically. 3D models of the tibias were built from CT before implantation, while implant positioning was reproduced with second CT after implantation. Radio-opaque beads were attached to the tibias for CT registration. Nonhomogeneous bone elasticity was derived from CT. The numerical model was implemented and analyzed with FE software Abaqus.

**Results:** For the 7 tibias, the 5 ROI, and the 3 loading conditions, the coefficient correlation between measured and predicted strain was 0.70, with a slope of 0.71. The predicted bone strain was maximal around the keel, and at the border of the plate. Bone strain reached 2% below the keel and at the border of the plate. Shear strain was lower than that of other prosthetic joints and complications are more frequent, including formation of cysts and implant loosening.

Furthermore, the design of revision implants will become crucial in the next years. Numerical models have the potential to help address these concerns. Our study aims to illustrate the potential of a numerical model by comparing the constraints at the bone-implant interface for two different designs of tibial components.

**Methods:** We used a numerical model developed and validated from 7 cadaveric prosthesis conformity combined with CT Imaging. The validation of the model was achieved by comparison of experimental with numerical strain during axial loading. The numerical model calculated bone strain, tension-compressions and shear stress at the bone-implant interface for an axial loading of 2000 N. Two distinct tibial anchorage were tested and compared: a central keel vs. a sagittal blade with a proximal cylinder.

**Results:** Bone strain was maximal above the fixation structure for both designs. Strain was below 1% for the blade design, while there was a small volume (4 mm³) above 1% with the central keel. At the bone-implant interface, there was no tension, but only compression, for both designs. Peak compression was located above the plate for the keel design, and above the cylinder for the blade design. Shear stress was maximal above the fixation structure for both designs. Overall strain and stress were higher for the keel than for the blade design, because of a lower bone-implant contact area.

**Conclusion:** The sensitivity of our model was demonstrated by its ability to detect differences in the patterns of primary stability for two distinct TAR tibial anchorages. Our study doesn’t allow qualitative assessment of one implant against the other because only a specific part of evaluation has been addressed. Nevertheless, this model offers a great potential to provide information regarding the primary stability of different implant designs and could also contribute to the development of revision implants.

**A new rare Complication of Osteonecrosis of the Distal Tibia after Dislocation Fracture to the Ankle Joint – Three Cases**

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**Introduction:** Ankle fractures are very common among young and middle aged active persons. Dislocation of the talus combined with a fracture to the malleoli and the associated ligaments is the most severe form. Immediate reduction helps to prevent further damage to the cartilage and soft tissue. Swelling, chronic pain, instability and consecutive osteoarthritis are the most common sequelae of possible
complications after such incidents. This report illustrates three cases of osteonecrosis in the unfractured tibial part which has not been described in literature before.

Methods: All three patients (27, 46 and 49 y.o.) were admitted to our hospital after suffering dislocation fracture to the ankle joint with immediate reduction. Two of them were operated immediately, one post-primarily. All of them were stabilized by medial and lateral screw and plate fixation, one required additional posterior buttress plating of the Volkmann’s fragment. The course of the fracture healing was followed by X-rays, CT and MRI.

Results: The consolidation of the fracture was in two cases uneventful. One case showed loosening of the posterior buttress plate due to osteonecrosis in the unfractured distal part of tibia and a subsequent lack of purchase of the screws. Upon full weight bearing and sportive stress, a new entity of pain occurred 4 to 12 months after trauma. An MRI revealed for all three cases the diagnosis of osteonecrosis. None of the necrosis was detected in the distal fractured part in terms of a sequestrum but located in the distal not fractured tibial part.

Conclusions: Posttraumatic osteonecrosis is commonly associated with fractures of the femoral neck, tibia and the scaphoid, due to their particular blood supply. Our cases suggest a new pattern of posttraumatic osteonecrosis. Whereas osteonecrosis of the distal tibial epiphysis is a known complication of the growing bone, there is to our knowledge no published data on osteonecrosis of the distal unfractured tibia associated with dislocation fractures of the ankle in adults. The consequence cannot be solely explained by disruption of a particular blood vessel; and non-traumatic causes of osteonecrosis (sickle cell disease, coagulopathy, steroid use and Morbus Gaucher) were not present in our patients. We assume that the combination of a heavy trauma, disruption of the peristeenal blood supply and the surgical trauma added up to this new and rare but serious complication.

Temporal Parameters Abnormalities Associated with Severe Hallux Valgus: A Gait Analysis Study

Swati Chopra, Kevin Moerenhout, Xavier Crevoisier
CHUV

Introduction: Hallux valgus (HV) is a condition, commonly seen in females, affecting the first metatarsophalangeal joint (MTP1) by progressive subluxation and valgus angulation. Studies have reported the altered biomechanics in HV but resources are limited. This study aims to assess the temporal parameters in patient with severe HV with more descriptive information regarding the stance duration.

Method: Two study groups were compared. The control group consisted of ten patients aged between 30–61(mean 45) years presenting no signs of HV. The case group consisted of ten severe HV patients aged between 35–58(mean 52)years presenting mean M1/M2 angle of 15.5° (13–20), M1/P1 angle of 31.3° (22–39) and DMAA of 9.7° (0–16) and markedly decreased functional scores including the stance duration.

Results: When comparing the HV group with the control group, significant difference (p <0.05) is observed in most temporal distance parameters (table 1).

Table 1: Temporal assessment results.

<table>
<thead>
<tr>
<th>Temporal parameters</th>
<th>CASES</th>
<th>CONTROLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stance (%)</td>
<td>59.4 (4.7)*</td>
<td>57.7 (2.4)</td>
</tr>
<tr>
<td>Swing (%)</td>
<td>40.6 (4.7)*</td>
<td>42.4 (2.4)</td>
</tr>
<tr>
<td>Cadence</td>
<td>103.3 (8.9)**</td>
<td>121.8 (12.2)</td>
</tr>
<tr>
<td>Load (%)</td>
<td>11 (2.3)</td>
<td>12 (3.2)</td>
</tr>
<tr>
<td>Foot-Flat (%)</td>
<td>59.8 (8.7)**</td>
<td>54.0 (9.1)</td>
</tr>
<tr>
<td>Push (%)</td>
<td>278 (8.4)**</td>
<td>34.7 (8.2)</td>
</tr>
<tr>
<td>Stride length</td>
<td>1.2 (0.1)*</td>
<td>1.3 (0.2)</td>
</tr>
<tr>
<td>HSP (%)</td>
<td>19.3 (3.1)</td>
<td>21.3 (7.1)</td>
</tr>
<tr>
<td>TOP (%)</td>
<td>-78.8 (6.8)*</td>
<td>-78.8 (6.8)*</td>
</tr>
</tbody>
</table>

* p <0.05; ** p <0.01; (%): of gait cycle; (°): of stance phase; (°): movement in degrees; HSP: heel-strike pitch angle; TOP: toe-off pitch angle.

