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Abstracts
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Common extensor tendon avulsion mimicking tennis elbow: clinical and structural results following knotless anchor repair (9599)

Michael Glanzmann; Dominik Rickenbacher; Johannes Gleich; Christoph Kolling; Jürg Oswald; Laurent Audigé

Introduction: Lateral epicondylitis or tennis elbow is one of the most frequent elbow disorders and in the majority of cases successfully treated non-operatively. In some cases an extensive tear of the common extensor tendon (CET) insertion may maintain chronic symptoms. This study documents the clinical and structural results following repair of the common extensor tendon insertion using a knotless anchor.

Methods: 20 patients with chronic lateral elbow pain and a MRI-proven high-grade CET tear were included in this study. All patients had undergone unsuccessful conservative treatment for at least 6 months before surgery. The surgical intervention included a diagnostic arthroscopy with removal of the posterolateral plica and an open repair of the CET. Mayo Elbow Performance Score (MEPS), quick Disabilities of the Arm, Shoulder and Hand Score (quickDASH), patient-rated tennis elbow evaluation score (PRTEE) were obtained. Grip strength was measured with a hand dynamometer and compared to the contralateral side. Minimal follow-up time was 12 months. At final follow-up an ultrasound examination was performed to evaluate tendon healing. Adverse events which occurred throughout the period between operation and final follow-up were documented.

Results: 18 of 20 patients were available for clinical follow-up. One patient was satisfied with the result but too busy to participate and one patient was lost. The median follow-up time was 3.1 years (range 1-6.4). The mean age of the patients was 48 years (range 20-74). From baseline to follow-up the median MEPS significantly improved from 55 to 100 (range, 52 to 114) of contralateral side value. Ultra- sound imaging showed an intact insertion in all cases but calcifications were noted in 5 individuals. All patients reported a satisfaction score of 7 or more on the numeric rating scale. One patient underwent ulnar nerve decompression 11 months following the procedure.

Conclusion: Repair of high-grade CET tears resulted in a high success rate for pain relief and patient satisfaction. Postrepair tendon integrity was confirmed by ultrasound. Repairing the CET tear may reduce the risk of iatrogenic posterolateral instability occurring with complete release.

Avoid injuries to the anconeus nerve. A revision of the topographical course (9639)

Mauro Maniglio; Ezequiel Zaidenberg; Ezequiel Martinez; Carlos Zaidenberg

Introduction: The anatomy of the anconeus nerve is clinically important because of the proximity of this nerve to most posterior elbow approaches and the importance of the anconeus muscle as a secondary elbow stabilator. The knowledge of its course is crucial to protect this nerve.

The aim of this study was to take a precise look on the Anconeus nerve, its origin and insertions of the muscular branches and to map the topographical course of this important branch of the radial nerve. We investigated these in detail in reference to clear anatomical landmarks, all of which can be palpated precutaneous with ease.

Methods: We performed an anatomical dissection in 15 fresh frozen elbows specimens. The radial nerve was followed distally until the anconeus nerves start to detach from the radial nerve. This “apparent origin” was recorded in relation to the intercondylar line (ICL). The anconeus nerve was further traced distally up to its entry to the anconeus. A concomitant innervation or nerve branches to the medial head of triceps brachi were visualized and the diameter of the nerve was measured at its apparent origin and in his muscular insertion. The relation between the topographic course of nerve as regard of chosen landmarks (Tip of the olecranon, medial and lateral epicondyly) were assessed.

Results: The Anconeus nerve separated with an initial diameter of 1.5mm (SD: 0.2) from the radial nerve at about 16.4 cm (SD: 1.5cm) proximal to the lateral epicondyle, postero-medial of the humerus. The nerve run between the lateral and the medial head of the triceps, before entering the medial head ad an average of 10.2cm (SD: 2.4 cm) proximal to the intercondylar line (ICL) and running intramuscular until the distal humerus. Exiting the muscle for a short distance, the nerve lies on the periosteum of the distal humerus and the dorso-lateral articular capsule of the elbow joint, before entering the anconeus muscle with an average diameter of 0.5 mm (SD:0.1 mm).

Two different types were found: 8 nerves innervate also the lateral head of the triceps and the other 7 nerves only contribute two branches to his innervation.

Conclusion: Upper extremity surgeons should, be aware of the course of the anconeus nerve, to avoid iatrogenic injuries to the nerve in posterior elbow approaches. We want to underscore the critical passage of the nerve on the peristium and the articular joint capsule, between the medial head of the triceps and the insertion into the anconeus muscle.

1-year Treatment Effects for Rotator Cuff Repair in a Large Single Center Registry (9734)

Laszlo Molnar; Philipp Meyer; Jörg Huber

Introduction: The treatment effect (TE) is a method to measure the outcome for each treatment as number with patient questionnaires. TE = complaint reduction/baseline complaints. 1 is the best outcome and corresponds to a patient without symptoms. A positive score means amelioration, 0 staying unchanged and a negative score worsening. In this study, the TE's for rotator cuff repair were calculated in a large single center registry.

Methods: Included were all consecutive patients with rotator cuff lesions appropriate for arthroscopic rotator cuff repair. Excluded were those with large irreparable cuff lesions, revision, osteoarthritis, and/or polyarthritis. All patients had assessment with Quick Dash (3 questions for symptoms, 8 for impairments) preoperatively, after 3, 6 and 12 months. A physiotherapist measured abduction, external/internal rotation and abduction force.

All patients had primary rotator cuff repair in one clinic by one of two experienced shoulder surgeons and identical follow up treatment.

The treatment effects (TE) were calculated using the Quick Dash score normalized from 0 to 100. The TE’s were divided in five qualitative outcome categories. Complete reduction after intervention: TE > 0.95, >50% complaints reduced: TE > 0.5 to 0.95, <50% reduced TE >0.2 to 0.5. Unchanged TE 0.2 to -0.2 and worse (more complaints > MCID) <-0.2.

Results: From 01/2011 to 12/2018, 621 patients had rotator cuff repair and complete data. Thereof were 254 women (41 %), the average age was 61.3 years (from 23 years to 84 years), and comorbidities (measured in ASA scores) were 26% ASA 1, 61% ASA 2, 13% ASA 3, no ASA 4. The mean Quick Dash score reduced significantly from mean 42.28 (SD 17.8) preop to 8.9 points 12 months postop (SD 12.2) (p <0.001).
TE’s ranged from 1 to -2.31 (mean 0.77; SD 0.44). The five outcome categories were: 37% with complete reduction, 49% with reduction>50%, 8% with reduction <50%, 4% unchanged and 2% worse. 575 patients ( = 94%) responded to treatment. Mean range of abduction ameliorated from 118.0 (SD 41.1) to 149.8 (SD 15.5) degrees and mean abduction force augmented from 2.15 (SD 2.1) to 3.13 kg (SD 1.7); both significant (p <0.05).

Conclusions: Outcome for rotator cuff repair can be measured as treatment effects with a patient questionnaire. 94% of the patients responded to treatment and had reduction of symptoms, regain of ROM and abduction force, only 6% of the patients had no or negative treatment effect.

Prediction Model For Functional Outcome after Repair Using Deep learning Method. A Pilot Study (9744)
Alexandre Lädermann¹; Arnold Andersson; Philippe Collin; Hugo Bothorel; Frank Kolo; Patrick Denard
¹ Hôpital de La Tour
Introduction: The greatest triumph of surgery today...lies in finding ways for avoiding surgery. Artificial intelligence has the potential to guide treatment for orthopedic conditions such as arthroscopic rotator cuff repair (ARCR). The purpose of study was to evaluate the ability of machine learning to predict outcomes of after ARCR based on preoperative and intraoperative data that predict relevant forever. Different algorithms have been refined to build an AI clinical model based on pre- and intraoperative data that predict postoperative SANE scores at one and two years to learn when to operate and twenty years to learn when not to operate.

Methods: 920 ARCRs with minimum 2 year follow up were analyzed from data prospectively collected data in a large database. Patient demographics, preoperative patient reported outcome measures, and intraoperative data were used to predict SANE scores at one and two years postoperative. The database was initially divided into training (89%) and testing (11%) subsets. Then, 20% of the training data was used as a validation set. Machine learning algorithms were used to generate predictive models with a minimum acceptable accuracy of 90%.

Results: Three different model (linear regression, decision tree and neural network) accuracies were 80%, 86% and 97% based on various inputs. The neural network model with patient demographics, age at treatment, Body Mass Index, smoker, diabetics, preoperative ASES scores, tear size, physical score, mental score, hand dominance and tendon retraction had a 97% accuracy for predicting postoperative SANE scores.

Conclusion: It is commonly said in the surgical field that it takes five years to learn when to operate and twenty years to learn when not to. Our study suggests that the second part of this quotation might not be relevant forever. Different algorithms have been refined to build an AI clinical model based on pre- and intraoperative data that predict efficiently rotator cuff outcomes. With an accuracy of 97%, the model is not a simple heuristic; it could be integrated into existing healthcare information systems to help clinicians develop better and more reasonable treatment programs and more adequately inform patients about expected results. Bigger set including objective and radiological data seem however necessary to obtain preoperative safer guidelines, patient’s needs being unique and not simply aligned on SANE improvement thresholds.

Clinical results of dynamic anterior stabilization (DAS) with a minimum two-year follow-up (9745)
Alexandre Lädermann¹; Marko Nabergoj; Sidi Wang; Philippe Collin
¹ Hôpital de La Tour
Introduction: Chronic and recurrent anterior glenohumeral instability is a common pathology that preferentially affects young and athletic adults and usually results in degenerative arthropathy. The purpose of this study is to evaluate the short-term outcomes of the arthroscopic Dynamic Anterior Stabilization (DAS), which is a transfer of the intra-articular portion of the long head biceps through the subscapularis split and fixation on the anterior glenoid, combined with the Bankart repair.

Methods: We performed a retrospective study of 23 consecutive patients with a history of chronic or recurrent shoulder dislocations and a minimum of two-year follow-up. Exclusion criteria were glenoid bone loss more than 20%. Out of 23 patients, one person was lost to follow-up and two people were revisited with Latarjet procedure.

Results: During the study period 20 patients were treated for chronic anterior shoulder instability with arthroscopic Bankart repair and DAS with a minimum follow-up of two years. The average follow-up was 3.3 ± 0.5 years (median; 3; range, 2-3.4-2). There were 9 women and 11 men. Their average age was 31.2 ± 12.6 years (median, 29, range, 18-68). We noticed a statistically significant increase (p <0.001) in Rowe score from preoperative 38.0 ± 15.6 to postoperative 95.5 ± 9.0. At the final follow-up, statistically significant differences were observed in shoulder anterior elevation (p 0.005) compared with the preoperative results. We noticed a trend of increase comparing the preoperative and postoperative external and internal rotation, however the difference was not statistically significant. Four patients presented signs of hyperlaxity, three practiced sport with armed type gestures, two in competition. Three patients presented with a recurrence.

Conclusions: The DAS procedure has been shown to be an effective treatment of chronic anterior shoulder instability with anterior glenoid bone loss smaller than 20%, while avoiding a deficit in shoulder range of motion.

Internal Rotation Hand in the Back After Reverse Shoulder Arthroplasty is Dependent of Subscapularis Tendon Healing, Scapular Tilt and Internal Rotation at 90° of Abduction (9747)
Alexandre Lädermann¹; Philippe Collin
¹ Hôpital de La Tour
Introduction: Recovery after RSA of internal rotation hand in the back (IRI) remains unpredictable. The present study aims to confirm the role of the subscapularis tendon and identify other factors such as scapulothoracic mobility (tilt) and IR at 90° of abduction (IR2). Our hypothesis was that recovery of IR is dependent of multiple factors.

Methods: 87 patients were included. The study focused on 3 predictive factors for IR recovery: subscapularis tendon healing (ultrasound-controlled; no ultrasound was performed when muscle fatty infiltration was ≥3); scapular tilt; IR2 in degrees. The same surgical technique and the same prosthetic was consistently used. The Constant scoring system was used, particularly for IRI (10 points). Recovery of functional IRI was also evaluated by dividing patients into 3 groups: type 1 with hand to buttock, type 2 with possible but unsmooth IRI, type 3 with complete IRI. Statistical analysis (uni- and multivariate) was performed by comparing Type 1 (unsatisfactory IRI) vs Types 2 and 3 (functional IRI).

Results: Subscapularis healing was successful in half cases. Constant score was 74% in patients with healed subscapularis vs 71 in non-healed subscapularis (p <0.05). With a healed subscapularis, IRI was better (7.2 vs 5.1 points, p <0.05) and more patients had types 2 and 3 IRI (p=0.03). An increased IR2 was correlated to better IRI (p <0.0001). With regard to scapular tilt, no significant difference was observed, except when IR2 was <50° (p=0.004). When comparing type 1 and types 2 and 3, multivariate analysis found a highly significant difference (OR=1.10 [IC: 1.06-1.17]; p <0.001) for IR2; a significant difference for subscapularis healing (OR=5.14 [IC: 1.30-16.71]; p=0.002), and a trend towards a significant difference for the tilt (OR=1.16 [IC: 1.03-1.32]; p=0.066). The probability for better functional IRI was multiplied by 1.16 for each additional degree in scapular tilt, by 1.10 for each additional degree of IR in position 2 and by 4.36 in case of subscapularis healing.

Conclusion: Subscapularis healing rate was low. The healing process was significantly associated with the recovery of functional IRI. Scapula tilt and IR2 play an important role and IRI recovery is multifactorial. The present study classified IRI recovery as functional or not functional. These results show that repairing subscapularis could also enhance IRI recovery by acting on the 2 other factors.

Long Head of Biceps Tenotomy in Rotator Cuff Repair: Short term clinical outcomes after 1-year follow-up (9749)
Marko Nabergoj¹; Alexandre Lädermann²; Sidi Wang³; Philippe Collin³
¹ Valdoltra Orthopaedic Hospital; ² Division of Orthopaedics and Trauma Surgery, La Tour Hospital, Meyrin, Switzerland; Department of Orthopaedics and Trauma Surgery, ³ La Tour Hospital, Meyrin, Switzerland; Department of Orthopaedics and Trauma Surgery,
Introduction: The greatest triumph of surgery today...lies in finding ways for avoiding surgery. Artificial intelligence has the potential to guide treatment for orthopedic conditions such as arthroscopic rotator cuff repair (ARCR). The purpose of study was to evaluate the ability of machine learning to predict outcomes of after ARCR based on preoperative and intraoperative data that predict relevant forever. Different algorithms have been refined to build an AI clinical model based on pre- and intraoperative data that predict postoperative SANE scores at one and two years to learn when to operate and twenty years to learn when not to. Our study suggests that the second part of this quotation might not be relevant forever. Different algorithms have been refined to build an AI clinical model based on pre- and intraoperative data that predict efficiently rotator cuff outcomes. With an accuracy of 97%, the model is not a simple heuristic; it could be integrated into existing healthcare information systems to help clinicians develop better and more reasonable treatment programs and more adequately inform patients about expected results. Bigger set including objective and radiological data seem however necessary to obtain preoperative safer guidelines, patient’s needs being unique and not simply aligned on SANE improvement thresholds.

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Methods: We performed a retrospective study of 23 consecutive patients with a history of chronic or recurrent shoulder dislocations and a minimum of two-year follow-up. Exclusion criteria were glenoid bone loss more than 20%. Out of 23 patients, one person was lost to follow-up and two people were revisited with Latarjet procedure.

Results: During the study period 20 patients were treated for chronic anterior shoulder instability with arthroscopic Bankart repair and DAS with a minimum follow-up of two years. The average follow-up was 3.3 ± 0.5 years (median; 3; range, 2-3.4-2). There were 9 women and 11 men. Their average age was 31.2 ± 12.6 years (median, 29, range, 18-68). We noticed a statistically significant increase (p <0.001) in Rowe score from preoperative 38.0 ± 15.6 to postoperative 95.5 ± 9.0. At the final follow-up, statistically significant differences were observed in shoulder anterior elevation (p 0.005) compared with the preoperative results. We noticed a trend of increase comparing the preoperative and postoperative external and internal rotation, however the difference was not statistically significant. Four patients presented signs of hyperlaxity, three practiced sport with armed type gestures, two in competition. Three patients presented with a recurrence.