Conclusion: Temporal parameters are visibly affected in the HV group. Longer stance phase including longer foot flat duration but shorter push off phase are characteristic patterns for the HV population.

Mineral density and penetration strength of the subchondral bone plate of the talar dome: high correlation and specific distribution patterns

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Introduction: The subchondral bone plate plays an important role in stabilising the joint and unit and in the pathomechanism of osteochondral lesions and osteoarthritis. The objective of the study was to measure (I) mineral density distribution and (II) subchondral bone plate penetration strength of the talar dome joint facet in order to display and compare specific distribution patterns.

Methods: Ten cadaver specimen were used for CT-scans wherefrom densitograms were derived by means of CT-osteoabsorptiometry (CT-OAM), and for mechanical indentation testing wherefrom penetration strength was obtained.

Results: Two different distribution patterns were found for mineral density and penetration strength. 6 out of 10 specimens (60%) showed bicentric maxima (anteromedially and anterolaterally), while the other 4 specimens (40%) showed a monocentric maximum (either anteromedially or anterolaterally). Highly significant correlation (p <0.0001) of both methods confirmed that mineral density relied on local load characteristics.

Conclusion: Biomechanical properties of the subchondral bone plate of the talar dome joint facet showed specific distribution patterns. CT-OAM has shown to be a reliable method to display mineral density distribution non-invasively. We recommend CT-OAM for non-invasive analysis of biomechanical properties of the subchondral bone plate in osteochondral joint reconstruction, as well as in prevention and treatment of osteoarthritis and osteochondral lesions.

Posters

SWISS MED WKLY 2013;143(Suppl 198) · www.smw.ch
Does proximal femoral osteotomy in Legg-Calvé-Perthes disease predispose to angular mal-alignment of the knee?

Stéphane Tercier

Introduction: Through there is an impression that proximal femoral varus osteotomy (FVO) can result in a valgus deformity at the knee there is no agreement about this issue. The aim of this study was undertaken to ascertain whether a FVO predispose to the development of genu valgum in children with Legg-Calvé-Perthes disease (LCPD).

Methods: Ninety five children with unilateral LCPD who underwent a FVO during the active stage of the disease and 31 children who were treated non-operatively were followed till skeletal maturity. The FVO was performed with a 20 degree varus angulation in all the patients and weight-bearing was not permitted till the stage of reconstruction. The alignment of the knee was assessed at skeletal maturity. A subset of 27 operated children also had full length standing radiographs of the limbs. The mechanical axis deviation (MAD), femur-tibial angle (FTA), lateral distal femoral angle (LDF A) and the medial proximal tibial angle (MPTA) were measured on these radiographs.

Results: The frequency of clinically appreciable mal-alignment of the knee was not greater on the affected side in patients who had undergone FVO when compared to the unaffected limb and also when compared to the affected limb in non-operated patients. The mechanical axis of the lower limb of operated children was relatively in more varus than that of normal limbs but they fell within the normal range.

Discussion: This study does not support the impression that a proximal femoral osteotomy for LCPD predisposes to clinically relevant degrees of genu valgum in children who have had 20 degrees of varus angulation at the osteotomy site and who have avoided weight-bearing for a prolonged period following surgery. Further studies are needed to clarify if genu valgum would have developed if early post-operative weight-bearing was permitted.

MRI changes in calf muscles of Cerebral Palsy (CP) patients after BoNT-A injections. Preliminary report.

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Aim: Mid and long term muscle modifications on MRI induced by Botulinum Toxin Type A (BoNT-A) injections. Schroeder et al. made a prospective study were two volunteers accepted to be injected with BoNT-A. Microscopy changes in the calf muscles of CP patients who underwent BoNT-A injections in the calf more than one year before.

Methods: Twelve CP patients (3 females, 9 males) underwent BoNT-A injections in the gastrocnemius muscle. MRI and biopsy was performed one year after an abnormal sign on MRI and denervation atrophy in the biopsy. MRI and biopsy were correlated. The purpose of this study was to evaluate changes of MRI changes in calf muscles of CP patients who underwent BoNT-A injections in the calf more than one year before.

Results: Seventeen GN and 13 S muscles were injected. Mean age at first injection was 4.1 years (range, 1-7). Mean age at time of MRI was 8 years (range, 7 to 11). Patients were injected 3 times on average (range, 1 to 6). Time between injections was 12 months on average (range, 7 to 32). Nine out of 17 GN and 11 out of 13 S had hyper intensity on T2-weighted sequences. Three out of 4 not injected S muscles showed MRI changes, probably because proximity of the injected gastrocnemius. The anterior compartment of the involved leg always had normal MRI signal. GN muscles with normal and abnormal MRI signal had similar BoNT-A dose. However, the time between MRI and last injection was shorter in patients with abnormal MRI signal (19 v/s 35 and 19 vs 41 months in GN and S). One patient had a GN biopsy showing histological denervation signs after 12 month post BoNT-A injection.

Conclusion: Denervation signs with high intensity signal on MRI T2-weighted sequences are still present over 1 year after BoNT-A injections. Further control group without BoNT-A injection should be done.

Significance: Indications for repeated injections at 3 or 6 months should be re-considered on the basis of this observation.

Longitudinal evolution of lower limb ranges of motion in cerebral palsy

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Introduction: The literature is scarce regarding the long-term evolution of clinical parameters according natural evolution and treatment received can help the clinician to optimize treatment strategies CP patients.

Objective: The purpose of this study is to determine the long-term ROM of the lower extremities in CP patients with respect to the different types of treatment received.