Conclusions: The DAS procedure has been shown to be an effective treatment of chronic anterior shoulder instability with anterior glenoid bone loss smaller than 20%, while avoiding a deficit in shoulder range of motion.
ANNUAL MEETING SWISS ORTHOPAEDICS, JUNE 24-25, 2021

**Introduction:** The treatment of a pathological long head of biceps (LHB) in conjunction with arthroscopic rotator cuff repair surgery has been a matter of debate. Many favors tenotomy due to the simplicity of the procedure but others prefer tenodesis due to higher complications on performing tenotomy. Our study aims to highlight the outcome of patients undergoing LHB tenotomy in arthroscopic rotator cuff repair surgery focusing on the occurrence of Popeye sign and bicipital cramps. Our hypothesis is that patients who undergo the above procedure will have minimal pain and deformity following surgery with good functional outcomes. **Methods:** A single center non-randomized prospective observational study was performed between May 2015 till June 2017 in all patients undergoing arthroscopic rotator cuff repair surgery. The long head of biceps was assessed on all these patients intra-operatively and those with non-pathological LHB were excluded. Important demographic data including the patient’s body mass index (BMI) and work level were also collected. Postoperatively, patients were observed for the occurrence of Popeye sign and bicipital cramps at 6 months and 1 year follow up. Patients with Popeye sign and bicipital cramps were compared with the ones without and evaluated in terms of pain, shoulder subjective value (SSV) score, and Constant score. **Results:** A total of 208 patients were included in our study with a mean age of 61 and a mean BMI of 27.5. 38 patients developed Popeye sign (18.3%) at 6 months follow up, and it remained the same at 1 year. There was no significant difference in terms of mean VAS, Subjective Shoulder value (SSV) score, and Constant score when compared with the group with no Popeye sign. 50% of patients with Popeye sign were heavy labor workers. Bicipital cramps were observed in 15 patients (7.2%) at 6 months follow up, and it increased to 17 patients (8.2%) at 1 year. The mean SSV score, Constant score and pain score in these patients were significantly higher at 6 months and 1-year follow-up. Majority of patients with bicipital cramps were heavy labor workers (80%). **Conclusion:** Occurrence of Popeye sign and bicipital cramps in patients following LHB tenotomy is fairly low. However, the majority of patients who perform heavy labor work have a higher chance of developing bicipital cramps, which have a poorer functional outcome.

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**Does Computerized CT-based 3D Planning Of The Humeral Head Cut Help To Restore The Anatomy Of The Proximal Humerus After Stemless Total Shoulder Arthroplasty? (9770)**

Florian Grubhofer; Jon JP Warner; Mark D. Price

**BACKGROUND:** Restoration of proximal humeral anatomy (RPHA) after total shoulder arthroplasty (TSA) has been shown to result in better clinical outcomes than is the case in non-anatomical humeral reconstruction. Preoperative virtual planning has mainly focused on glenoid component placement. Such planning also has the potential to improve anatomical positioning of the humeral head by more accurately guiding the contour of the humeral head, and selection of anatomical humeral component size. Hypothesis of the study: The use of preoperative 3D planning helps to reliably achieve RPHA after stemless TSA. **METHODS:** 100 consecutive stemless TSA (67 males, 51 right shoulder, mean age of 62 ± 9.4 years) were radiographically assessed using preoperative planning. The humeral head neck angle (HNA) and humeral head height (HHH) were measured to assess additional geometrical risk factors for poor RPHA. **RESULTS:** The mean distance from the premedior to the implanted head COR was 4.3mm ± 3.1mm. Thirty five shoulders (35%) showed a deviation of less than 3mm (mean 1.9, ±1.1) and 65 shoulders (65%) a deviation of ≥ 3mm (mean 8.0 ± 3.7). Overstuffing was the main reason for poor RPHA (88%). The level of the humeral head cut was responsible for overstuffing in the 46 of the 57 overstuffed cases. The preoperative HHD, HHH and the HNA were significantly larger, higher and more in valgus angulation in the group with accurate compared to the group with poor RPHA (HHD of 61.1mm ±4.4 vs 55.9 ±6.6, p <0.001; HHH 8.6±2.2 vs 7.6 ± 2.6 p=0.026, varus angulation of 134.7° ± 6.4° vs. 131.0° ±7.91, p=0.10). **CONCLUSION:** Restoration of proximal humeral anatomy after stemless TSA using CT-based 3D planning was not precise. A poorly performed humeral head cut was the main reason for overstuffing which was seen in 88% of the cases with inaccurate RPHA. Preoperative small HHD, low HHH and varus angulated HNA are risk factors for poor RPHA after stemless TSA.

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**Speed of Recovery of the Most Common Performed Shoulder Surgeries (9771)**

Florian Grubhofer; Lukas Ernstmbrunner; Jon JP Warner

**BACKGROUND:** Shoulder surgery results in several months of rehabilitation, which is often underestimated by patients preoperatively. Currently, there is little written about this process of recovery. Such information would help patients to anticipate the trajectory of their recovery. This would also provide a reference point allowing surgeons to compare patient’s progress in their recovery. The purpose of our study was to analyze and document the expected rate of recovery for the most common shoulder operations. **METHODS:** A retrospective analysis of all patients who underwent Total Shoulder Arthroplasty (TSA), Reverse Total Shoulder Arthroplasty (RTSA), Arthroscopic Rotator Cuff Repair (ARCR) and arthroscopic Biceps Tenodesis (BT) using our prospectively collected data from our surgical outcome system (SOS) registry was performed. All patients included had a complete 2 year follow up data set. The pain score (VAS) was measured preoperatively, at 2, 6, 12 weeks and 6, 12, 24 months. The ASES and SANE score were recorded preoperatively, after 6, 12 and 24 months. The speed of recovery, which was defined as percentage of the total improvement, for each procedure was assessed as the primary outcome parameter at all time points. **RESULTS:** All shoulder interventions resulted in significant improvement of the pain, SANE and ASES score two years after shoulder surgery. The speed of recovery of all three scores was highest after TSA at all measured time points and slowest after ARCR and BT. Measured by the pain score, 90% and 82% of the total improvement after TSA and RTSA was completed after 6 weeks compared to 58% respectively 59% after ARCR and BT. Six months postoperative the ASES recovery rate was significantly higher after arthroplasty (TSA 96% and 85%) compared to ARCR and BT (76% and 77%). The SANE score recovery rate was between 82% and 92% (TSA 92%, RTS1 89%, ARCR 87%, BT 82%) 6 months after surgery. After 1 year all patients group reached 89% or more percent of total improvement in all scores, except of the pain after ARCR (89%). **CONCLUSION:** The speed of early recovery is fastest after TSA and slowest after arthroscopic rotator cuff repair and biceps tenodesis. After TSA and RTS1, >80% of the total pain reduction is achieved 6 weeks postoperatively, whereas after ARCR and BT, >80% of the pain reduction is achieved only 6 months postoperatively. At 6 months postoperatively, the differences in recovery curves are small and hardly noticeable at 12 months.

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**Mid-Term Results of Arthroscopically-Assisted Latissimus Dorsi Transfer for Irreparable Posterosuperior Rotator Cuff Tears (9776)**

Manuel Waltenspül; Benedikt Joehum; Lukas Filli; Lukas Ernstmbrunner; Karl Wieser; Dominik Meyer; Christian Gerber

**Introduction:** With the progress in arthroscopic surgery, latissimus dorsi transfer (LDT) for irreparable posterosuperior rotator cuff tears (RCTs)
Despite their advanced age and the typical numerous co-
morbidities, this patient population over 85 years of age showed a dis-
tinct clinical improvement for their daily activities with high rates of pa-
tient satisfaction. Radiographical analysis identified stable results 2 years after surgery.

**Muscle edema of retraction and pseudofatty infiltration after traumatic rotator cuff tears (9792)**

SiDi Wang¹; Frank Kolo; Joe Chiu; Marko Nabergoj; Von Rechenberg Brigitte; Alexandre Lädermann²

¹ Hôpital de la Tour Meyrin; ² Hôpital de la Tour

**Introduction:** Traumatic rotator’s cuff’s tear leads to retraction, which can be visualized on MRI. Additionally, it could also result in edematous lesions of the cuff’s muscles and pseudo fatty infiltration (FI), which further evolution through time has not been described in the current literature. The aim of this study was 1) to confirm the existence of a new type of edema of retraction, 2) to reveal a related potential pseudoFI, and 3) to describe the timeline of development of rotator cuff muscle edema.

**Methods:** We conducted in parallel two studies: a basic science study on 14 sheep to confirm the existence of muscle edema and pseudoFI and a retrospective study of 62 prospectively identified human with a traumatic rotator cuff tear associated to muscle edema. Our cohort consisted of 49 men (79%) and 13 women (21%) with an average age of 65 years. The average time gap between the trauma and the MRI was 46 days.

**Results:** First, the animal study confirmed that traumatic edema of retraction exists and can be mixed up with FI on T1 sequences. Second, we observed on human MRI that 52 patients (87%) had supraspinatus (SS) retraction; 6 (12%) had a stage 1, 25 (48%) stage 2 and 21 (40%) stage 3 retraction. Infraspinatus (IS) retraction has been observed in 33 patients (50%); 5 (15.2%) had stage 1, 16 (48.5%) stage 2 and 12 (36.4%) stage 3 retraction. Subscapularis (SSc) edema has been seen in 49 patients (79%), 30 patients (61%) had peripheral edema, 5 (10%) musculotendinous edema, 11 (22%) muscle body edema and 3 (6%) had a global SSc edema. Comparison between T1 and T2 FS/DIXON sequences of the MRI showed in 54 patients (87%) hypersignal which could be either FI or pseudo FI of the muscle. A positive tangent sign has been observed in only one patient (2%).

**Conclusion:** This study revealed a new type of edema of retraction that can appear already after few hours following a trauma. This edema has different characteristics, delay and location compared to edema of retraction. Such edema could theoretically explain muscle fibers dissec-
tions as well as rapid development of FI observed after trauma. This edema is associated with hypersignal on T1 sequences that can be mistaken with FI. All these findings are important regarding diagnosis, treatment and have legal implication notably to defend patients against insur-
ances.

**BiPOD Arthroscopically Assisted Bidirectional Stabilisation Technique for Acromioclavicular Joint Injury: Two-Year Clinical and Radiological Outcomes (9816)**

Benedikt Ambüh¹; Richard James Murphy²; Michael Schär³; Johannes Wehns¹; Beat Kaspar Moor⁴; Matthias Zumstein⁵

¹ Inselspital Bern; ² Orthopädie Sonnenhof; ³ Hôpital du Valais

**Introduction:** Reverse shoulder arthroplasty (RSA) has been on the rise in the past decades and showed excellent long-term outcomes. The indica-
tions for RSA were successively extended to a broader age spectrum. The objective of this study was to identify the benefits of RSA in the elderly population with a considerable comorbid-
ity burden and an affiliated higher perioperative risk.

**Methods:** In this observational study, based on our local RSA registry, we identified 42 patients (73.8% females) with a minimum age of 85 years (age range 85-91 years) at time of surgery and a completed post-
operative follow-up at 2 years. Clinical evaluation consisted of pain, Sub-
jective Shoulder Value (SSV), Constant Score (CS), Shoulder Pain and Disability Index (SPADI) and patient satisfaction. Radiographic evaluation followed the international consensus core-set. Pre-existing medical con-
ditions were categorized following the American Society of Anesthesiolo-
gists (ASA)-categories: ASA II (23.8%) with minor and ASA III (76.2%) with major co-morbidities. Indications for surgery were rotator cuff defi-
ciency in 78.6%, post-traumatic conditions in 16.7% and primary arthro-
sitis in 4.8% of the cases.

**Results:** All postoperative clinical evaluations showed a significant improve-
ment 2 years after RSA implantation. Pain [0-10] decreased from 6.1 (SD 2.4) to 2.0 (SD 2.7) (p < 0.001). Clinical scores improved likewise: CS from 33.6 (SD 2.4) to 80.9 points (SD 13.6), SSV from 36.3% (SD 19.7) to 67.4% (SD 25.9) and SPADI from 28.7 (SD 19.5) auf 71.2 points (SD 19.5) (p < 0.001). 87.5% of patients stated to opt in favor of the surgery again, judging by their personal outcome. On a scale from 0 - 10, patients rated their satisfaction considering their preoper-
ative expectations and their actual result with a mean of 8.3 points (SD 2.8). Radiographic evaluation showed no signs of early loosening, migra-
tion or dislocation after 2 years. Two periprosthetic spina scapulare frac-
tures were identified and treated non-operatively.

**Conclusion:** Despite their advanced age and the typical numerous co-
morbidities, this patient population over 85 years of age showed a dis-
tinct clinical improvement for their daily activities with high rates of pa-
tient satisfaction. Radiographical analysis identified stable results 2 years after surgery.

Is it worth the risk? Clinical and radiographic outcomes 2 years after implantation of reverse shoulder arthroplasty in an advanced geriatric population (9780)

David Endell¹; Alexandra Grob²; Markus Scheibel³; Alex Marzel³

¹ Schulthess Klinik Zürich; ² Triemli Spital Zürich; ³ Research and Development Department, Shoulder and Elbow Surgery, Schulthess Klinik Zürich

**Introduction:** Reverse shoulder arthroplasty (RSA) has been on the rise in the past decades and showed excellent long-term outcomes. The indica-
tions for RSA were successively extended to a broader age spectrum. The objective of this study was to identify the benefits of RSA surgery in an advanced geriatric population with a considerable comor-
bitity burden and an affiliated higher perioperative risk.

**Methods:** In this observational study, based on our local RSA registry, we identified 42 patients (73.8% females) with a minimum age of 85 years (age range 85-91 years) at time of surgery and a completed post-
operative follow-up at 2 years. Clinical evaluation consisted of pain, Sub-
jective Shoulder Value (SSV), Constant Score (CS), Shoulder Pain and Disability Index (SPADI) and patient satisfaction. Radiographic evaluation followed the international consensus core-set. Pre-existing medical con-
ditions were categorized following the American Society of Anesthesiolo-
gists (ASA)-categories: ASA II (23.8%) with minor and ASA III (76.2%) with major co-morbidities. Indications for surgery were rotator cuff defi-
ciency in 78.6%, post-traumatic conditions in 16.7% and primary arthro-
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**Results:** All postoperative clinical evaluations showed a significant improve-
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morbidities, this patient population over 85 years of age showed a dis-
tinct clinical improvement for their daily activities with high rates of pa-
tient satisfaction. Radiographical analysis identified stable results 2 years after surgery.
Results: Mean follow-up was 26 months (range, 24–34). Clinical outcomes scores demonstrated extremely good two-year results: relative Constant score, 97.9/100; ACJ Index, 89.4/100; Subjective Shoulder Value, 92.4/100 and Taft Score 11.1/12. Final CC difference compared to the contralateral side showed a mean of 0.7 mm (SD +/-1.8 mm) at two years. Complication rate was 9%.

Conclusion: The BiP0D technique shows excellent intermediate-term results and low complication rate. We recommend use of this technique for stabilisation of all acute, unstable ACJ injuries.