Methodology: A retrospective research of clinical gait analysis database between 1993 and 2012 were performed according the following inclusion and exclusion criteria: have undertaken two complete clinical examinations, being between 5 and 15 years of age during the first examination, being older than 15 years in the second examination. ROM of the hip, knee and ankle measured with a manual goniometer during the clinical examination were analyzed. ROM of the legs that received treatment were compared with the ROM of the legs without treatment with a Mann-Whitney U test (p <0.05).

Results: Twenty-four CP patients were included in this retrospective study. There were 12 hemiplegic patients, 10 spastic diplegia patients, and 2 tetraplegic patients corresponding to 40 legs with complete data. Fifteen legs benefited from surgical treatment and/or toxin injections (25 legs no treatment). Patients who had Achilles tendon lengthening improved their ankle dorsiflexion (an increase of about 6°, p <0.05). Patients who had surgery on their hamstrings or an osteotomy showed an improvement or a stabilization of their hip flexion. However, the entire ROM for all the lower extremities joints decreased.

Conclusions: This preliminary study shows a general decline in long-term ROM of the lower limbs in CP patients. Decrease on the range of motion is reduced with surgical treatments. Future studies are needed to determine the relationship between the change of the clinical features and the walking ability in CP patients on a long-term period.

References:

No need for search of asymptomatic urinary tract colonization before elective hip and knee arthroplasty

Cindy Bouvet, Anne Lübbeke, Leonardo Pagani, Carole Band, Ilker Uncay, Pierre Hoffmeyer

HUG

Objectives: The search for asymptomatic bacterial urinary tract infection and its eradication before elective hip and knee arthroplasty surgery is controversial, but reflects widespread practice. The influence of perioperative antimicrobial prophylaxis of cefuroxime 1.5 g IV. The median duration of postoperative urinary catheter carriage was 0 days (range, 0–13d).

Results: A total of 480 asymptomatic patients (370 hip arthroplasties; 297 females; median age 71 y: 61 immune-suppressed) were enrolled. On Day 3 postoperative, urine analysis was pathological for fewer patients (90 leukocyturia, 13 positive nitrates, and 171 patients with a bacterial colonization mostly due to E. coli, and other classical pathogens). Almost all patients received a single-dose perioperative prophylaxis of cefuroxime 1.5 g IV. The median duration of postoperative urinary catheter carriage was 0 days (range, 0–13d).

On Day 3 postoperative, urinary analysis was pathological for fewer patients (90 leukocyturia, 13 positive nitrates, and 198 colonizations). However, cefuroxime perioperative prophylaxis of colonization changed the microbiology of urinary colonization towards more Gram-positive pathogens. 50% of patients revealed another urinary microbiology within 4 days between admission and the postoperative period. Overall, only 30 patients (6%) developed a symptomatic urinary tract infection during a follow-up period of 3 months, of which one third of the pathogens were unrelated to those found during hospitalization for arthroplasty. All these symptomatic infections were treated with antibiotics. None of them (0%) needed to the joint prosthesis. Minimal laboratory costs for preoperative urinary analyses alone were estimated at 33,000 CHF, respectively.
Conclusion: Provided that urinary catheters are avoided or removed as rapidly as possible, pre- or postoperative routine urine evaluation of asymptomatic arthroplasty patients are costly and only moderately predict the pathogen of a potential future infection. If symptomatic infection occurs in a small minority of these patients, a targeted individualized antibiotic therapy prevents for urosepsis and haemogenous spread to joint prostheses.

The safety and efficacy of high-dose daptomycin combined with rifampicin for the treatment of osteoarticular infections

Constantinos Roussos, Philippe Alves, Maruschka Francescato, Daniel Muller, Pierre Vaudaux, Kheeltass Jugin, Ilker Uçkay, Philipp Alves, Maruschka Francescato, HUG

Aims: Treatment of Gram-positive osteoarticular infections require an adequate surgical approach combined with long-term antimicrobial therapy. The aim of this study was to evaluate the safety and efficacy of high-dose regimens of daptomycin, which is a recently introduced antibiotic active against multi-resistant Gram-positive pathogens, administered to patients with osteoarticular infections in combination with rifampicin.

Methods: This single center, non-comparative, prospective study evaluated the safety and efficacy of a combined regimen of intravenous daptomycin (8 mg/kg/day) and oral rifampicin (600 mg/day) in patients with Gram-positive osteoarticular infections, with a minimal follow-up of 1 year. Creatine phosphokinase, transaminases, bilirubin and serum creatinine, were measured at baseline and regular intervals.

Results: Sixteen patients (median age: 63.5 years; 11 males, 5 females) presenting with staphylococcal (n = 15) or streptococcal (n = 1) osteoarticular infections were enrolled and treated with a median number of 2 (range: 1–6) surgical procedures. The median daily doses of daptomycin and rifampicin, administered for a median duration of 21 (range: 10–122) days were 8.15 (range: 6.6–8.9) mg/kg/day and 600 (range 600–900) mg/day. The combined regimen of daptomycin and rifampicin was well tolerated by all except one patient, without requiring treatment adjustment or discontinuation. One patient developed allergic responses probably due to rifampicin after 42 days. Fifteen (94%) patients showed favorable clinical and microbiological outcomes.

Conclusions: The combined regimen of high-dose daptomycin and rifampicin was well tolerated and may provide a useful alternative to standard glycopeptide therapy for Gram-positive osteoarticular infections.

Epidemiology of extended-spectrum beta-lactamase-producing Enterobacteriaceae in a septic orthopaedic ward

Constantinos Roussos, Philippe Alves, Alexis Bonvin, Maruschka Francescato, Mathieu Zingg, Ilker Uçkay, Pierre Hoffmeyer, HUG

Objective: Wards cohorting infected orthopaedic patients may be particularly prone to transmitting extended-spectrum beta-lactamase producing Enterobacteriaceae (ESBL-E), due to high antibiotic use and long hospital stays.

Methods: We analyze their epidemic pattern by performing molecular typing of ESBL-E isolated from patients and healthcare workers during 20 months from our septic ward.

Results: Between March 2009 and November 2011, 186 patients were admitted from the community and 1335 transferred from other institutions, totalling 12,401 patient-days with an average length of hospital stay of 27 days. Bed occupancy averaged 83%. Among 565 swabs, ESBL-E were detected in 204 samples from 45 patients, suggesting nosocomial carriage in affected patients. In six patients, two different ESBL-E strains were detected, and 3 patients carried three distinct isolates. Among the 45 positive patients, 29 (64%) were detected during the first three days of admission, the remainder after a median duration of 13 days of hospitalisation (range 7–52 d). At the time of sampling, 26 patients received antibiotic therapy without clinical activity against their respective ESBL-E; a further 7 patients were treated with antibiotics which their ESBL-E strains were susceptible to in vitro (carbapenems or quinolones). Most positive patients were asymptomatically colonised with ESBL-E. Two patients had arthroplasty infections due to ESBL-E, of which one was acquired on our ward. We also screened 41 healthcare workers (HCW) on 49 occasions during the study period. Six samples (13%) were positive. None of the ESBL-E detected in HCW were related to any of the patient isolates. Among 60 environmental samples taken at the peak of the epidemic (room floors, beds, curtains, tables, doors, offices, computers, telephones, kitchen, physiotherapy material, and toilets), none revealed ESBL-E.

Conclusion: The epidemic pattern of ESBL-E produces an ongoing public health concern. Regular environmental sampling is needed to control the spread of ESBL-E. Due to ESBL-E resistant Enterobacteriaceae, environmental swabs and sampling of non-sterile sites should be performed. Patients and HCWs should be educated on the importance of hand hygiene, personal protective equipment, and antibiotic stewardship.

Consideration of the causative pathogen may be necessary for the decision for implant retention in the management of infected total knee prostheses

Raphaël Kohlphant, Line Zürcher-Plund, Ilker Uçkay, Robin Peter HUG

Background: For prosthetic joint infections (PJI) of the knee, the option of debridement with implant retention has a higher risk of infection recurrence than procedures with implant removal.

Objectives: While staphylococcal methillin-resistance is known as a risk for relapse; the inherent role of the underlying pathogen is practically always neglected in international recommendations. We hypothesize that retention of infected knee arthroplasties is futile for staphylococcal PJI but might be a valid option for streptococcal PJIs, which may show a better outcome with this approach.


Results: In 21 patients with a mean age of 80.4 years (19 immunosuppressed and polymorbid) a primary attempt was made to salvage the implant (11 cases) with arthroscopic (10 cases) lavage and debridement and 3 months of concomitant antibiotic treatment. After mean active follow-up of 7 years (range, 4–20 y), patients were in remission in only seven cases (7/21, 33%). The 14 recurrences occurred on average after 8.4 months after the antibiotic therapy (range, 0.5–17 mts) and were due to the same pathogen as during the first episode. However, this low success rate was different between the microbiological strata. Remission was achieved in 0% of all MRSA infections (0/3); in 0% (0/3) of methicillin-resistant coagulase-negative staphylococcal infections; in 29% (27/96) of methicillin-sensitive S. aureus infections; but in 75% (3/4) of infections due to various streptococci.

Conclusion: Our small case series in our orthopastry cohort suggests that the decision for the option of debridement and retention of knee PJI should also base on the pathogen, and not merely on the methillin-resistance. This approach is futile for MRSA infections, but might be a valid option for streptococcal PJIs.

Isolated Musculoskeletal Echinococcosis, a Report of Two Cases

Nadine Kaiser1, Veronique Erard1, Peter Wahl, Marius Kpee1, Gianluca Maestretti1, Emanuel Gautier1, Hôpital cantonal Fribourg, 1Inselspital Bern

Background: Alveolar echinococcosis (AE) is a highly lethal, invasive parasitic infection, caused by the larval form of the tapeworm E. multilocularis (EM). It is endemic in central Europe, especially in some regions of Switzerland. This disease is rather rare, but difficult to treat. The liver is affected in 98% of cases. Few cases with isolated infection of bone or muscle without liver involvement have been reported so far. We report two patients from rural area of Fribourg (Switzerland) with isolated musculoskeletal AE.

Case 1: A 59 years old woman who presented with a recurrence of an inflammatory lesion in the thoracic paravertebral muscle after being treated initially in another hospital. She had received marginal surgical excision and antibiotics after identification of a coagulase-negative Staphylococcus, which had been considered despite absence of an implant. Proof of EM came from the histopathological examination of the tissue removed at revision.

Case 2: A 64 years old woman, presenting an extensive chronic ixiolac osteoarthritis with progredient pelvic instability. Surgical debridement and stabilization was performed. Despite negative microbiological cultures she was treated with antibiotics for 3 months as histopathology showed the presence of an Echinococcus multilocularis (EM). It is endemic in central Europe, especially in some regions of Switzerland. This disease is rather rare, but difficult to treat. The liver is affected in 98% of cases. Few cases with isolated infection of bone or muscle without liver involvement have been reported so far. We report two patients from rural area of Fribourg (Switzerland) with isolated musculoskeletal AE.

Discussion: In both cases initial histology conclude to a specific inflammatory granulomatous reaction. Diagnosis was confirmed more than one year after onset of symptoms. The two cases illustrate that musculoskeletal infection by EM exists even without affection of the commonest organs such as liver, lung or brain. The diagnosis of AE may be missed at histopathology and interpreted as bacteriological infection, possibly culture negative, delaying the diagnosis for an extended period of time. Negative serologic results do not exclude the disease.
Echinococcosis has to be part of differential diagnosis of tumourlike process especially in the presence of a culture-negative inflammatory process.

**Extra-articular knee resection for a secondary chondrosarcoma evolving from an isolated enchondroma of the distal femur: A case report.**

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**Introduction:** Enchondromas are among the most current benign bone tumours. Malignant degeneration is extremely rare (<1%) and generally presents as a low grade chondrosarcoma. For localized grade 1 lesions, the treatment of choice is curettage. Wide excision and reconstruction is generally not necessary, unless locally advanced or more aggressive behaviour is suspected at presentation.

**Case report:** A healthy 72 yo male presented with pain and recurrent knee joint effusion. X-rays show a classical central distal metaphyseal enchondroma of the femur associated with subtile osteolysis of the lateral condyle. MRI confirms the presence of a locally aggressive chondromatous lesion based in a classical enchondroma. Core needle biopsy revealed a grade 1 chondrosarcoma, which was in contrast to the radiological appearance of the lesion. Total body CT-scan did not reveal metastatic disease. A wide resection was planned, as a high-grade lesion and joint contamination was suspected.