Is Routine Shoulder Magnetic Resonance Imaging Necessary for the Diagnosis of Adhesive Capsulitis of the Shoulder? (9829)
Dimitris Dimitriou; Elin Winkler; Christoph Zindel-Geisseler; Karl Wieser; Florian Grubhofer; Samy Bouaicha
Universitätsklinik Balgrist

Introduction: Adhesive capsulitis (AC) of the shoulder is a debilitating condition with a high socioeconomic burden affecting up to 5% of the general population[1, 2]. The diagnosis of AC might be challenging, as it is a diagnosis of exclusion, and it is based mainly on the clinical examination[3]. Although shoulder MRI is commonly performed in patients with AC, the cost-effectiveness of MRI in AC diagnosis is not yet justified. Therefore, the purpose of the present study was to report the validity of MRI in terms of identifying an additional shoulder pathology in AC patients not previously recognized in the clinical examination and any change in the treatment based on the MRI findings.

Materials and Methods: The medical records of all the patients presented in our outpatient clinic with a diagnosis of AC from January 2017 to December 2017 were retrospectively reviewed. Patient demographics, the number of patients with a shoulder MRI, the diagnosis on the first medical report, changes in the diagnosis or identification of other shoulder pathologies following the shoulder MRI (if performed), and changes in the suggested treatment plan (physiotherapy, intraarticular shoulder injection, NSAR) were recorded.

Results: A total of 325 patients diagnosed with an AC (Male: 159, Female: 166) and an average age of 50±10 (range: 18 to 81) years were included. In 211/325 patients (65%), a shoulder MRI was performed. The diagnosis of AC changed in 0/325 (0%) patients, whereas additional shoulder pathologies were identified in 33/325 (10%) patients, following the shoulder MRI, mostly rotator cuff tears (partial:20/33 (61%), transmural: 9/33 (27%), re-rupture following reconstruction: 3/33 (9%) and labrum tear:1/33 (3%). No change in the suggested treatment plan was observed, and no surgery was performed to address the other shoulder pathologies at the minimum follow-up of 2 years. The total cost of the MRIs performed in the patients with AC was 253.200 CHF in 2017 in our institution.

Conclusions: The present study results suggest that the lack of cost-effectiveness of MRI in the diagnosis of the AC does not justify routine magnet resonance imaging should therefore only be considered based on clinical suspicion of additional shoulder pathologies.

Structural Musculotendinous Parameters Predicting Failed Tendon Healing after Rotator Cuff Repair (9844)
Maurits G. L. Olthof¹; Martin Flück²; Paul Borbas³; Paola Valdivieso⁴; Marco Toigo⁵; Fabian Egli⁶; Jethin Joshy⁷; Lukas Filli⁸; Jussi Smedereker⁹; Christian Gerber¹; Karl Wieser¹
¹ Balgrist University Hospital, University of Zurich; ² University of Zurich, Balgrist Campus; ³ Department of Orthopaedics, Balgrist University Hospital, University of Zurich; ⁴ University of Zurich, Balgrist; ⁵ Balgrist Hospital, University of Zurich; ⁶ Balgrist University Hospital; ⁷ Balgrist Hospital, University of Zurich, Department of Orthopaedics

Background: Healing of the rotator cuff after repair constitutes a major clinical challenge with reported high failure rates (13-94%). Identifying structural musculotendinous predictors for unrepaired rotator cuff repair could enable improved diagnosis and management of patients with rotator cuff disruption.

Purpose: To investigate structural predictors of the musculotendinous unit for failed tendon healing after rotator cuff repair.

Results: Mean follow-up was 26 months (range, 24–34). Clinical outcomes scores demonstrated extremely good two-year results: relative Constant score, 97.9/100; ACJ Index, 89.4/100; Subjective Shoulder Value, 92.4/100 and Taft Score 11.1/12. Final CC difference compared to the contralateral side showed a mean of 0.7 mm (SD +/-1.8 mm) at two years. Complication rate was 9%.

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Conclusion: The BiP0D technique shows excellent intermediate-term results and low complication rate. We recommend use of this technique for stabilisation of all acute, unstable ACJ injuries.
Conclusion: The biomechanical analysis may provide an explanation why patients with MRCT type B and E experience a high incidence of pseudoparalyse. Besides, the significant increase in teres minor activity for patients with an MRCT type D accords well with previous observations of teres minor hypertrophy.

Uncemented vs. cemented reverse total shoulder arthroplasty for primary treatment of proximal humerus fractures in elderly – A case-control study (9859)

Manuel Kramer; Bernhard Jost; Melanie Manser; Martin Olach; Vilijam Zdravkovic; Christian Sross
Kantonsospital Sankt Gallen

Introduction: We started uncemented RTSA for primary treatment of PHF in elderly patients in 2017 to simplify primary and eventual revision surgery. However, recent reports raised concerns about early bone resorption at the proximal humerus. Thus, it was the aim of this study to find whether there was a difference in functional or radiographic outcomes between cemented and uncemented RTSA in such patients.

Methods: In 2017 and 2018, 17 consecutive patients underwent uncemented RTSA (group nC) for the primary treatment of a PHF and completed clinical and radiographic follow-up at 2 years. For case-control comparison, we could include 34 age and sex matched (propensity score matching 1:2) patients who underwent cemented RTSA for the same indication between 2011 – 2016, and had completed 2-years follow-up examination as well (group C). The two groups were compared in terms of clinical (Constant score) and radiographic (greater tuberosity healing, implant loosening, bone resorption) outcome at 2 years after the index procedure.

Results: Group nC included 12 female and 5 male (mean age 74.1 (58.0 – 88.8)) and group C 30 female and 4 male (mean age 74.5 (64.1 – 85.8)). The mean deltoid tuberosity index (DTI) was 1.41 (1.20 – 1.70) in group nC and 1.42 (1.21-1.73) in group C. At final 2 year follow-up, the relative Constant score was 98% (71 – 118) in group nC and 97% (36 – 125) in group C (p = 0.85). The greater tuberosity healed in anatomic position in 77% in group nC and in 79% in group C (p = 1.0). No sign of loosening was seen in group nC whereas 8 (24%) patients in group C had some radiolucent lines at the cement-bone interface of the humeral site (p = 0.58). On the other hand, all but one patient in group nC showed at least grade 1 (50% grade 3) bone resorption at the proximal humerus (p <0.001). The complication and revision rate was low in both groups. One patient in group nC and 2 patients in group C needed revision surgery.

Conclusion: Uncemented and cemented RTSA for PHF in elderly osteoporotic patients lead to excellent functional results with low complication and revision rate after 2 years. Bone resorption at the proximal humerus after uncemented RTSA was frequent and not clinically relevant, but may complicate future revision surgery. This effect has been described as “stress shielding” analogous to the hip but is not yet fully understood at the proximal humerus. Longer follow-up is needed to understand the relevance of this radiographic phenomenon.

Conservative treatment of Rockwood type III acromioclavicular joint dislocation with two different types of braces: a comparative prospective randomized trial (9894)

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¹ Bürgerspital Solothurn; ² Universitätsspital Basel; ³ Balgrist

Introduction: Management of acromioclavicular joint dislocations (ACJD) is discussed controversially with low-grade injuries (Rockwood I-II) commonly treated conservative and high-grade (Rockwood IV-VI) operatively, but there is an ongoing debate about the treatment of Rockwood III injuries, with non-operative treatment being favoured in recent literature. The aim of this study is to compare clinical and radiological outcomes of non-operative treatment with a brace, which elicits a direct reduction force to the lateral clavicle, to a sling. We hypothesised the brace might yield in better ACJ reduction and cosmesis.

Methods: In this dual centre prospective randomised controlled trial, all patients sustaining a ACJD Rockwood III between July 2017 and August 2020 were included. Patients with previous ipsi- or contralateral ACJ injury or surgery were excluded. Randomisation occurred in the emergency department to either the sling or the brace group. Patients were followed up at 1, 6 and 12 weeks. Patient reported outcome measurements included subjective shoulder value (SSV) and American Shoulder and Elbow score (ASES) at each follow-up and Constant score at 6 and 12 weeks. Vertical lateral clavicle displacement was assessed on bilateral panoramic anteroposterior radiographs using coracoclavicular (CC) distance to calculate the CC-index.

Results: 35 consecutive patients were included across the two sites, 18 (all male) in the brace and 17 (14 male) in the sling group. Baseline characteristics did not differ significantly between groups, average age was 40 years and BMI 25.5 kg/m². Analysis revealed no statistical difference in CC-index between groups at time of injury, 6 weeks and 12 weeks post-injury (p=0.39, p=0.11 and p=0.21). SSV improved from 30 and 35 post-injury to 81 and 84 at 12 weeks in the sling and brace group, respectively (p=0.59). ASES improved from 48 and 38 to 82 and 83, respectively (p=0.84). Similarly, Constant score improved from 64 and 67 to 82 and 81, respectively (p=0.90). One patient in the brace group underwent ACJ stabilisation with hamstring autograft at four months due to persistent pain.

Conclusion: This randomised controlled trial showed no statistically significant difference between the brace and sling group in clinical (SSV, ASES, Constant Score) or radiological (CC-index) outcomes after conservative treatment of Rockwood III injuries.
Lengthening of the clavicle, a new technique in patients with a brachial plexus birth palsy. (9897)
Stijn de Jooede¹; Martijn Schotanus²; Lodewijk van Rhijn³; Steven Samijn²
¹ Spital Grabs, Switzerland; ² Zuyderland Medical Center; ³ Maastricht University Medical Center

Introduction: Brachial plexus birth palsy (BPBP) can lead to an imbalance of shoulder musculature with glenohumeral contractures and osseous deformities. Besides hypoplasia of the scapula and shortening of the clavicle, also protraction, lateralization and elevation of the scapula can be observed. As a consequence, the Trapezius, Levator Scapulae and Supraspinatus muscles are overloaded which can lead to pain. It is hypothesized that lengthening of the clavicle, may reposition the scapula to the best approached anatomical position. This study presents the initial results of this technique in BPBP patients.

Methods: 8 patients (median age 19.5 years) were included and underwent a 2-lengthening osteotomy of the clavicle of the affected shoulder. Preoperatively the osseous deformities were confirmed with a CT-scan. PROMs, DASH-Scores and Mallet-Scores and Range of Motion (ROM) were evaluated pre- and postoperatively.

(Preliminary) Results: After 3.5 years follow-up, all patients were satisfied with the result and would undergo the operation again. The median VAS for satisfaction was 9.0 (range 7 – 10). Pain reduced to a median NRS of 1.5 (range 0 – 5). However, shoulder function, measured by Mallet-Scores, DASH-Scores and ROM did not improve.

Conclusion: Short term results show that, in BPBP patients with a mal-position of the scapula, lengthening of the clavicle is a promising technique to reduce pain based on overloading, without affecting shoulder function.

Augmented Reality through Head-Mounted Display for Navigation of baseplate component placement in Reverse Total Shoulder Arthroplasty – a cadaveric study (9900)
Philipp Kriechling¹; Marios Loucas¹; Rafael Loucas¹; Philipp Fünnstahl²; Fabio Casari¹; Karl Wieser¹
¹ Balgrist Universitätsklinik; ² Balgrist Campus AG

Background: To achieve optimal clinical outcome in Reverse Total Shoulder Arthroplasty (RTSA), accurate placement of the components is essential. The recently introduced navigation technology of augmented reality (AR) through head-mounted displays (HMD) offers a promising new approach to visualize the anatomy and navigate component positioning in a variety of orthopedic surgeries. We hypothesized that AR trough HMD is feasible, reliable, and accurate for guidewire placement in RSA baseplate positioning.

Methods: Twelve human cadaver shoulders were scanned with computed tomography (CT) and RTSA baseplate positioning was 3-D planned using dedicated software. The shoulders were prepared through a deltopectoral approach and an augmented reality hologram was superimposed using dedicated software. The shoulders were CT-scanned a second time and the deviation from the planning was calculated.

Results: The mean deviation of the entry point was 3.5 mm ± 1.7 mm (95% CI 2.4 mm; 4.6 mm). The mean deviation of the planned trajectory was 3.8° ± 1.7° (95% CI 2.6°; 4.9°).

Conclusion: Augmented reality seems to be feasible and reliable for baseplate guidewire positioning in reverse total shoulder arthroplasty. The achieved values were accurate.

Keywords: Reverse Total Shoulder Arthroplasty; Augmented Reality; Head-Mounted Display; Navigation; Experimental; Cadaveric; Orthopedic Surgery

Complications and Reinterventions in Reverse Total Shoulder Arthroplasty: Report of 854 primary cases. (9901)
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Balgrist Universitätsklinik

Introduction: Complications and reinterventions following reverse total shoulder arthroplasty (RTSA) impair life quality for the patient. The aim of this study was to report the incidence of implant-related complications and reintervention surgeries in our prospectively followed cohort of primary reverse total shoulder arthroplasties.

Methods: The prospectively collected clinical and radiographic data of 854 patients with primary implantation of a RTSA between January 2005 and August 2018 were analyzed. The complication and reintervention rates were evaluated. Complications, contrary to problems, were defined to affect the outcome negatively. Reinterventions are defined as all necessary surgeries, which include reoperations (without component change) and partial or total revision of the implants.

Results: A total postoperative, surgical-site complication rate of 22% (188 complications) in 18% (156 out of 854) of the shoulders was documented. The most common complications were acromial fractures (5.3%), glenoid loosening or dislocations (4.3%), RTSA instability (2.7%), humeral fracture or loosening (2.5%), and periprosthetic infection (1.6%). 135 reinterventions were performed in 82 shoulders (10%). The most common causes for reintervention were glenoidical complications (24%), instability (15%), acromial fractures (14%), unclear pain / scarring (14%), and infection (8%).

Conclusion: Although indication and implantation rates are continuously increasing, RTSA remains a high demanding surgical procedure. Roughly 1 out of 5 patients undergoing RTSA might face a complication and 1 out of 10 will need an reintervention.

Hemiarthroplasty as a salvage treatment for failed reverse total shoulder arthroplasty (9902)
Philipp Kriechling; Octavian Andronic; Karl Wieser
Balgrist Universitätsklinik

Background: The implantation rates of reverse total shoulder arthroplasties (RTSAs) are increasing worldwide, as are the associated complications and revisions. This requires the discussion of salvage therapies for nonrevocable arthroplasties. Revision to hemiarthroplasty may offer a valid fallback option in certain cases. The aim of this study was to analyze the incidence, indications and clinical outcomes, especially the reduction in pain levels.

Methods: A total of 1227 RTSA implantations between January 2005 and December 2018 with a minimum follow-up of 2 years were queried for revision to hemiarthroplasty before December 2019. The main indications for revision were complications related to the glenoid component (13/21), scapula spine fracture (3/21), instability (2/21), and infection (2/21). There was significant improvement in pain from 7±3 to 11±4 CMS points (15 months). The mean follow-up durations were 37±29 months (range, 12-123 months) following revision to hemiarthroplasty and 56±33 months (range, 24-124 months) after primary RTSA. The main indications for revision were complications related to the glenoid component (13/21), instability (2/21), and infection (2/21). There was significant improvement in pain from 7±3 to 11±4 CMS points (15 best, p=0.03) but not in CMS (absolute 31±11 vs. 29±16 points, relative 38±15% vs. 38±20%) or SSV (31±20% vs 30±18%). The mean postoperative forward flexion and abduction were 50±25° and 45±22°, respectively.

Conclusion: Failed RTSA not feasible to retain is a burdensome complication. Conversion to hemiarthroplasty is a fallback treatment option for reducing patient pain levels at least to a certain degree.
Shoulder kinematics after anatomical total shoulder arthroplasty. Can scapular rhythm be restored to normal pattern in comparison to a healthy reference group? (9906)

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Introduction: Anatomical total shoulder arthroplasty is a common surgical procedure for the treatment of glenohumeral arthritis. Nevertheless little is known about the kinematics following this surgical procedure. Arm elevation in scapular plane is a coordinated motion in glenohumeral and scapulothoracic joints. We hypothesized that the normal (native) shoulder motion pattern can be restored after anatomical total shoulder arthroplasty.

Methods: We compared arm elevation in the scapular plane of 20 shoulders after anatomical total shoulder arthroplasty (TSA, 15 patients, minimum of 2 year follow up) and 40 shoulders of young adult volunteers (20 participants, no shoulder pathology). We used Vicom three-dimensional motion analysis system with high-speed infrared cameras and skin markers. Glenohumeral and scapulothoracic kinematics were studied using the Upper Limb Evaluation in Movement Assessment (ULEMA) model. Data analysis was performed with Metlab and R.

Results: Mean age of the surgical group was 66 years (10 females, 5 males) whereas mean age of the healthy volunteers was 27 years (7 females, 13 males). All patients with TSA had a normal shoulder range of motion and were very satisfied or satisfied with the result. After surgery we could show an altered motion pattern especially in the first 50 degrees of elevation. In the first 20 degrees of elevation, the scapula performed medial rotation (countermotion to executed arm elevation). This is compensated with increased motion in the glenohumeral joint. Above 70 degrees of elevation the motion pattern is comparable between the two groups.

Conclusion: The shoulder kinematics during lateral arm elevation is not restored to normal pattern at 2 year follow up after anatomical total shoulder arthroplasty. In comparison to the kinematics of healthy adults, the most important difference is visible during the first 20 degrees of elevation. Therefore postoperative physical therapy should focus on stabilization exercises of the scapula and strategies to initiate movement of the arm.

Sling vs Brace after Surgery for Supraspinatus Tears: A Randomized Controlled Trial. (9914)

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Introduction: After a surgical treatment of the supraspinatus tendon lesions, the rehabilitation protocol can include the use of braces that keep the limb in an established position (commonly at 15 ° or 30 ° of abduction) or a support mitella, less voluminous and with a lower limitation in terms of movements of the articulation.

Methods: 110 patients treated surgically for a lesion of the rotator cuff are enrolled and randomly assigned to use an ultrasling brace positioned at 15 ° in abduction for 6 weeks or to use a mitella for 2 weeks. Patients are re-evaluated at 6 weeks, 3 months, and 6 months with clinical questionnaires, a physical examination and, only at the 6-month visit, with a magnetic resonance imaging.

Results: Fifty-nine patients (30 brace, 29 mitella) have completed 6-month follow-up. There were no statistically significant differences in terms of improvement in the DASH score, Constant score, and VAS 0-10 for pain at any of the 3 follow-ups (6 weeks, 3 months, 6 months). At the 6th month of follow-up, clinical positivity was found in at least one of the diagnostic tests for rotator cuff lesions, in 7 out of 30 patients in the group assigned to the brace and in 6 out of 29 patients in the group assigned to the mitella, with no significant difference between the groups.

Conclusions: The use of mitella and the use of 15 ° abduction brace show both satisfactory clinical recovery, with no difference in clinical results after the surgery for the lesion of the supraspinatus tendon.

Similar scapular morphology in patients with dynamic and static posterior shoulder instability (9928)

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Background: There is evidence that specific variants of scapular morphology are associated with dynamic and static posterior shoulder instability. To this date, observations regarding glenoid and/or acromial variants were analyzed independently, with two-dimensional imaging or without comparison with a healthy control group. Therefore, the purpose of this study was to analyze and describe the three-dimensional (3D) shape of the scapula in healthy and in shoulders with static or dynamic posterior instability using 3D surface models and 3D measurement methods.

Methods: In this study, 30 patients with unidirectional posterior instability and 20 patients with static posterior humeral head subluxation (static posterior instability, Walch B1) were analyzed. Both cohorts were compared with a control group of 40 patients with stable, centered shoulders and without any clinical symptoms. 3D surface models were obtained through segmentation of computed tomography images and 3D measurements were performed for glenoid (version and inclination) and acromion (tilt, coverage, height).

Results: Overall, the scapulae of patients with dynamic and static instability differed only marginally among themselves. Compared with the control group, the glenoid was 2.5° (P = .032), respectively, 5.7° (P = .001) more retroverted and 2.9° (P = .025), respectively, 3.7° (P = .014) more downward tilted in dynamic, respectively, static instability. The acromial roof of dynamic instability was significantly higher and on average 6.2° (P = .007) less posterior covering with an increased posterior acromial height of +4.8mm (P = .001). The acromial roof of static instability was on average 4.8° (P = .041) more externally rotated (axial tilt), 7.3° (P = .004) flatter (sagittal tilt), 8.3° (P = .001) less posterior covered with an increased posterior acromial height of +5.8 mm (0.001).

Conclusion: The scapula of shoulders with dynamic and static posterior instability is characterized by an increased glenoid retroversion and an acromion that is shorter posterolaterally, higher, and more horizontal in the sagittal plane. All these deviations from the normal scapula values were more pronounced in static posterior instability.

Impact of 30 years high-level rock climbing on the shoulder – an MRI study of 31 climbers (9929)

Silvan Beeler¹; Torsten Pastor; Benjamin Fritz; Lukas Filli; Andreas Schweizer; Karl Wieser

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Background: Rock climbers are particularly susceptible to shoulder injuries due to repetitive upper-limb movements on vertical or overhanging terrain. However, the long-term effects of prolonged climbing on the shoulder joints are still unknown.

Purpose: The purpose of this study was to analyze the prevalence of pain and degenerative changes in the shoulder joints after high-level rock climbing over at least 25 years. We hypothesized that specific climber-associated patterns of degeneration would be found.

Methods: Thirty-one adult male high-level rock climbers were compared to an age- and sex-matched control group of 31 nonclimbers. All participants underwent a detailed interview, standardized clinical examination, and bilateral (climbers) or unilateral (nonclimbers, dominant side) magnetic resonance imaging (MRI) scans. Clinical and MRI findings of the groups were compared.

Results: The lifetime prevalence of shoulder pain in the rock climbers was 77%. The rock climbers had significantly more abnormalities in the labrum (82% vs. 52%; p = 0.002), long biceps tendon (53% vs. 23%; p = 0.006), and cartilage (28% vs. 3%; p = 0.005). These increased changes positively correlated with climbing intensity. There were no differences between the two groups with respect to rotator cuff tendon pathology (68% vs. 58%; p = 0.331) and acromioclavicular (AC) joint degeneration (88% vs. 90%; p = 0.713). Despite the increased degenera-
Prolonged high-level rock climbing leads to a high prevalence of shoulder pain and increased degenerative changes to the labrum, long biceps tendon, and cartilage. However, it is not related to any restriction in shoulder function.

**Conclusions:** Prolonged high-level rock climbing leads to a high prevalence of shoulder pain and increases degenerative changes to the labrum, long biceps tendon, and cartilage. However, this is not related to any restriction in shoulder function.

**Posterior stability of the shoulder depends on acromial anatomy! A biomechanical proof of concept study (9950)**

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**BACKGROUND:** Static posterior glenohumeral subluxation leads to eccentric osteoarthritides (OA). Current surgical treatment correcting glenoid retroversion neither durably corrects posterior subluxation nor prevents progression of OA into Walch type B glenoids. As type B scapulae are characterized by a higher and horizontally oriented acromion we set out to test the hypothesis that the normal acromion is as a restraint for posterior humeral head translation and that restoration of normal anatomy of the acromion in a typical B1 scapula counteracts posterior translation and dislocation.

**METHODS:** Six 3-D printed scapular models were tested in a biomechanical shoulder simulator: (1) a statistical shape model (SSM) of the “normal” scapula, (2) an average scapula with a B1 glenoid, (3) scapula with a B1 glenoid after correction of glenoid orientation, (4) scapula with a B1 glenoid after correction of acromion orientation, (5) scapula with a B1 glenoid after correction of glenoid and acromion orientation, (6) a model of a shoulder with dynamic posterior shoulder instability with normal glenoid version of 0° but a highly pathological acromion. Tests provoking posterior subluxation were conducted in 35°, 60° and 75° of glenohumeral flexion: With the joint axially loaded (100N) and the humerus stabilized, a controlled anterior translation force was applied to the scapula. The test was stopped when either a force of 40N (acromion contact) was reached or at posterior dislocation. Translation (mm) between start and end point was measured. Pressure sensors documented acromion contact and the path of the humeral head on glenoid and acromion.

**RESULTS:** In 35° flexion, none of the shoulders except for the dynamic model dislocated. The “B1”, “B1 Acromion Correction” and “dynamic” model, however showed substantially increased posterior translation upon standardized loading (p <.001). In 60° flexion, only the “SSM” and “B1 Acromion + Glenoid Correction” did not dislocate. In 75° flexion all models dislocated.

**CONCLUSIONS:** Upon controlled, experimental posterior glenohumeral subluxation, normal acromial anatomy substantially decreases posterior translation and compulsory acromio-humeral contact prevents posterior dislocation. In 60° of glenohumeral flexion (90° of global flexion) stability can only be achieved if glenoid and acromial anatomy are restored to normal. Correction of excessive glenoid retroversion alone does not prevent abnormal posterior translation or dislocation.

**Factors Influencing Functional Internal Rotation after Reverse Total Shoulder Arthroplasty (9951)**

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**BACKGROUND:** Functional internal rotation (fIR) of the shoulder is frequently limited after reverse shoulder arthroplasty (RTSA). The objective of this study was to study a cohort of satisfied patients after RTSA who had comparable active mobility except for fIR and to identify factors associated with selective loss of fIR.

**METHODS:** A retrospective cohort study was conducted to compare two patient groups with either poor (≤ 2 points in the Constant-Murley score (CS)) or excellent (≥ 8 points in CS) fIR after RTSA at a minimum follow-up of 2 years. Influencing factors (demographic, surgical or implant related, radiographic parameters) and clinical outcome were analyzed.

**RESULTS:** 52 patients with a mean age of 72.8 (±9.3) and a mean follow-up of 41 months were included in the IR ≤ 2 group and 63 patients with a mean age of 72.1 (±8.0) and a mean follow-up of 59 months in the IR > 2 group. All patients had undergone RTSA with the same implant type and only two different glenosphere sizes (36 and 40) for comparable indications. A multivariate analysis identified the following significant risk factors for poor postoperative fIR: poor preoperative fIR (pts in CS: 3 range: 2-6 vs. 6 range: 4-8, p <.0001), smoking (17.3% vs. 6.5%, p=.004), male gender (59.6% vs. 31.7%, p=.002), less pre-to post-operative distalization of the greater tuberosity ± 19.4 mm vs. 22.2 mm, p=.026), a thin humeral insert (≤ 3mm: 23.1% vs. 54.8%, p=.039) and a high ASA score (≤ III: 30.8% vs. 14.3%, p=.043). Subscapularis repair status and glenosphere size had no influence on fIR. Clinical outcome scores improved in both groups from preoperatively to last follow-up. The IR ≥ 2 group had overall significantly better outcome scores compared to the IR ≤ 2 group (± 9.3% SSV and a 9.5% relative CS, p <.0001). There was no difference in CS between the cohorts when the score for fIR was discarded.

**CONCLUSION:** Independent risk factors for poor postoperative fIR after RTSA are poor preoperative fIR, smoking, male gender, less pre- to post-operative distalization of the greater tuberosity, a thin humeral insert height and a high ASA score. Except for male gender, these factors are modifiable. These findings may be a valuable addition to patient counseling as well as preoperative planning and pre- and intraoperative decision-making. The relevance of fIR for overall satisfaction is substantiated by this study.

**Extension of the Shoulder is Essential for Functional Internal Rotation After Reverse Total Shoulder Arthroplasty (9953)**

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**BACKGROUND:** The importance of functional internal rotation (fIR) of the shoulder is increasingly recognized. Unsatisfactory fIR after reverse total shoulder arthroplasty (RTSA) is frequent but unexplained. This study tested the hypothesis that limitation of fIR after RTSA is primarily related to a deficit of active extension rather than internal rotation of the shoulder.

**METHODS:** Fifty consecutive patients (mean age at RTSA: 70 (range, 40-100) years) were prospectively examined with special attention to fIR at a median of 4 years (range: 1-10 years). Patients with axillary nerve or deltoid dysfunctions were excluded. Extension was measured as the angle formed by the fully, actively extended shoulder and the trunk. Relative Constant-Murley Scores (rCS), Subjective Shoulder Values (SSV) and four activities of daily living (ADLs) requiring fIR were assessed. For analysis, patients were divided into a group with poor fIR (“fIR−”) defined as ≤ 2 IR CS points, and a group with good fIR (“fIR+”) with at least 4 IR CS points.

**RESULTS:** Active extension of the contralateral shoulders were comparable in the fIR− (mean: SD: 60.3° (±11.2)) and the fIR+ (68.1° (±14.2)) groups. With a mean of 55° (±14.3), active shoulder extension was an average of 16° greater in the fIR+ than in the fIR− group (39.1° (±10.8); p <0.001). In the fIR+ group no patient had an active extension <40° (range 40-85°). Shoulders with extension ≥ 40° but unsatisfactory fIR, usually had severe subscapularis fatty infiltration. The ability to perform ADLs behind the back correlated better with humeral extension than with the internal rotation CS.

**CONCLUSION:** For fIR after RTSA a humeral extension of 40° is mandatory. Only if 40° of extension are obtained, can severe subscapularis dysfunction prevent satisfactory fIR. Although essentially never reported, shoulder extension is as a crucial active movement to be preserved or restored during RTSA to allow performing ADLs.
Fixation of distal clavicle fractures with coracoclavicular instability – A comparative biomechanical study in human cadavers (9961)

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Introduction: The biomechanical need for CC stabilisation in the fixation of fractures with coracoclavicular (CC) instability (Neer type IIIB and VI) has been demonstrated by construct strength superior to that of isolated locking plate osteosynthesis. It was the purpose of this study to prove non-inferiority of the new cow-hitch suture repair technique compared to the well-established suture tape double-button fixation with regard to overall fixation strength and cyclic loading properties.

Methods: Twelve human cadaver shoulders (7 right, 5 left) were matched for sex and age (mean age 75 ± 5 years). An oblique parasagittal fracture line 20 mm medial to the AC joint line was created and the CC ligaments were dissected. Six shoulders were reconstructed by a double FiberTape® fixation with two suture buttons (group DB), the remaining six shoulders by a novel cow-hitch suture repair using a double FiberWire® with only coracoid button fixation (group CH). Both reconstruction techniques were tested in a servo-hydraulic material testing machine for cyclic displacement (mm), stiffness (N/mm) and maximum load-to-failure (IN) after 500 cycles at 3 mm/s and isofemoral load between 15 and 70 N. Superior fragment displacement in space was recorded using a MicroScribe digitizer.

Results: There were no statistically significant differences regarding cyclic displacement (group DB: 0.7 mm; group CH: 1.3 mm; p = 0.36), stiffness (group DB: 177 N/mm; group CH: 116 N/mm; p = 0.17), maximum load-to-failure (group DB: 560 N; group CH: 492 N; p = 0.59) and superior displacement in space of the medial fragment (group DB: 3.2 mm; group CH: 1.6 mm; p = 0.48).

Conclusion: Fixation of unstable distal clavicle fractures using a novel double FiberWire® cow-hitch suture repair with isolated coracoid button fixation for stand-alone CC stabilization resulted in similar construct properties as a double suture button fixation with FiberTapes® whilst avoiding prominent clavicular implants.

Vergleich zwischen lateralisierter und nicht lateralisierter inverser Schultertotalendoprothese bei fortgeschrittener Dekatrophathie Hamada 4 und 5 mit glenohumeraler Arthrose (9980)

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Introduction: Fortgeschrittene Dekatrophathien medialisieren das Gelenkzentrum. Ein lateralisierter Design in der inversen Schulterendoprothese (invTP) soll funktionelle Ergebnisse, vor allem die Rotationsbewegung, verbessern.