We performed an extra-articular knee resection and reconstruction with a hinged modular total knee megaprosthesis. The definitive histology was grade 1 chondrosarcoma, the surgical margins were wide. The evolution was favourable and the patient was able to perform all his activities of daily living independently without pain at 6 weeks postop. Knee flexion reached 90°. The oncologic screening at 18 months did not show local or distant recurrence.

**Conclusion:** Joints near a benign tumour that suddenly become symptomatic or present an effusion might indicate a malignant transformation. Wide resection and prosthetic reconstruction remains an effective treatment option even in low grade cartilaginous lesions, if (1) the adjacent joint is not contaminated, or (2) joint-sparing surgery would result in a severe functional impairment of the limb.

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**Giant extraskeletal myxoid chondrosarcoma of the thigh treated by wide extraarticular resection and reconstruction with a tumor prosthesis**

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**Introduction:** Extraskeletal myxoid chondrosarcoma (EMC) is a rare soft tissue tumour with a high risk for local recurrence and metastases. While this entity is resistant to radio- or chemo-therapy, wide resection remains the treatment of choice.

**Case report:** A 60 yo male presented to our service with a large mass in his right thigh, slowly evolving over the past 7 years. His main complaint was the volume of his thigh. Imaging showed a 23 × 13 × 14 cm tumour in the quadriceps, eroding the cortical bone and with potential contamination of the knee joint. The risk of a pathological fracture was estimated considerable. A CT-guided core-needle biopsy revealed a FNCLCC grade 2 EMC. A thoraco-abdominal CT scan showed multiple pulmonary metastases. Due to the palliative situation with a very slow disease progression, a wide extraarticular resection of the distal femur and reconstruction with a megaprostheses were performed. Extensive skin necrosis necessitated three revision procedures for débridement and confection of a pediculated lateral gastrocnemius muscle flap. No complementary treatment was possible for the pulmonary metastases. At 18 months follow-up, he walked without crutches, was able to do his activities of daily living. He was painfree and highly satisfied with the result. During the follow-up, slow progression of the pulmonary metastases was noted, which remained asymptomatic.

**Conclusion:** Extraskeletal myxoid chondrosarcoma is a rare soft tissue tumour, and wide excision remains the treatment of choice. Whenever possible, limb salvage should be proposed to preserve function and quality of life.

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**Wide resection of the lateral malleolus and adjacent tibial, talar and calcaneal bones with ankle fusion and allograft reconstruction for an osteosarcoma**

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**Introduction:** Primary bone sarcomas around the ankle are rare. Due to the proximity of neurovascular structures and limited soft tissue reserves, limb salvage is often not possible.

**Case report:** A 19 yo male presented with pain and a progressive swelling of his ankle. X-rays revealed cortical erosions and an extensive periosteal reaction (sunburst) of the distal fibula. MRI showed a large mass of the fibula invading adjacent soft tissue. The lesion appeared close to the ankle joint, but with the articular cartilage as a barrier and without joint effusion. Core-needle biopsy revealed a high-grade chondroblastic osteosarcoma. No metastases were detected. After presentation at our multidisciplinary sarcoma board, the patient was subjected to neo-adjuvant chemotherapy (AOST 03-331).
Without any sign of intra-articular contamination of the ankle joint, surgical treatment consisted of wide resection of the lateral malleolus including a large skin patch, the distal third of the fibula, the lateral surfaces of the tibia and talus as well as the insertion of the lateral ligament on the calcaneus. The distal parts of the anterior, peroneal, and posterior muscular compartments were resected en bloc with the tumor. The defect was reconstructed with tibiotalar and talo-calcanean fusion, bony allograft and a plate. Soft-tissue coverage was achieved with a free fascio-cutaneous flap from the contralateral thigh.

Despite some important functional loss, limb salvage is superior to amputation.

Conclusion: Wide resection and reconstruction of the lateral malleolus is technically demanding but possible in selected cases. Neoadjuvant therapy with denosumab in a giant cell tumour. A case report.

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Introduction: Giant cell tumour (GCT) is a benign but locally aggressive primary osteolytic bone tumour, prone to local recurrence after surgery. Denosumab is a human antibody against RANKL, an over-expressed ligand present on normal multinucleated cells, responsible for bone destruction in GCT. We report the case of a patient with an advanced GCT of the distal radius. The lesion was treated with neoadjuvant denosumab, followed by curettage.

Clinical case: A 28 years old patient presented with a classical honeycomb osteolytic lesion in the left distal radius. Core-needle biopsy confirmed the diagnosis of GCT. Due to the proximity to the radio-carpal joint and advanced scalloping of the metaphyseal cortical bone, joint-salvage surgery was not possible. We initiated a neo-adjuvant treatment with denosumab (XGEVA), 120 mg/week for 1 month, followed by monthly injections for 6 months. During this time, a substantial bone recorticalization, without progression of the size of the tumour was noted. No local or systemic side effects were observed. We performed intra-lesional (curettage) excision and bone grafting after 6 months. Histological analysis revealed islets (10%) of viable tumour cells within fibrous tissue. Post-op evolution was eventless.

Discussion: While surgery remains the treatment of choice for GCT, joint-salvage may not always be possible in case of extensive epiphyseal involvement or in presence of pathological fractures, lesions may clear communication to specific anti-RANKL treatment with denosumab. Denosumab appears to slow down tumour growth and promote recorticalization of eroded bone. It might allow less aggressive surgical treatment in selected cases.

Surgical technique: A new surgical technique of shoulder arthrodesis using a free double-barrel vascularized fibular bone graft. Karl Wieser, Kourosh Modaresi, Bruno Fuchs, University Hospital Balgrist

Introduction: Arthrodesis of the shoulder is a straightforward and established alternative to reconstruct the shoulder function after extensive tumor resection of the proximal humerus. Functional results after arthrodesis compare preferable with those after prosthesis or spacer reconstruction. Despite potential complications, surgical results show that patients satisfaction of nearly 80% can be expected and in contrast to prosthetic, or osteoarticular allograft reconstruction function does not deteriorate over time. However with complication rates of up to 43%, efforts to develop new surgical techniques, with lower complication rates, are essential. The goal of the present report is to describe a new surgical technique of shoulder arthrodesis using a free double-barrel vascularized fibular autograft and analyse the first mid-term experience using this technique after wide resection of malign tumors of the proximal humerus.

Jaffe-Campanacci syndrome: an extremely rare cause of pathologic fracture of the femur

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Introduction: Non-ossifying fibromas are common benign bone tumors of children and young adults. They are usually single, asymptomatic and regress spontaneously in adulthood. Some rare cases of pathologic fractures have been described. Jaffe-Campanacci syndrome is the association of multiple non-ossifying fibromas, “café-au-lait” spots and some degree of type 1 neurofibromatosis. While the relationship between the two entities remains unclear, there seems to be some genetic similarities (partial or complete deletion of the gene NF1).

Case Report: A 17 yo female patient with a neurofibromatosis type 1 was referred to our tertiary centre with a pathologic fracture of the distal femur through a non-ossifying fibroma. She had a slight mental retardation and “café-au-lait” spots. Imaging revealed multiple typical non-ossifying fibromas of both distal femurs and proximal tibias. There was no impinging fracture of the contolateral side, and no other findings on thoraco-abdominal CT scanner. The fracture was treated by minimal invasive plate osteosynthesis. Histological analysis of tissue samples taken during the intervention confirmed the histologic diagnosis of non-ossifying fibroma. The fracture healed eventless and the patient returned to work after 3 months. At 12 months follow-up, the patient remained pain-free. Imaging revealed remodelling of the lesions.

Conclusion: Jaffé-Campanacci syndrome is an extremely rare cause of pathologic femur fracture. These fractures can be treated like any other, and good outcome is expected. There is still no consensus in regards to definition of the disease and its relationship with type 1 neurofibromatosis.

Arthrodesis of the Shoulder after Tumor Resection with an Autologous Double-Barrel Vascularized Fibular Bone Graft

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LCP 140° Paediatric Hip Plate for Fixation of Proximal Femoral Valgisation Osteotomy
Claudia Sidler-Maier, Kerstin Reidy, Hanspeter Huber, Reconstructive operation in paediatric orthopaedic surgery with applications in congenital and acquired disorders. Many implants have been used for the fixation of proximal femoral osteotomies, but so far, there is no literature about the use and outcome of the LCP 140° Paediatric Hip Plate for fixation in children. We present a retrospective analysis of 11 patients with valgisation of the proximal femur for different congenital and acquired disorders. Patients’ demographics, perioperative details, postoperative outcome and complications were retrospectively collected and analysed.

Methods: Between January 2011 and July 2012, 11 hips in 10 patients underwent valgisation of the proximal femur for different congenital and acquired disorders. Patients’ demographics, perioperative details, postoperative outcome and complications were retrospectively collected and analysed.

Results: The mean age of the 10 ambulatory patients (one with bilateral operation) who underwent proximal femoral valgisation osteotomy was 9.6 years (range: 7.3 to 11.8 years). All having had an uneventful surgery their mean hospital stay was 5.2 days (range: 3–9 days). Callus formation was observed in all cases at 6 weeks postoperative control and consolidation was complete in all cases after a mean of 221 days (85–533 days). We did not see any delayed unions or any case of non-union in our series. The mean corrected neck-shaft angle in our series was 20° (range 12° to 37°). The stability of the operative reduction including the corrected neck-shaft angle was maintained during the follow-up period (mean: 459 days, range: 168 to 700 days). There were no recurrences (variation) or complications requiring further treatment or revision.

Conclusion: In our series of 11 femoral valgisation osteotomies, the 140° LCP Paediatric Hip Plate was shown to be safe and applicable in the clinical setting with good results concerning the realization and maintaining of the corrected neck-shaft angle, duration of hospital stay, consolidation time and low complication rate. We therefore consider the 140° LCP Paediatric Hip Plate to be a valuable device for correction of pathological varus conditions of the proximal femur in children.

Neuropilins: Potential Markers for Osteosarcoma progression
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²Institute of Surgical Pathology, University Hospital Zurich
³University Hospital Balgrist, Orthopedic Research
INTRODUCTION: Osteosarcoma (OS) is the most frequent primary malignant tumor of bone in children and adolescents with a poor prognosis in case of metastatic disease. There are only a few established OS cell lines available for the research in the OS field. Here we have investigated by microarray analysis the gene expression of two OS cell lines, the human SAOS-2 and the mouse Dunn cells with low metastatic potential and derived cells with high metastatic potential, the LMS and LMK cells, respectively, to address their genetic stability during long-term in vitro culture. The cell lines used represent the most common type of osteoblastic OS.

METHODS: The human SAOS-2 and Dunn/LKM cell line systems were cultured in vitro for periods to achieve more than 150 and 460 cell doublings, respectively. The gene expression was analysed by microarray in early and late passages using Agilent SurePrint Human Gene Expression 8 × 60k and Agilent Mouse GE 4 × 44k v2 microarray kits, respectively. Chromosomal localization and pathway analysis was performed using DAVID (http://david.abcc.ncifcrf.gov/).

RESULTS: In the low metastatic parental cell lines SAOS-2 and Dunn 53 and 79 genes, respectively, were differentially (>2-fold; p < 0.01) expressed during in vitro culture. In the metastatic derivatives, the LMS and LMK cells, respectively, address their genetic stability during long-term in vitro culture. The cell lines used represent the most common type of osteoblastic OS.

CONCLUSIONS: The chromosomal localization and pathway analysis showed a significant enrichment of genes involved in “local adhesion.” The expression of NRP1 and NRP2 expression was associated with patient survival. The average score of each marker was calculated. A marker was evaluated if more than 50% of the patients showed a change in expression. Assuming that a downregulation was associated with patient outcome and an upregulation with patient mortality, we compared the marker expression before and after chemotherapy with the patients’ 5-YS, resulting in a prognostic score. Between 32 and 39 patients met all evaluation criteria (i.e., non-metastatic OS, no neoadjuvant chemotherapy, biopsy, resection) for a given marker. Statistical analysis was performed using Fisher’s exact test with p < 0.05.