Results: Die Basisparameter waren vergleichbar. Die CS- (Unterschied 0.7 Punkte (95%CI -0.9 bis 2.3); p = 0.85) und SPADI-Ergebnisse (7 Punkte (1.8 bis 12.7); p = 0.36) unterschieden sich nicht. Die Außenrotation der Gruppe LAT betrug Mittlewert 33°, die der Gruppe NONLAT 19° (p < 0.05). Mehr Patienten der LAT Gruppe konnten den Lendenwirbel 3 erreichen (79% gegenüber 25% in der Gruppe NONLAT) (p = 0.043). Die Gruppe NONLAT hatte mehr untern Überhang der Glenosphäre (2,4mm (0.9 bis 4.0); p = 0.004), Medialisierung des Rotationszentrums (COR) (4,5mm (0.2 bis 7.8); p = 0.024), Tiefenverlagerung des glenohumeralen Rotationszentrums (5,4mm (1.4 bis 9.3); p = 0.01), grösseren Distalisierungswinkel (13,4° (6.9 bis 20.8); p = 0.002) sowie eine tiefere Baseplate-Position (-0.1 (0.6 bis -0.6); p = 0.01) während die Gruppe LAT mehr laterales Humerusoffset (-12,7mm (-16.3 bis -9.0); p <0.001) und einen höheren Lateralisierungswinkel (-17.4° (-24.3 bis -10.4); p <0.001) aufwies. Scapular Notching zeigte keinen signifikanten Unterschied (p = 0.42).

clinical outcome. Malrotation of radiographs may influence these measurements and affect clinical decision-making. Therefore, it was the aim of this study to analyze the effect of malrotated radiographs on proximal humeral measurements in PHF.

**Methods:** Ten consecutive patients with displaced PHF, available bilateral CT scan, and a precise initial true anteriorposterior (AP) radiograph were included. Digitally reconstructed radiographs (DRRs) of the injured and uninjured side were aligned to obtain a true AP view. Different viewing angles with 10° increments (±30° maximum) were generated by rotation around the horizontal (flexion/extension) and vertical axis (ante-/retroversion) of the scapula. NSA and eccentric head index (EHI) were measured by two independent readers to assess intraclass correlation coefficients (ICC) and 95% limits of agreement (LoA). The influence of malrotation was assessed by paired comparisons, as were the differences in NSA and EHI between clinical and digital true AP views.

**Results:** True AP DRRs approximated the clinical true AP view by a mean difference of 3° and a LoA range of 12° for NSA, and a mean difference of 0.12 and a LoA range of 0.36 for EHI (p <.02). NSA in injured shoulders was most susceptible to malrotation around the vertical axis (p <.03), with largest differences seen for anteversion, whereas ±10° of vertical malrotation did not influence NSA in uninjured shoulders. While DRRs malpositioned in extension had no influence on NSA (p >.70), ≥20° and 30° of flexion demonstrated differences in injured and uninjured shoulders, respectively (p <.05). EHI was only influenced by malrotation in anteversion in uninjured shoulders (p <.03). ICCs were good (>0.7) for all viewing angles in the injured shoulders, but varied widely in the uninjured shoulders.

**Conclusion:** This study highlights distinct differences in susceptibility for malrotated radiographs between fractured and uninjured shoulders. NSA is more susceptible to malrotated radiographs than EHI, with malrotation in anteversion demonstrating the most substantial differences. Since images with malrotation in anteversion are particularly frequent in patients with PHF on first admission, clinicians should be aware of the false interpretation of NSA in these cases.

**Outcome of management of fractures of the proximal humerus using a patient-specific, evidence-based treatment algorithm (10110)**

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**Background:** Previous prospective studies have identified person – specific risk factors for different types of treatment of proximal humeral fractures (PHF) and allowed the creation of a treatment algorithm with the potential to improve overall outcome and to reduce the complication rate. It was the purpose of this study to evaluate the results and complications of treatment of PHF using a patient specific, evidence-based algorithmic approach

**Materials and Methods:** All patients with isolated PHF between 2014 and 2017 were included and prospectively followed. The initial treatment algorithm (V1) based on patient’s functional needs, bone quality and fracture type, was further refined after 2 years (V2). Adherence to protocol, clinical outcome and complications were analyzed at 1 year post trauma.

**Results:** The study included 334 patients (mean age 66 years, 68% female): 226 were treated conservatively, 60 with open reduction internal fixation (ORIF), 39 with RTSA and 4 with hemiarthroplasty. After 1 year, the pre-injury EQ-5D values were regained (0.88 vs 0.89) and the respective mean relative Constant Score (rCS) and mean subjective shoulder values (SSV) were 96% and 85%. Overall complication and revision rates were 19% and 13%. Treatment conforming to the algorithm outperformed non-conforming treatment with respect to rCS (97% vs 88%, p = 0.016), complication rates (16.3% vs 30.8%, p = 0.014) and revision rates (10.6% vs 26.9%, p <.001).

**Conclusion:** Treatment of PHF using a patient specific, evidence-based algorithm restored pre-injury quality of life as measured with EQ-5D and approximately 90% of a normal shoulder as measured by CS and SSV. Adherence to the treatment algorithm was associated with significantly better clinical outcome and a substantially reduced complication and revision rate.
How to improve the performance of outpatient surgery in hospitals designed for inpatient surgery? The example of hand surgery under WALANT (9765)

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Introduction: Most Swiss hospitals were built in the 70s and 80s, a time when inpatient surgery was the standard. Within the last decade, outpatient surgery has widely developed in order to reduce health care costs. In addition, the COVID-19 pandemic has significantly reduced accessibility to operating rooms due to the shortage of anesthesiologists recruited to intensive care units. In response, we have reorganized our practice by carrying out full days of surgery dedicated to patients who undergo surgery under “Wide Awake Local Anaesthesia, No Tourniquet” (WALANT).

The aim of this study is to assess the impact of the WALANT technique on both, surgery and turnover times, in patients who have surgery for carpal tunnel syndrome or spring finger in mini-open technique.

Method: This is a retrospective study comparing patients who had carpal tunnel release or spring finger release either under endovenous anaesthesia (EVA) performed by an anesthesiologist or under WALANT performed by the surgical team. Surgery involving other simultaneous procedures were excluded. Surgery time was measured from incision to closure and turnover time was measured from closure of the previous procedure to incision of the next. The time preceding the first surgery of the day was not counted. Surgery time of senior and junior surgeons were compared.

Results: Between January 2017 and January 2021, 80 carpal tunnel releases (50 under EVA and 30 under WALANT) and 72 spring finger releases (42 under EVA and 30 under WALANT) were carried out. The mean surgery time of carpal tunnel release by senior surgeons was 12.3 minutes under EVA and 15.3 minutes under WALANT (p-value 0.68) and the mean surgery time by junior surgeons was 14.6 minutes under EVA and 20.1 minutes under WALANT (p-value <0.05). The mean surgery time of spring finger release by senior surgeons was 10.4 minutes under EVA and 10.0 minutes under WALANT (p-value 0.532) and the mean surgery time by junior surgeons was 16.0 minutes under EVA and 15.8 minutes under WALANT (p-value 0.49). The turnover time for EVA and WALANT was 37.2 minutes and 18.3 minutes, respectively (p-value <0.0001).

Conclusion: Despite the COVID-19 pandemic, the switch to days dedicated to patients having surgery under WALANT improved the performance of the outpatient operating rooms. A slight increase in surgery time in carpal tunnel surgery under WALANT was compensated by halving the turnover time between two surgeries.

Low Profile Transverse Plating for Treatment of Dorsal Rim Fracture of the Distal Radius: A Mid-Term Follow-Up of Functional and Radiological Result. (9898)

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Introduction: The distal radius fracture accounts for 17.5% of all fractures in an orthopedic trauma unit. In case of intra-articular fractures with dorsal involvement, reduction by dorsal approach and plate fixation is preferred. The techniques described in the literature use two dorsal plates to maintain the distal fragment. In this technique, we first stabilize the intra-articular fragments with a dorsal plate and finish the reconstruction with two additional plates. The purpose of this construction is to have a more accurate reduction of the joint surface and less conflict between the extensor tendons and the plate without sacrificing stability. This study evaluates the functional and radiological outcome of this technique.

Methods: Between 2012 and 2019, 16 patients underwent osteosynthesis of distal radius with the novel technique. All fractures were C3.2 (AO Classification). We evaluate the radiological result according to the anatomical score. The functional outcome was evaluating with the PWRE score.

Results: At a minimum follow-up of 2 years, the mean average of the PWRE score was 14.8/100. The average of Batra anatomical score was 90.4/100 (excellent). No cases showed extensor tendinitis or a complication.

Conclusion: Our technique involves the use of plates with a lower profile but with a structure, that reinforces the three columns in a more accurate manner. This allows a good reduction with a fixation as stable as other techniques already described previously in the literature.

3D planning and patient specific instrumentation for intraarticular corrective osteotomy of trapeziometacarpal and finger joints (9864)

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Introduction: Intraarticular corrective osteotomies with the aim of restoring joint congruency are indicated when posttraumatic bone deformities become symptomatic. The aim of the study was to evaluate joint congruency, feasibility and functional outcome of 3D printed patient-specific instrumentation (PSI) for corrective osteotomies of malunions of intraarticular fractures in trapeziometacarpal and finger joints with a minimally invasive approach to the affected joint.

Methods: Patients who underwent an intraarticular corrective osteotomy at the metacarpals (MC) or phalanges were included. Preoperative CT scans were acquired of the malunited and the contralateral bone. Segmentation was followed by analysis of malposition and surgical planning with a software allowing standard computer-aided design (CAD) functions. Automatic volumetric fitting, quantification of malposition, calculation of cutting planes and the design of individualized bone surface contact drilling, sawing and reposition guides were performed. The surgical procedure was realized using PSI and arthrotomies were documented. Postoperative clinical follow up included range of motion (ROM) and grip strength. Joint congruency and consolidation was analyzed with CT scans.

Results: Ten patients (mean age 28.4 ±12.8 years, range 14 – 51 years) were included with a mean follow up of 21 ±18 months (3 – 59 months). Eight osteotomies were localized at the MC and two at the proximal phalanx. Corrections at the trapeziometacarpal joint were performed using a mini-arthrotomy. No arthrotomy was performed at the phalanges. Mean combined ROM increased from 112° ±69° to 128° ±82° (p=0.001). Average grip strength (47.8± 8.1kg) did not differ to the contralateral side (47.8 ±8.1kg, p=0.818). All articulations showed joint congruency and osseous consolidation 61 ±8 days (54 – 78 days) postoperatively.

Conclusion: PSI reliably corrects intraarticular deformities at the trapeziometacarpal and finger joints without the need for an additional arthroscopy in the finger joints and improves functional outcome at medium-term follow up.
Assessing fatty infiltration of paraspinal muscles in patients with lumbar spinal stenosis: Goutallier classification and quantitative MRI measurements (9680)

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Introduction: Fatty infiltration of paraspinal muscle is associated with spinal disorders. Fatty infiltration of muscle can be assessed qualitatively (i.e. Goutallier classification) and quantitatively using image processing software. The aims of this study were to compare paraspinal muscle fatty infiltration assessed using the Goutallier classification versus quantitative MRI measurements and to investigate the association between anthropometric parameters and paraspinal muscle morphology and fatty infiltration in patients with symptomatic lumbar spinal stenosis (LSS).

Methods: Patients affected by symptomatic LSS scheduled for surgery with available magnetic resonance images of the lumbar spine were included in this retrospective cross-sectional study. Fatty infiltration at each lumbar level was rated according to the Goutallier classification and quantified based on the cross-sectional area (CSA) of paraspinal muscle, of its lean fraction (LeanCSA), the ratio between LeanCSA and CSA and the CSA relative to the CSA of vertebral body (RCSA). Considering the muscle as a single unit, overall fatty infiltration according to Goutallier, overall CSA, LeanCSA, LeanCSA/CSA and RCSA were computed as averages (aGoutallier, aCSA, aLeanCSA, aLeanCSA/LeanCSA and aRCSA). Associations among parameters were assessed using Spearman’s respective Pearson’s correlation coefficients.

Results: Eighteen patients, mean age of 71.3 years, were included. aGoutallier correlated strongly with aLeanCSA and aLeanCSA/LeanCSA (R = 0.673 and R = 0.754, both P < 0.001). There was a very strong correlation between values of the left and right sides for CSA (R = 0.956, P < 0.001), LeanCSA (R = 0.900, P < 0.001) and LeanCSA/LeanCSA (R = 0.827, P < 0.001) at all levels. Among all anthropometric measurements, paraspinal muscle CSA correlated the most with height (left: R = 0.737, P < 0.001; right: R = 0.700, P < 0.001), while there was a moderate correlation between vertebral body CSA and paraspinal muscle CSA (left: R = 0.448, P < 0.001; right: R = 0.454, P < 0.001). Paraspinal muscle CSA correlated moderately with BMI (left: R = 0.423, P < 0.001; right: R = 0.436, P < 0.001), and there was no significant correlation between aLeanCSA or aLeanCSA/LeanCSA and BMI.

Conclusions: The Goutallier classification is a reliable yet efficient tool for assessing fatty infiltration of paraspinal muscles. We suggest to take body height as reference for normalization in future studies assessing paraspinal muscle atrophy and fatty infiltration.

O-arm and Surgivisio use for percutaneous vertebral cementoplasty: a comparative study on 121 patients (9705)

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Introduction: Vertebral compression fractures are frequent in the aging population, and are regularly treated by percutaneous vertebraloplasty or kyphoplasty. Advances related to computerized navigation allow a more accurate surgery without new imaging acquisition, and related irradiation. New technologies trend to optimize the irradiation for the patient. The objective was to compare results of O-arm navigation and new all-in-one 2D/3D Surgivisio device in percutaneous cementoplasty procedures.

Methods: We retrospectively reported the results of all patients prospectively included for percutaneous navigated vertebraloplasty or kyphoplasty for vertebral compression fractures during an 18-month duration in two spine centers. Demographic, operative and irradiation data were collected, as well as the image quality subjectively evaluated by the surgeon. Effective dose (E) in millisievert (mSv) was calculated using the PCMXC software and the recommendations of the International Commission for Radiological Protection.

Results: 121 patients were included, 60 in the O-arm group and 61 in the Surgivisio group. A total of 161 vertebrae were analyzed. Compared to the Surgivisio group, E was significantly higher in the O-arm group, with a mean of 11.58 versus 1.14 mSv respectively (p < 0.001). 2D part of E received by the surgeon was also significantly higher in the O-arm group, with an average of 2.18 versus 0.47 mSv respectively, p < 0.001. Operative time was also significantly higher in the O-arm group (34.17 versus 30.12 minutes respectively, p = 0.044). ANOVA method showed no correlation between E and surgeon level for both groups (p = 0.240 and p = 0.171 respectively). Image quality was similarly sufficient in 3D but significantly better in the O-arm group in 2D (p = 0.013).

Conclusion: With a 10 times higher radiation exposure with the use of the O-arm, technological advances in intraoperative imaging showed a clear dose reduction for patients and surgeons during percutaneous navigated cementoplasty, while keeping a sufficient image quality to perform the surgery.

Intraoperative duplex-ultrasound for safe surgical reduction of displaced hangman fractures in patients with atypical course of the vertebral artery: a case report of two patients. (9723)

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Introduction: An atypical course of the vertebral artery can be medically relevant in displaced Hangman fractures, especially if the artery course runs within the fracture gap of the C2 isthmus. During surgical reduction of the fracture, the artery can be entrapped and occluded inside the fracture, potentially leading to ischemic conditions of the brain. Duplex-ultrasound of the vertebral arteries is a safe, validated and non-invasive technique to measure the blood flow, to assess the morphology of the vertebral arteries and is commonly used as a neurovascular diagnostic method. The aim of this study was to report two cases according to the CARE (case reporting) guidelines, in which intraoperative duplex-ultrasound was performed to secure safe surgical management of hangman fractures in two patients with an atypical course of the vertebral artery.