RESULTS: Nineteen out of 36 markers showed a change in expression in response to neoadjuvant chemotherapy in more than 50% of the specimens. Prominent changes in expression were, for example, seen with Vimentin (change observed in 87% of n = 38 evaluable samples), PTEN (84%, n = 38), Caprin (79%, n = 33), CXCR4 (77%, n = 39), matrixmetalloproteinase (MMP-7) (73%, n = 33) and tumor suppressor P16 (59%, n = 37). However, only one expression changes of MMP-9 (p = 0.012) and P16 (p = 0.044) yielded a significantly negative correlation with patient 5-YS.

CONCLUSIONS: A change in protein expression provides valuable information about the impact of chemotherapeutic treatment and thus, may further assist in predicting patient survival. Based on our results, we suggest monitoring MMP-1 and P16 immunoactivity before and after neoadjuvant chemotherapy. Prediction of patient survival by MMP-1 and P16 immunoactivity in osteosarcoma tumor samples taken before and after neoadjuvant chemotherapy
Bernhard Robl³, Sander Botter³, Knut Husmann³, Franziska Seeli³, Beata Bode³, Walter Born³, Bruno Fuchs¹
¹University Hospital Balgrist, Orthopedic Research
²Institute of Surgical Pathology, University Hospital Zurich
INTRODUCTION: In osteosarcoma (OS) treatment, the most valuable marker with prognostic value for the chance of survival is the amount of tumor necrosis after neoadjuvant chemotherapy. However, by combining the external radiological information with tumor necrosis, this may be predicted more accurately. We therefore performed immunohistochemistry of 36 known tumor marker proteins on OS tumor samples, collected before and after chemotherapeutic treatment. Changes in staining intensity and stained area were correlated with the patients’ 5-year overall survival (5-YS).

MATERIALS AND METHODS: Non-necrotic tumor samples at the time of diagnosis (biopsies) and after neoadjuvant chemotherapy (resections) were paraffin embedded to generate a tissue micro array (TMA) representing 86 patients. TMA sections were immunostained in duplicates for the expression of 36 tumor markers. A semi-quantitative 3-point scoring system, combining staining area and staining intensity (quantified with Matlab software) reflected the expression of the marker before and after chemotherapy. The average score of each marker was calculated. A marker was evaluated if more than 50% of the patients showed a change in expression. Assuming that a downregulation was associated with patient outcome and an upregulation with patient mortality, we compared the marker expression before and after chemotherapy with the patients’ 5-YS, resulting in a prognostic score. Between 32 and 39 patients met all evaluation criteria (i.e., non-metastatic OS, no neoadjuvant chemotherapy, biopsy, resection) for a given marker. Statistical analysis was performed using Fisher’s exact test with p < 0.05.

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Photodynamic therapy as a novel strategy against osteosarcoma

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University Hospital Balgrist, Orthopedic Research

Introduction: Osteosarcoma (OS) represents a common primary bone malignancy in children and adolescents. More than 30% of patients develop lung metastasis, which is the leading cause of mortality. Consequently, suitable early diagnostic markers of metastasizing OS and corresponding treatment targets are urgently needed.

Objective: We propose to study the effects of CD44 knockdown on tumorigenic and metastatic phenotypes of OS cells.

Methods: Three groups of SCID mice were intratibially injected with 143-B/LacZ cells with stably down-regulated CD44 expression (143-B/shCD44), control cells bearing non-targeting shRNA (143-B Ctrl shRNA), or control cells bearing the empty vector (143-B EV). Tumor development was examined weekly by X-ray and tumor volume was determined by caliper measurements. The mice were sacrificed 21 days after tumor cell injection and in situ lung perfusion was performed. Organs were fixed and LacZ gene expressing tumor cells were visualized upon X-Gal staining. The indigo-blue stained metastases on the lung surface were counted under the microscope.

Results: Mice bearing shCD44 xenografts developed larger primary tumors and had significantly increased number of pulmonary metastases when compared to those in control animals. In contrast to our in vitro data, experiments in vivo using the orthotopic xenograft mouse model implicated CD44 as a metastasis suppressor gene in 143-B cells.

Conclusions: The apparent discrepancy between in vitro and in vivo outcomes of CD44 knockdown on tumorigenic and metastatic properties of 143-B cells highlights the essential impact of tumor environment on OS progression. In conclusion, our study identified CD44 as a metastasis suppressor in this particular experimental OS model.

Proof of principle study of metastasis suppression by P2G overexpression

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1University Hospital Balgrist, Orthopedic Research, 2Instituto Clinico Humanitas IRCCS, Milano

Introduction: The CXCR4/SDF-1 chemokine axis plays a role in growth and metastatic potential of osteosarcoma (OS) cells. In the present study we disrupted this axis using the P2G CXC receptor mutant in 143B OS cells and evaluated the impact on tumor growth and lung metastases. P2G is an SDF-1 mutant which competes with the native SDF-1 for CXCR4 and thereby prevents the signaling.

Methods: IacZ tagged human 143B OS cells were manipulated to overexpress P2G or the control empty vector (EV). The cells carrying the empty vector (EV) were used as a control. The cells were intratibially injected in SCID mice. In order to characterize the tumorigenic properties of the cells, X-ray and μCT scans as well as caliper measurement of the tumor volumes were performed.

Results: We found a significantly increased tumor volume for the P2G compared to the EV cells. For the tumor cells expressing SDF-1, a small, but not significant increase in tumor volume was observed. In vitro migration assays showed that P2G and SDF-1 overexpression diminished the SDF-1 mediated CXCR4-dependent migration of 143B OS cells.

Conclusions: Our study demonstrated the potential of using P2G overexpression as a novel approach to inhibit tumor progression and metastasis in OS.
the number of lung metastases was quantified for the P2G and EV-P2G group when compared to the control. There was a clear tendency, downregulation of CXCR4 by specifically blocking antibodies in SCID mice inhibited lung metastases of OS cells. In our study we found that overexpression of P2G in OS cells also efficiently diminished lung infiltration in mice. However, similar to the results derived in the apparently, there is heterogeneity in the cell population of 143B cells, seen in primary tumor size indicating that OS cells rely on other than analysis of the effect of CXCR4 downregulation by means of P2G expressed locally in the lung as a potential therapeutic strategy for metastasizing OS.

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Introduction:

Osteosarcoma (OS) is the most frequent primary bone cancer. It arises in bone during periods of rapid growth and primarily affects adolescents and young adults. ΔNp63, a hedgehog signaling component, are transcription factors capable of inducing motility, invasion and metastasis in many types of cancer but a hedgehog signalling component, are transcription factors capable of their role in OS is poorly understood. We are investigating the influence of ΔNp63α and ΔNp63ε in OS progression. We could show that expression of ΔNp63α and GLI2 is upregulated in invasive OS cell lines. In ΔNp63α overexpressed SaOS-2 cell lines (SaOS-2-ΔNp63α, GLI2 expression was evident when compared to the empty vector (SaOS-2-EV) where little or no expression could be detected. 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 revealed that GANT61 treatment induced G0/G1 arrest in SaOS-2-ΔNp63ε and 143B cells.

Methods:

ΔNp63α stable SaOS-2 cell lines were generated by retroviral infection. The expression levels of ΔNp63α and GLI2 were analysed by western blot (WB) and real time PCR (qRT PCR) in OS cell lines. Co-localization analysis of ΔNp63α and GLI2 were performed by immunocytochemistry. FACS was utilised for determination of cell cycle stage after treatment with GANT61.

Results:

ΔNp63α and GLI2 were upregulated in invasive OS cell lines as revealed by WB and qRT PCR. Immunocytochemistry revealed that ΔNp63α and GLI2 show colocalisation in the nucleus in SaOS-2-ΔNp63α and 143B cells. Treatment with GANT61 for 24 hours induced G0/G1 arrest in SaOS-2-EV and 143B cells.

Conclusions:

Our results indicate that there might be a mutual interaction between ΔNp63α and GLI2 in OS progression. To further elucidate the functional role, SaOS-2-ΔNp63ε cells will be injected in an established intratibial mouse model and treatment with GANT61 will be carried out.

CR-EQUIPEMENTS™ SACH Foot versus Otto BOCK™ SACH Foot

Alain LACRAZ, Katia Turcot, Yoshi Sagawa, Jean Lenoir, Gorki Carmone², Stéphane Armand, Mathieu Assal², Hôpitaux Universitaires de Genève, ²Hôpitaux Universitaires de Genève, ³Lenoir Orthopédie, ⁴Clinic la Colline – Genève

Introduction: The International Committee of the Red Cross (ICRC) has designed a Solid Ankle Cushion Heel (SACH) foot produced at low cost by CR-EQUIPEMENTS™. This foot is available worldwide in all orthopedic centers supported by the ICRC. The purpose of this study is to compare patient satisfaction with the CR-EQUIPEMENTS™ SACH foot with that made by Otto BOCK™, the latter considered by many as the “golden foot.”

Materials and methods: Cross-over and double blind trial involving patients with traumatic trans-tibial amputation, autonomous in ambulation for more than two years and without co-morbidities affecting gait and balance. Each patient was equipped with one foot and then the other, without knowledge of the specific type. Each foot was worn for 7 days. The patients’ satisfaction with patient satisfaction with the specific foot was evaluated by the CIRO-QI and the SPS-7 scale.

Results: There were 15 patients, 12 men and 3 women with a mean age of 46.9 ± 12.5 years (range, 26.9–73.4 years), who met the criteria of the study and the completed the entire trial. The SAT-PRO questionnaire showed slightly better satisfaction for the CR-EQUIPEMENTS™ foot (80%; p = 0.0025) compared to the Otto BOCK™ foot (78%; p = 0.039); however this difference was not statistically significant (p = 0.06). The foot-oriented questionnaire revealed a difference in favor of the CR-EQUIPEMENTS™ foot, but this was not statistically significant (p = 0.06).

Discussion: This study demonstrated that the CR-EQUIPEMENTS™ foot provided comparable satisfaction to the Otto BOCK™. This is the first study that addresses patient’s satisfaction using the CR-EQUIPEMENTS™ foot in the context of humanitarian aid provided by the ICRC.


Efficiency and cost analysis of patient-reported outcome assessment after total knee arthroplasty: Comparing paper questionnaires to the tablet

Nicolai Kesterke, Bernhard Jost, Annelise Spitz, Karlmeinrad Giesinger

Introduction: Patient-reported outcome (PRO) assessment is an important outcome parameter after total knee arthroplasty (TKA). PRO tools like the Forgotten Joint Score (FJS) or the WOMAC score investigate patients’ symptoms and impairments in daily living. The most common PRO assessment modality is paper and pencil questionnaires. The logistics and administration of paper questionnaires and manual data entry for statistical analyses are costly and time consuming. Tablets have become a favourable alternative to efficiently assess PRO measures.

Objective: To evaluate efficiency and costs of PRO assessment after TKA using two different modalities of administration: paper and pencil questionnaires and tablet assessment.

Method: We prospectively followed-up patients (2 months and 1 year after TKA) administering different PRO scores in two modalities. The WOMAC score (24 questions) and the Forgotten Joint Score (FJS, 12 questions) were completed by 34 patients in their paper and pencil
version and by 50 patients on a tablet. 80 patients completed the FJS in its computer-adaptive version (FJS-CAT). Questionnaire completion was timed for all PRO assessment tools and modalities. Time for manual data entry of the pencil and paper version into our database was also recorded. The study nurse costs were calculated.

**Results:** Average time to complete the WOMAC score in a pencil and paper version and manual data entry was 598 seconds. Average completion time for the WOMAC score on tablets was 113 seconds with no further data entry being necessary. Average time to complete the FJS-12 was 107 seconds in its pencil and paper version (including manual data entry) and 33 seconds on tablets. Explanation time for the WOMAC and FJS-12 on paper was 21 seconds on average whereas the explanation time for the tablet versions of the WOMAC and the FJS-12 was 97 seconds. Personnel costs for the WOMAC on tablet were substantially lower than for the pencil and paper version (2.91 sFr vs. 8.26 sFr). The personnel cost for the FJS-12 showed no significant difference (1.64 sFr) between the two modalities of administration.

**Conclusion:** PRO measurement with tablets is an efficient option of patient assessment. It can substantially decrease time and cost for data collection in large patient samples in clinical routine. This effect seems to increase with questionnaire length. Another benefit is the exclusion of potential transcription errors since no manual data entry is needed.
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