Methods: Two patients with displaced Hangman fractures (Effendi-Levigne type II) were diagnosed with an atypical course of the vertebral artery running through the fracture gap. This endangered safe surgical management with the risk of iatrogenic occlusion or injury during reduction through entrapment of the vessel inside the fracture gap. Therefore, an intraoperative duplex ultrasound of the vertebral artery in the segments V2 and V3, the segments proximal and distal of the fracture, was conducted before and after reduction, and at the end of the surgery by a neurovascular imaging specialist. The surgical treatment in both cases included closed reduction and posterior unilateral spondylodesis of the cervical segment C2/3, followed by anterior cervical discectomy and fusion (ACDF) of the same segment.

Results: In both patients, a safe reduction of the fracture was performed. Neither occlusion nor dissection of the vertebral artery occurred. The duplex ultrasound before and after reduction, and at the end of the procedure showed normal flow of both vertebral arteries with excellent reassessibility. At follow-up examinations 6-weeks and 6-months postoperatively, the patients showed a favorable clinical outcome, radiographic signs of fusion, and no evidence of impairment of the vertebral artery.
Conclusion: This case report serves as proof-of-concept, demonstrating the feasibility of this regimen to minimize the risk of entrapment or occlusion of the vertebral artery in the surgical management of displaced Hangman fractures with atypical course of the vertebral artery running inside the fracture gap.

Pedicle Subtraction Osteotomy with vs without Patient Specific Guides (9860)

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Introduction: Patient-specific instruments (PSI) is well established for complex osteotomies in orthopaedic surgery and for placement of pedicle screws in spine surgery. However, PSI has not been employed for pedicle subtraction osteotomy (PSO) up to now.

Methods: 6 fresh frozen human cadavers were used to perform PSO’s on the vertebrae L1, L3 and L5. Half of the PSO’s (n=9) were performed with the traditional free-hand (FH, n=9) technique and the others with the use of 3D-printed guides (PSI). Preoperative CT-scans were obtained and 3D-segmented to develop the PSI. Each PSI-guide consisted of five parts, the ground block, which was attached to the upper and lower adjacent vertebrae with pedicle screw fixation, two posterior osteotomy blocks to cut the spinous process and laminae, and two anterior osteotomy blocks (left and right), which enabled a dorsally closing wedge osteotomy of the vertebral body while retracting the neural structures. The goal of each PSO was to gain a lordosis of 30° through the osteotomized vertebrae. Time was measured to execute the PSO’s in both groups.

Postoperatively, CT scans were obtained to measure the accuracy of the planned versus executed PSO in the PSI group and to compare the FH-technique.

Results: The creation of additional lordosis was significantly more accurate with PSI compared to FH-technique with a mean difference to the aimed 30° in the PSI group being 2.35° ± 3.06° versus 10.62° ± 4.24° in the free-hand group (p=0.004). The gain of lordosis was significantly greater in the PSI than the FH group with 27.65° ± 3.06° versus 22.01° ± 6.37° (p=0.027). Furthermore, a significant reduction of the gap between the laminae adjacent to the posterior wedge could be achieved with the PSI technique 4.19 mm ± 2.65 mm versus 11.81 mm ± 7.59 mm with the FH-technique. The angular difference between the computer aided planning and execution of the osteotomy planes with the PSI technique was 3.8° ± 2.6° and the metric distance between planned and executed osteotomy at the level of the lamina was 1.6 ± 1.3 mm and at the vertebral body entry point 1.4 ± 0.9 mm. The time required to perform a PSO was 17:34 ± 6:00 min in the PSI group versus 14:33 min ± 3:30 min in the FH group (p=0.336).

Conclusion: PSI with PSI was more accurate and achieved a greater gain of lordosis compared to the traditional FH procedure in the cadaver model. Investigation of this technique in human is warranted.

Robot-mounted digital 3D microscope for spinal decompression surgery (9892)

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Introduction: Surgical microscopes are established instruments for spinal decompression surgery. Potential new generations are developed, but not yet investigated systematically. The aim of this study was to evaluate the RoboticScope® (BHS Technologies GmbH, Innsbruck, Austria), consisting of a head-mounted display, a microscopic camera and a robotic arm. The surgeons head movements are directly translated to the robotic arm which carries out the corresponding movement of the camera.

Methods: Two experienced spine surgeons each performed 3 laminotomies on a fresh-frozen cadaver using the RoboticScope® (cadaveric study). The performance of the new device was evaluated with a likert-scale questionnaire. The categories analyzed were visualization, usability, ergonomics, and overall impression. To directly compare the RoboticScope® with a conventional microscope, an in vitro study was carried out. The experimental setup consisted of hollow 3D-printed boxes with an inner dimension similar to the spinal canal. Nine operators (3 experienced surgeons, 2 orthopedic assistants, 4 non-surgeons) were asked to identify and grasp the lower of 2 spheres at top of 2 columns with different or same heights located inside the box. The number of failed gripping attempts, the height estimation and the time used were measured.

Results: In the cadaveric experimental setup, the RoboticScope® was rated as equally good or superior to the conventional microscope in 14 of totally 24 questions (grade ≥ 3). In 10 questions, the experienced surgeons rated the new device as inferior (grade ≤ 2). In the in-vitro study, there were no significant differences between the microscopes concerning, both the errors in identifying the deeper sphere and the number of failed attempts at the grasp (p=0.497 and p=0.451). Similarly, there was no significant difference when comparing these factors between groups. In general, the average time in seconds to grasp the sphere using the RoboticScope® was 6.06 ± 2.37 compared to 4.73 ± 2.13 using a conventional microscope (p=0.011). Neither surgical training nor multiple experimental runs appeared to have a significant effect (p=0.575 and p=0.715).

Conclusion: The RoboticScope® seems applicable as a microscope in spinal decompression surgery. However, disadvantages still exist in usability and visualization. In terms of ergonomy, the RoboticScope proved to be advantageous over conventional microscopes.

Automated Pedicle Screw Trajectory Extraction from Postoperative CT Scans (9909)

Marco von Atzigen¹; Joëlle Ackermann²; Florentin Liebmann; Mazda Farshad; Philipp Fünfstahl

INTRODUCTION: Postoperative evaluation of spinal fusion surgery includes the examination of the pedicle screw trajectories on Computer Tomographies (CT). In addition to grading pedicle screw perforation using the Gertzbein-Robbio scale, a 3D analysis of the screw trajectories can provide more detailed information on deviations from the anatomical axes of the pedicles. However, 3D analysis requires segmentation of the bone anatomy and parameterization of the screws which are time-consuming tasks. A more automated method for 3D screw trajectory determination in postoperative CT would allow more efficient outcome assessment and quality control of treatments.

METHODS: In this study, a machine learning based algorithm is presented which is capable of calculating the 3D pedicle screw trajectory from postoperative lumbar spine CT in real-time. Given a CT scan, the algorithm extracts the start and end positions of all implanted screws without being affected by other metallic implants such as rods. The 3D trajectory of the pedicle screws is eventually calculated from these start and end points. Our method was evaluated on 14 postoperative CTs of lumbar spines against manually defined screw trajectories.

RESULTS: The average orientation error of the obtained screw trajectory was 1.68 ± 0.93° ranging from 0.13° to 3.97°. The total calculation time for one CT amounted to roughly 0.39 seconds on a high-end graphics card.

CONCLUSION: The accurate trajectory estimation along with the short computation time promote the use of our machine learning based algorithm for real-time extraction of screw trajectories from intraoperative CT scans. In the future, this may not only enable intraoperative screw trajectory evaluation, but would also thereby improve the surgical outcome and consequently increase treatment quality.
Spine fractures at a university hospital: proportional incidence, clinical characteristics and treatment – a retrospective 10-year analysis of a level one trauma centre (9977)

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Introduction: Fractures of the spine have a reported incidence of 19-90/100k. The occurrence of spinal fractures is often associated with a significant impact on activities of daily living and account for a significant socio-economic burden. Delayed diagnosis and missed injuries may lead to an increased morbidity and mortality. The aim of this study was to determine the (a) demographic characteristics, (b) proportional incidence, (c) treatment techniques with evolution over time, and (d) complications over a ten-year period

Material and Methods: Using our clinical information system, we obtained data from all patients suffering from an acute vertebral fracture between January 2002 and December 2012. The fractures were allocated for etiology (traumatic, osteoporotic and pathologic), management of the fracture, associated complications and site of occurrence

Results: (a) We identified 4,620 patients with 8,307 vertebral fractures. All pairs of measures were significantly positively correlated. Many institutions exhibit a preference for the use of one outcome instrument over another, and have a history of data collection with their chosen instrument; the ability to share data via the developed crosswalk, to convert scores between the two scales, should open up more centres/registries for collaboration and facilitate the pooling of data in meta-analyses.

(c) More than two thirds of fractures needed surgical treatment (5,695 fractures = 66.6%). Especially the mid and lower thoracic spine as well as the lumbosacral spine were more often treated surgically. After 2009 there was a significant decrease in surgery for osteoporotic fractures. While in 2009 and before the adjusted probability for surgery in osteoporotic fractures was 88.6% (95% CI: 87.0%-90.2%) in 2010 and after the adjusted probability decreased to 79.0% (95% CI: 74.1% – 83.9%).

(d) Out of 4,622 surgeries performed, we found 290 complications in 260 patients. Implant Failure was the most frequent complication (82/290 = 28%) followed by surgical site infection (58/290 = 20%).

Conclusion: From 2002-2012 fractures treated at the university hospital of Bern were equally distributed between males and women. Male patients suffering from vertebral fractures were younger and more frequently affected from traumatic injuries than females (predominantly osteoporotic fractures). The proportional incidence for trauma-associated fractures was 49% (4,063 fractured vertebrae). Osteoporotic fractures accounted for 3,386 fractures (41%), and pathologic fractures for 878 fractures (10%).

Methods: We performed a secondary analysis of data from conservative and operative patients with spinal disorders, from 2 observational studies and a registry (N = 3,324 patients; 57±17y; 60.3% female), that had completed both an ODI and COMI at baseline and 1-year follow-up (FU). Correlations between the two instruments’ baseline scores, FU scores and change-scores (baseline and 1y FU) were computed. The Cohen’s α for agreement (κ) was calculated with respect to achievement of the minimal clinically important change (MCIC) score on each instrument (ODI, 12.8 (Copay et al 2008) points; COMI, 2.2 points (Mannion et al 2006)) using the actual change-scores for each as well as those predicted from the change-scores on the alternative instrument. It was hypothesized that baseline, FU, and change-scores for the two instruments would be at least moderately correlated (r > 0.5) and have moderately similar responsiveness (α > 0.4 for agreement in % reaching MCIC).

Results: All pairs of measures were significantly positively correlated (baseline, 0.71; 1y FU, 0.84; change-scores, 0.73). Overall, 53.9% patients achieved MCIC based on ODI change-scores and 52.4%, based on ODI change-scores; on an individual basis, there was 78% agreement between them, with x = 0.56. The corresponding figures for achievement of MCIC based on individuals’ change-scores predicted from their change-scores on the alternative instrument were 56.6% and 55.6%, respectively (x = 0.56).

Conclusion: Many institutions exhibit a preference for the use of one outcome instrument over another, and have a history of data collection with their chosen instrument; the ability to share data via the developed crosswalk, to convert scores between the two scales, should open up more centres/registries for collaboration and facilitate the pooling of data in meta-analyses.

Development of a crosswalk for the bidirectional mapping of two commonly used condition-specific patient-reported outcome measures, the Oswestry Disability Index (ODI) and the Core Outcome Measures Index (COMI) (9982)

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Schulthess Klinik

Introduction: Cross-walking is a method of mapping scores on different patient-reported outcome instruments that measure similar domains. It requires that changes in outcomes from two measures in the same individuals should be correlated and similarly responsive to change. The Oswestry Disability Index (ODI) and the Core Outcome Measures Index (COMI) are two commonly used self-rating outcome instruments in patients with spinal disorders. However, there is currently no formal crosswalk between the two that would otherwise allow the scores of one to be interpreted in terms of the other. This study aimed to create such a crosswalk.

Methods: We performed a secondary analysis of data from conservative and operative patients with spinal disorders, from 2 observational studies and a registry (N = 3,324 patients; 57±17y; 60.3% female), that had completed both an ODI and COMI at baseline and 1-year follow-up (FU). Correlations between the two instruments’ baseline scores, FU scores and change-scores (baseline and 1y FU) were computed. The Cohen’s α for agreement (κ) was calculated with respect to achievement of the minimal clinically important change (MCIC) score on each instrument (ODI, 12.8 (Copay et al 2008) points; COMI, 2.2 points (Mannion et al 2006)) using the actual change-scores for each as well as those predicted from the change-scores on the alternative instrument. It was hypothesized that baseline, FU, and change-scores for the two instruments would be at least moderately correlated (r > 0.5) and have moderately similar responsiveness (α > 0.4 for agreement in % reaching MCIC).

Results: All pairs of measures were significantly positively correlated (baseline, 0.71; 1y FU, 0.84; change-scores, 0.73). Overall, 53.9% patients achieved MCIC based on ODI change-scores and 52.4%, based on ODI change-scores; on an individual basis, there was 78% agreement between them, with x = 0.56. The corresponding figures for achievement of MCIC based on individuals’ change-scores predicted from their change-scores on the alternative instrument were 56.6% and 55.6%, respectively (x = 0.56).

Conclusion: Many institutions exhibit a preference for the use of one outcome instrument over another, and have a history of data collection with their chosen instrument; the ability to share data via the developed crosswalk, to convert scores between the two scales, should open up more centres/registries for collaboration and facilitate the pooling of data in meta-analyses.

Transformaminal Thoracic Interbody Fusion: patient-reported outcome at 12 months (9998)

Jani Puhakka; Anne F. Mannion; Daniel Haschtmann; Tamas Fekete; Markus Loibl; Dezsö Jeszenszky; Schulthess Clinic

Introduction: Transformaminal interbody fusion was initially popularized by Jeszenszky & Harms for the lumbar spine (T12F). The same approach has later been introduced on the thoracic spine (TTIF). All vertebrae involved are treated at the same time. A few publications have reported the clinical results of TTIF, mostly case reports or small series, and rarely including patient-reported outcomes. Here we report the patient-reported outcome of TTIF at 1-year follow-up.

Methods: A search was performed in our institutional spine register, which is based on the Spine Tango registry framework. Included were all TTIF procedures performed at least one year prior to data extraction, from 2012 to 2020. Patients had been asked to complete the Core Outcome Measures Index (COMI) before surgery and 12 months later.

Results: In total, 62 patients had undergone TTIF within the study’s time-frame (21 males, 41 females; mean age 64.8 (SD 18.7) years). Altogether, TTIF was performed on 78 levels by four different surgeons. The primary diagnosis was degenerative spine disease in 39 (63%) cases, fracture-related spine disease in 18 (29%) cases, and non-degenerative deformity in 5 (8%) cases. The majority of the TTIF procedures were performed on the lower thoracic spine, with the level of procedure being T3/4 in 2, T6/7 in 1, T7/8 in 1, T8/9 in 3, T9/10 in 5, T10/11 in 4, T11/12 in 27, and T12/L1 in 35 cases. A prefabricated cage was used in 55 (70.5%), Harms cage in 16 (20.5%), autograft in 6 (8%), and allograft in 1 (1%) of the TTIFs. Overall, 50/62 (81%) patients completed a preoperative COMI and 52/62 (84%) a 1-year COMI. A total of 42 (68%) patients completed both a preoperative and a 1-year FU COMI. Their COMI score reduced from a mean (SD) value of 8.0 (SD 1.9) preoperatively to 5.0 (SD 2.4) at 12 months’ follow-up. 63.5% of patients reported that the operation helped/helped a lot, and 71.2% were satisfied/very satisfied with their care. There were two intra-operative dural lesions, two wound infections, and one case of postoperative sensory dysfunction.

Conclusions: Transformaminal Interbody Fusion is a feasible approach to be used in the thoracic spine where interbody support and/or correction of a deformity is needed. There were no iatrogenic spinal cord lesions
Development of a machine-learning based model for predicting multidimensional outcome after surgery for degenerative disorders of the spine (09999)

Daniel Müller; Daniel Haschtmann; Dave O’Riordan; Markus Loibl; Frank Stefan Kleinstück; Tamas F. Fekete; François Porchet; Raluca Reitmeir; Dezsoe Jeszenszky; Anne F. Mannion

Background: Recent years have seen the emergence and increasing use of patient-reported outcomes in clinical studies of treatment effectiveness, and it has become clear that individual outcomes can be quite heterogeneous. When consenting a patient for surgery, it is important to be able to offer an evidence-based, individualised prediction regarding the likely outcome. This study used a comprehensive set of data collected over 12 years in an in-house registry to develop a parsimonious model to predict the multidimensional outcome of patients undergoing surgery for degenerative spinal pathology.

Methods: Data from 8374 patients (mean age 63.9 (14.9-96.3) yrs, 53.4% female) were used for model development, predicting the 12-month scores for the Core Outcome Measures Index (COMI) and its subdomain scores. The data were split 80:20 into a training and test set. The top predictors were selected by applying recursive feature elimination based on a Lasso cross validation model retaining the top 15 predictors (out of 172) per outcome, allowing the retention of a practical number of 20 (out of 39) input variables to be used as a clinical decision-support system (CDSS). Based on the 111 top predictors (of the 20 variables), Ridge cross validation models were trained, validated, and tested for each outcome dimension.

Results: Preoperative back and leg pain, nationality, the number of pre-existent spine surgeries, age, type of intervention, preoperative quality-of-life, body-mass index, number of affected levels, Charlson comorbidity, and ASA score, were among the strongest outcome predictors in most models. The R2 of the models on the validation/test sets averaged 0.16/0.13. Models based on all 39 input variables performed only slightly better in terms of R2 (0.17/0.14) underlining the good performance of the CDSS based on 20 input variables. A preliminary online tool was programmed to present the predicted outcomes for individual patients, based on their presenting characteristics.

Conclusion: The prediction models provide reliable estimates to enable a bespoke prediction of the outcome of surgery for individual patients with varying degenerative pathologies and baseline features. The models form the basis of a simple, freely-available online prognostic tool developed to improve access to and usability of prognostic information in clinical practice. This should serve to facilitate decision-making and assist in managing patient expectations.

3D Printed highly porous trabecular titanium (3DTi) cervical interbody cages using electron beam melting technology promote early in vivo bony ingrowth. A preliminary report of a prospective analysis (10012)

Nermine Habib; Cristina Goga; Fatos Ramadan; Daniele Valsecchi; Timo Miesbach; Philippe Otten; Gianluca Maestretti

Introduction: Encouraging in vitro results suggest that highly porous trabecular titanium 3D-printed (3DTi) cages modeled using electron beam melting technology (EBM) and with a similar structure to the trabecular bone display the ability to stimulate osteoinductive cell proliferation and differentiation. These implant intrinsic properties might offer an increased capacity for osteoinduction and potential for bone regeneration. The objective of this study was to investigate the osteointegration and bone ingrowth capabilities as well as the safety and efficiency profile of a 3DTi cervical cage in vivo.

Methods: We performed a prospective analysis of 20 consecutive patients presenting with degenerative cervical spine conditions and benefiting from one- to three-level ACDF. Last-generation 3DTi cages made of highly porous trabecular titanium and 3D printed using the CAD/CAM technology by means of EBM (MT Ortho s.r.l., Acì Sant’Antonio, CT, Italy) were implanted. These innovative anatomically structured cages consist of two trabecular titanium endplates, with a porosity of 80% and a pore size of 1 mm, and lateral windows with a central cavity for cell colonization and subsequent bone regeneration. Anterior plate support was added depending on the pre-operative findings and presence of myelopathy. Fusion rates were assessed using a CT-scan at 3 months and 1 year. The VAS pain score and NDI were also evaluated.

Results: Early bony ingrowth through the cage was observed in 100% of patients at 3-months. Fusion was achieved in 83.3% and 100% of cases at 3 months and 1 year respectively. VAS score for radicular pain and axial pain showed an improvement in 89.2% and 75.8% of cases. An improvement of the NDI by 74.5% was observed. No cage subsidence or migration was recorded. No major implant-related peri-operative complications were noted.

Conclusions & perspectives: In accordance with recent in vitro studies, 3DTi cervical cages showed frequent early bony ingrowth and excellent fusion rates with an optimal safety profile. These results appear to be independent from the diagnosis or additional plating. Our preliminary data on fusion-rates and complication profile needs to be validated in a larger patient cohort as well as after long-term follow-up.
The PAO As Successful Therapy For Hip Dysplasia And Acetabular Retroversion – Long-Term Results Of 35 Years Of Experience In 1044 Hips (9725)

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Background: Since its first description in 1984, the periacetabular osteotomy (PAO) has become the gold standard in the surgical treatment of hip dysplasia (DDH). Since 1997 the PAO is used for correction of acetabular retroversion (RV) as well.

Objective: The aim of this study was to calculate (1) long-term survival of the hip and (2) predictive factors for survival following all PAOs ever performed at the inventor’s institution for DDH or RV.

Methods: We performed a retrospective case-series including 1044 PAOs between 1984-2019. Our follow-up-rate was 93%, 844 hips underwent PAO for DDH. The mean age at surgery was 29±10 (16–48) years. 30% had previous surgery. The mean follow-up for PAO in DDH was 14±9 (1-35) years.

129 hips underwent PAO for correction of RV. The mean age at surgery was 22±7 (16–45) years. Previous surgery was performed in 14%. The mean follow-up for PAO in hips with RV was 12±7 (1-22) years.

Survival was calculated with the endpoint of conversion to total hip arthroplasty (THA) using Kaplan-Meier-analysis. Preoperative demographic, clinical and radiographic data were evaluated and predictive factors for conversion to THA with corresponding hazard ratios were calculated with a Cox-regression-analysis.

Results: The survival rate of all PAOs performed for DDH resulted 50% at the 35-year follow-up. Out of 844 hips, 205 hips converted to THA after a mean of 14 (0.3-35) years. For the treatment of DDH, predictive factors for poor long-term outcome included age >40 years (hazard ratio [HR] 1.83; p <0.001), preoperative arthritis Tönnis grade ≥ 2 (HR 3.63; p <0.001) and previous surgery (HR 1.44; p=0.013).

The survival rate for PAOs for correction of RV was 93% at 22-year follow-up. Out of 129 hips 5 converted to THA after a mean of 11 (0-18) years. Predictive factors for conversion to THA following PAO for RV included arthritis Tönnis grade ≥ 2 (HR 7.12; p <0.001) or previous surgery (HR 4.16; p=0.008).

Conclusion: DDH and RV are two very different hip pathologies, which DDH and RV are two very different hip pathologies, which

The Fovea Capitis Moves Outside of the Fossa Acetabuli during Normal Range of Motion in Patients with Femoral Malversion; A 3D Based Motion Study (9753)

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Introduction: Lesions of the fossa-foveolar-ligamentous complex have been described in young patients undergoing hip joint preserving surgery, but the pathomechanism is unknown. We propose a new potential explanation for these lesions: the fossa foveolar mismatch (FFM). It is defined by an overlapping contact of the fovea of the femoral head with the lunate surface of the acetabulum (“off the track”) leading to an internal impingement of the ligamentum capitis femoris and related degenerative lesions. Based on our clinical, radiographical and intraoperative observations, we hypothesize that such a pathological tracking pattern is more frequent in patients with femoral malversion. The aim of this study was to compare the FFM-index in patients with excessive (deficient) femoral version during physiological range of motion.

Method: IRB approved three-dimensional (3D) motion study. Analysis of 110 hips with femoral malversion (68 excessive, 22 deficient) eligible for joint preserving surgery in our institution (2011-2020). Hips with Perthes, posttraumatic disorders, previous surgery and incomplete documentation excluded; 44 hips left for analysis (10 deficient and 34 excessive femoral version). Computed tomography based 3D models were segmented using the commercially available software AMIRA (Visage imaging Inc, Carlsbad, CA, USA). Virtual excision of the fossa acetabuli and marking of fovea caps. Then analysis with validated 3D collision detection software. Using a standardized direct medial view on the resected FA and the transparent lunate surface, the FFM-index was calculated for the following motions: flex-extension, ab-adduction, and internal/external rotation. FFM-index: ratio between the fovea located outside of the fossa and the total foveolar tracking surface.

Results: While the deficient version group had a significantly higher proportion of foveolar tracking outside the fossa in internal rotation (median range 0.10 [0.0-0.28] compared to 0 [0.0-0.30]; p=0.001), patients with excessive femoral version had a significantly higher FFM-index in external rotation (0.21 [0.0-0.43] compared to 0.14 [0.06-0.21]; p=0.046). During flex-extension and ab-adduction the fovea was mainly located in the acetabular fossa in both groups.

Conclusion: Patients with femoral malversion present different patterns of foveolar maltracking. This could explain lesions of the ligamentum

Geriatric Patients with Acetabular Fractures have a Higher One-Year Survival compared to Proximal Femoral Fractures: A Matched Case-Control Study of 486 Patients. (9736)

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Introduction: Due to demographic changes, the prevalence of geriatric acetabular fractures rises. Operative treatment is more complex compared to proximal femoral fractures and often does not allow full-weight-bearing. We asked: what are (1) the cumulative one-year-mortality rate, (2) perioperative complications, and (3) predictive factors associated with one-year-mortality following operative treatment of acetabular and proximal femoral fractures.

Materials and Methods: In this institutional review board (IRB) approved comparative study, 486 consecutive, surgically treated, elderly patients (136 acetabular and 350 proximal femur fractures) were included. Patients with proximal femoral fractures had significantly higher Charlson comorbidity and frailty indices, ASA scores as well as sarcopenia. We therefore performed a case-control matching for the following factors: gender, Charlson comorbidity index, frailty and sarcopenia. Thus we obtained two comparable groups of 129 acetabular and 129 proximal femoral fractures. Cumulative mortality rates at one year were evaluated through Kaplan-Meier survivorship analysis; perioperative complications were documented and graded. After confirming that the proportionality assumption was met, cox-proportional-hazard modelling was conducted to identify factors associated with one-year mortality rates.

Results: The acetabular fracture group had a significantly lower cumulative one-year-mortality before (18% compared to 33% for proximal femoral fractures, log-rank p = 0.001) and after matching (respectively 18% compared to 36% log-rank p = 0.005). Nevertheless, they had a significantly higher overall perioperative complication rate (68% compared to 48%, p <0.001). In our multivariable cox-regression analysis, age, a perioperative blood loss >1L and wheelchair mobilization were associated with higher one-year-mortality after acetabular fracture surgery. For proximal femoral fractures, age and the 5 item modified frailty index were associated with a higher one-year-mortality, whereas full weight bearing was associated with lower one-year-mortality.

Conclusions: Despite the complexity of operative treatment and a higher perioperative complication rate for acetabular fractures in the elderly, the cumulative one-year-mortality is lower than after proximal femoral fractures, even after case-control matching.
Gluteus Maximus Tendon Transfer for Severe Abductor Insufficiency – Clinical and MRI Results after a Minimum Follow-Up of 2 Years (9778)

Armando Hoch; Dominik Kaiser; Stefan Rahm; Reto Sutter; Patrick Zingg

Introduction: Severe insufficiency of the hip abductors can lead to pain and Trendelenburg limping. For these patients, gluteus maximus transfer is a surgical treatment option. So far, little is known about the clinical outcome and in particular the structural integrity of the reconstruction. Our hypothesis was that these patients benefit overall from surgery, with a positive impact on pain, but non-relevant improvement on hip abductor strength.

Methods: We investigated 8 (6 female, 2 male) consecutive patients who underwent a gluteus maximus transfer for severe insufficiency of the hip abductors in our institution from 01.01.2016 to 30.06.2018. After a minimum of 24 months follow-up, the patients were called in for a clinical and radiological examination including MRI of the hip abductors. Pre- and postoperatively the pain level (visual analogue scale (VAS) 1 to 10), hip abductor strength (polio grade, M1 – M5), Trendelenburg sign and Trendelenburg or Duchenne limping were assessed. Integrity of the reconstruction, muscular trophy and fatty infiltration were analyzed on the pre- and postoperative MRI.

Results: Mean follow-up was 35 months (range 26 – 54). Pain level averaged 5.3 points (range 2 – 7.5) preoperatively and 2.5 points postoperatively (range 0 – 6.5) on a VAS (p = 0.048). The pain level decreased in every patient (p <0.01). Hip abductor strength did not significantly improve postoperatively (2.5 points preoperatively (range 2 – 4) and 3.1 points postoperatively (range 2 – 4); p = 0.29). Trendelenburg sign remained positive in all patients. Limping was present in 7 out of 8 patients preoperatively and in 3 out of 8 patients postoperatively (p = 0.12). There was no tear of the muscle transfer. Muscular trophy and fatty infiltration of the abductors and the transferred part of the gluteus maximus remained unchanged.

Conclusions: Gluteus maximus transfer for severe hip abductors lesions offers reliable pain relief after a minimum of 2 years follow-up. Muscle transfer integrity was confirmed in all cases. However, relevant improvement of muscle strength was seen only in 50% of the patients.

Deep learning for fully-automated quantification of avascular necrosis of the femoral head on 3D hip MRI in young patients eligible for joint preserving hip surgery: A pilot study (9795)

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Introduction: Size of necrosis is an important prognostic factor in the management of femoral head necrosis (AVN), usually estimated on radiographs and MRI. Ideally, a fast- volumetric assessment of necrosis size
would be desirable. Thus, we evaluated a deep-learning method to automatically quantify the necrotic bone in AVN.

Methods: IRB-approved retrospective study of 34 patients (mean age 30 years, 14 women) with AVN according to the 2019 ARCO grading: I (negative x-rays); 3 hips; II (no fracture); 5 hips; IIIA (head collapse <2 mm): 14 hips; IIIB (head collapse >2 mm): 12 hips. Patients underwent preoperative 3T hip MRI including 0.8 mm3 3D T1 VIBE on which manual ground truth segmentation of necrosis was performed by an experienced reader and then used to train a convolutional neural network (2D U-Net). A 3-fold cross-validation was performed between manual and automatic volumetric analysis of absolute/relative necrosis volume which was compared between early and advanced AVN (ARCO I/II versus IIIA/IB). Mean difference between manual and automatic segmentation was compared with paired t-tests and correlation was assessed with Pearson correlation coefficients. We compared size the absolute and relative size of the necrosis between early and advanced stages of AVN (ARCO I/II versus IIIA/IB) using Mann-Whitney U test. A p value <0.05 determined statistical significance.

Results: Mean absolute and relative AVN volume was comparable between manual (8.2±7.4cm3, 17±15%) and automatic (7.3±6.7cm3, 15±14%) segmentation (both p >0.05) and showed a strong correlation (r=0.63 and p <0.001, respectively). Manual and automated segmentation detected a difference (both p <0.05) in relative necrosis volume between early and advanced AVN: 9±8% vs 20±16% and 7±8% vs 18±14%, respectively.

Conclusion: Applying a deep learning method for volumetric assessment of AVN is feasible and showed very strong agreement and enabled to distinguish early vs advanced disease stages which paves way for evaluation in larger datasets, with the goal to determine its prognostic value.

Subtrochanteric osteotomy in the management of femoral mal torsion results in ante -posterior malcorrection of the greater trochanter – computed simulations of 3-D surface models of 100 cadavers (9798)
Andreas Flury¹; Fabian Aregger; Stefan Rahm; Armando Hoch; Patrick Zingg
¹ Balgrist University Hospital, University of Zurich

Background: Femoral mal torsion is associated with different hip disorders, i.e. femoroacetabular impingement or hip dysplasia, and may be addressed with subtrochanteric rotational osteotomy. Investigating femora with reduced antetorsion, previous studies suggested that a too posterior position of the GT might result after subtrochanteric osteotomies, explained by a compensatory increased posterior tilt of the greater trochanter (GT). The purpose of this study was to investigate the GT’s behavior in simulated subtrochanteric osteotomy and quantify the GT’s change in position in the axial plane.

Methods: Measurement of functional and anatomical femoral torsion, and position of the GT and lesser trochanter was performed using three-dimensional (3-D) surface models of 100 cadavers from 9798 models representing the body of a male human (173cm/73kg), was equipped with metal oxide semiconductor field effect transistors in different organ locations such as red bone marrow, liver, spleen, lung, gonads and bladder to measure radiation exposure. LV, OLV and ILV of the phantom representing the body of a male human (173cm/73kg), was equipped with computed simulations of three standard views (lateral (LV), outlet (OLV) and inlet (ILV)). The acquisition protocol was repeated three times to adjust the variability. The effective dose was calculated according to the guidelines of the International Commission on Radiological Protection. Radiation exposure was measured for FSG placement of 2 transverse ISS based on clinical experience regarding fluoroscopy time (lateral view 2 min; inlet and outlet views 1 min each). Additional measurements were conducted to calculate the effective dose for a 3D scan as used for navigated ISS (3D high-quality), for intraoperative verification of proper guide wire placement (3D standard-quality) and for postoperative CT, using a state-of-the-art scanner and protocol. The following workflows were compared: FSG including postoperative CT (FSG-CT) vs. FSG with intraoperative 3D scan (FSG-3D) vs. navigation including an intraoperative 3D standard-quality scan (NAV-3D).

Results: The effective dose for FSG-CT and FSG-3D were 5.12 mSv and 4.78 mSv, respectively. For NAV-3D, the effective dose was the lowest (3.00 mSv). The effective dose of a high-quality 3D scan required for navigation was 1.94 mSv, compared to 1.06 mSv for a standard-quality 3D scan. Radiation exposure of a standard-quality 3D scan was comparable to postoperative CT (1.06 vs. 1.40 mSv) with both counting for <40% compared to the effective dose for FSG ISS placement (3.72 mSv).

Conclusion: Intraoperative 3D scanning can be recommended, either combined with prior FSG ISS placement or following 3D navigation without increasing radiation exposure compared with alternative workflows with postoperative CT control.

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Conclusion: Intraoperative 3D scanning can be recommended, either combined with prior FSG ISS placement or following 3D navigation without increasing radiation exposure compared with alternative workflows with postoperative CT control.

Radiation exposure of 3 standard fluoroscopic views used in iliosacral screw placement: organ involvement and potential implications for the surgical technique (8800)
Hannes Kuttner; Emanuel Benninger; Christoph Meier
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Objective: Fluoroscopy-guided minimally invasive transverse placement of cannulated iliosacral screws (ISS) through S1 and/or S2 is an established technique to stabilize fractures of the posterior pelvic ring. Usually, three standard views (lateral (LV), outlet (OLV) and inlet (ILV)) are used. However, this technique may be associated with a considerable amount of radiation exposure. It was the aim of this experimental study to evaluate radiation exposure for three clinical workflows.

Methods: An anthropomorphic cross sectional dosimetry phantom, representing the body of a male human (173cm/73kg), was equipped with metal oxide semiconductor field effect transistors in different organ locations such as red bone marrow, liver, spleen, lung, gonads and bladder to measure radiation exposure. LV, OLV and ILV of the phantom were obtained with a mobile C-arm with three minutes of irradiation for each view. The acquisition protocol was repeated three times to adjust the variability. This data was used to calculate the effective dose and the organ doses according to the guidelines of the International Commission on Radiological Protection (ICRP).
Results: The effective dose was the lowest for LV (0.46 mSv/min) with about the double and fourfold amount of that for OLV (0.95 mSv/min) and ILV (1.85 mSv/min), respectively. For LV, the highest organ dose was found in colon (0.119 mSv/min), followed by red bone marrow (0.090 mSv/min). For OLV, colon (0.070 mSv/min) was also the most affected organ, followed by bladder (0.135 mSv/min). Regarding LV, stomach showed the highest organ dose (0.918 mSv/min) and colon was also considerably affected (0.321 mSv/min).

Conclusion: Usually, the correct starting point of the guide wire is determined on LV. ILV and OLV are then alternately applied for a proper visualization of the advancing guide wire. Based on our study, one should consider to advance the guide wire as far as possible exclusively guided by an exact LV to reduce irradiation with the guide wire aimed straight on line with the central beam of LV. ILV and OLV may be used sparingly to confirm the correct wire position and to determine proper screw length. However, if the radiological anatomy of LV is considered not to be sufficient enough for a safe advancement of the guide wire, OLV and ILV may have to be used more often to improve safety despite higher radiation exposure.

Clinical outcome and patient satisfaction in patients with hamstring rupture treated with modified proximal surgical anchor refixation (9846)

Tomas Chocholac; Linda Bühl; Corina Nüesch; Niklas Bleicher; Annette Müller; Ueli Loffel; Karl Universitätsspital Basel (USB)

Introduction: Although repair of proximal hamstring rupture is a routine procedure, to date evidence regarding patient satisfaction and clinical outcome after refixation is scarce. We aimed to describe the clinical outcome and patient satisfaction in patients with a modified surgical technique 2 years after surgery.

Methods: This single center retrospective study included 9 patients (5 female, 4 male) treated surgically between 2016-2018 with a median age of 61.8 (range: 52.1–80.4) years and a follow up with median of 52.8 months (21.6-73.6). Eight patients had a complete proximal hamstring rupture and one patient a partial rupture (2 of 3 tendons) with at least 1 cm displacement. All hamstring tendons were attached to the lateral aspect of the sciatic tubercle to improve the pretension and prevent local irritation over the sciatic tubercle. The clinical outcome included range of motion, muscle strength of individual muscle groups (M1-5, Janda), local tenderness on palpation and while sitting, and local skin sensitivity. Patients rated their satisfaction between 0 (not satisfied at all) and 100 (extremely satisfied). All data are presented as median (range).

Results: Maximum hip flexion did not differ between the operated and the non-operated hip neither with flexed knee (120 [115–120]°) nor with fully extended knee (operative hip 80 [60–110]°; non-operated hip 80 (70–110)°). Eight patients achieved full marks (L2-5: M5/S5) in clinical muscle strength and one only slight decreased M4/S5; (female, 65 years, BMI 29.4 kg/m2). None of the patients felt any tenderness when palpated and all had normal sensitivity around the surgery scar. Patients were very to extremely satisfied with the treatment (100 [90–100]%).

Conclusions: Although reduced muscle strength of the hamstring muscles after surgical anchor refixation has been reported, patients in our study treated with more proximal/lateral surgical anchor refixation had excellent clinical muscle strength, less local irritation over the ischial tuberosity and most were extremely satisfied with the result after the surgery. While these results are very promising, further biomechanical studies are needed to measure isokinetic muscle strength and dynamic functional hip outcome.

Deep Learning Based Fully Automated 3D MRI Models of Hip Cartilage and Labrum: A pilot study (9874)

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Introduction: MRI has emerged as the modality of choice to assess hip joint damage. However, standard evaluation is based on 2D images. Ideally, 3D information of cartilage and labrum morphology from MRI would be available. However, manual segmentation for 3D reconstruction of cartilage and labrum is very time consuming and is therefore not routinely applied in clinical practice. Deep learning-based methods have the potential for automatic 3D segmentation of cartilage and labrum from hip MRI.

We aimed to validate a new deep learning-based method for automatic segmentation of cartilage and labrum against manual segmentation.

Methods: This IRB-approved retrospective study included 33 consecutive selected patients (34 hips) eligible for joint preserving hip surgery. Patients with previous surgery, trauma, childhood hip disease or avascular necrosis of the femoral head were excluded. The mean age in the patient series was 30 years (range 18 – 52 years) with 64% of female patients. All patients underwent a direct 3 Tesla MR arthrography including a high-resolution 3D T1 weighted sequence. Hips were assigned to 5 subgroups based on AP pelvic radiographs: hip dysplasia (lateral center edge angle (LCE) <20°; n=6), borderline dysplasia (LCE 20–25°; n=4), normal acetabular coverage (LCE 25–38°; n=12), deep hips (LCE >38°; n=6) and severe retroversion (n=7). 3D manual segmentations of cartilage and labrum served as training data for the neural network (2D U-Net) to obtain an automated 3D model of cartilage and labrum. A three-fold cross validation was performed and mean cartilage and labrum volume were compared between manual and automated segmentations. Correlations were assessed with Spearman correlation coefficient.

Results: Mean volumes were comparable for manual and automatic segmentation of cartilage (6887 ± 1319 mm3 and 7028 ± 1266 mm3, respectively) and labrum (volume of 2290 ± 1053 mm3 and 1976 ± 441 mm3, respectively). A very strong correlation between manual and automatic segmentation of cartilage (r = 0.88, p <0.0001) and labrum volumes was found (r = 0.81, p <0.0001).

Conclusion: This pilot study shows that deep learning methods allow automatic and accurate segmentation of cartilage and labrum based on 3D hip MRI. This validation highlights the potential for 3D assessment of cartilage and labrum in large data sets and paves way to routine use of these 3D MRI models of cartilage and labrum to potentially improve surgical decision making.

Management Of Pelvic Ring Injuries In High-Energy Trauma Patients: An Institutional Series (9885)

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Background: Pelvic ring injuries (PRI) in high-energy (HE) trauma patients with hemodynamic (HD) instability are complicated by a high mortality rate (up to 32%). Multiple management strategies for HD unstable PRI are described in literature, but there is no consensus for a standardized approach with the best patient outcomes. Since 2000, at our tertiary referral level I trauma center, a standardized protocol for HD stable and unstable HE PRI is applied. HD unstable patients not responding to pelvic belt, liquids administration and transfusions undergo urgent pelvic mechanical stabilization. If still HD unstable, angiography and potentially embolization are performed. The aim of this study was to evaluate mortality and outcome of the management protocol used at our institution.

Materials & Methods: The institutional severely injured patients’ registry was reviewed to retrospectively collect demographic, clinical and radiologic data of a consecutive series of HE PRI patients treated from January 2014 to December 2019. Early and late mortality, mean packed red blood cell (PRBC) units need in the first 24 hours, intensive care unit (ICU) and hospitalization length of stay (LOS) were evaluated as outcome measures.

Results: We included 189 high-energy PRI patients, 121 HD stable and 68 HD unstable, whose mean age was 44.2 and 46.2 years, respectively.
The main cause of injury was a fall from height in the whole population. Most fractures were type B AO/OTA in unstable (54.4%) and stable (69.4%) patients. The mean ISS was higher for HD unstable (35.6) than stable (20.2) patients. There was a statistically significant difference in mortality between groups, with early mortality (<48 hours) of 17.6% vs. 0% in unstable and stable patients, and late mortality (cumulative 60-day mortality) of 29.4 vs. 3.3% respectively. Unstable patients required a higher number of PRBC units (5.3 vs. 0.1 units for HD stable). The ICU and hospitalization LOS was 11.25 and 37.4 days respectively for unstable and 1.9 and 20.9 days respectively for stable patients.

Conclusions: In HD unstable patients, the protocol used at our institution shows a low early mortality rate (17.6%) and similar late mortality (29.4%) compared to the literature. Due to the variety of management protocols of HD unstable HE PRI patients reported in the literature, comparative studies are needed to determine the best management strategies according to patients’ prognosis.

A Statistical Shape Model Based Analysis of (Reverse) Periacetabular Osteotomies – Technical considerations to achieve the targeted correction (9903)

Philipp Kriechling¹; Laura Leoty²; Philipp Fürnstahl²; Patrick Zingg³; Lazaros Vlachopoulos¹

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Introduction: The Bernese (Reverse) Periacetabular Osteotomy (PAO and rPAO) has been proven to be an effective surgical treatment for developmental dysplasia of the hip, severe acetabular retroversion and some protrusio acetabuli. In severe cases with higher degrees of correction, especially in reverse PAO, a relevant overlap between fragment and pelvis might occur and lead to a necessary fragment translocation possibly resulting in change of the rotational center. The aim of the present study was to analyze the necessary transllocation as a function of the degrees of correction using a statistical mean model of the pelvis.

Methods: A mean statistical shape model was used to simulate a Bernese (reverse) PAO and calculate rotations from -20° to +20° in the frontal (FP), sagittal (SP) and transversal (TP) plane, and a combination thereof. Consecutively, the intersection depth and intersection volume between the mobilized fragment and the pelvis were calculated for each part of the pelvis and altogether. Thereafter, the minimal translation of the fragment necessary to avoid segment overlap was calculated.

Results: For PAO related rotations in case of dysplasia, the maximum intersection distance between pelvis and fragment was 6.5 mm for 20° FP rotation, 10.4 mm for 20° SP rotation, and 6.6 mm for combined 20° rotation in FP and SP. The necessary translation of the rotation center was 6.7 mm for 20° FP rotation, 8.0 mm for 20° SP rotation. The combination of both resulted in 6.0 mm infero-lateral translation. For rPAO related rotations in case of acetabular retroversion, the maximum intersection distance was 5.3 mm for 20° FP rotation, 28.9 mm for 20° SP rotation, and 28.1 mm for a combination of both. The necessary translation was 4.6 mm for 20° FP rotation and 18.6 mm for 20° SP rotation. The combination of both resulted in 17.7 mm translation.

Conclusion: Acetabular reorientation by the Bernese (Reverse) PAO results in translation of the fragment and in a consecutive change of the rotational center. This finding is more pronounced with higher degrees of fragment reorientation, becomes especially relevant in reverse PAO for femoracetabular impingement or protrusio acetabuli and might limit the initial intention to overall improve hip biomechanics. Exact preoperative 3D planning of the desired position with specified fragment offset might be necessary to avoid negative impact on joint loading and leg length.

Total hip arthroplasty after osteosynthesis of proximal femoral fractures compared to primary Total hip arthroplasty (9908)

Alisa Schleicher; Philipp Neidenbach; Stefan Blümel; Michael Leunig; Hannes Rüdiger

Schulthess Klinik

Introduction: Total hip arthroplasty (THA) after proximal femoral fracture osteosynthesis (OS) is technically more demanding than primary THA. Since poorer outcome has been reported, aim of the study was to describe intra- and postoperative complications and radiological outcomes compared to primary THA.

Methods: We conducted a retrospective single-center study of 85 Patients (25 male 65±13 yrs, 60 female 72±12 yrs) who have had THA (cTHA) after OS of proximal femoral fractures between 2009 and 2016. Patients were converted to THA after failed OS, nailing (n=52), cancellous screws (CS) (n=18) or sliding hip screw (SHS) (n=15). Reasons for conversion, intra- and postoperative data (duration of surgery, blood loss and adverse events) were recorded from our clinical information system. Radiographic outcomes (heterotopic ossification, sclerosis and osteolysis) were assessed pre-op, immediately post-op and 5 yrs post-op. Patient reported outcomes were collected. This gathered data then was compared with a cohort of 191 Patients (97 male 68±10 yrs, 94 female 70±13 yrs) with a primary THA (pTHA).

Results: The main reasons for conversion to THA was osteoarthritis (n=27), non-amil-union (n=32) and cutout of the implant (n=10). The time between OS and THA ranged from 1 month to 47 yrs (median 1.08 yrs). 12% of the cases required a trochanteric refixation, 2.4% patients suffered an intra-op fracture that needed fixing. Heterotopic ossification, grade 3 and 4 (Brocker classification) were present in 4 cases. All patient reported outcomes showed a rapid progression between pre-op scores and 6 months and plateaued after 5 yrs FUP. Comparing the cTHA with the pTHA group we found longer time of surgery 113±33 minutes (cTHA) vs. 63±19 minutes (pTHA), furthermore blood loss was 473±300 ml (cTHA) vs. 323±180 ml (pTHA). In the cTHA group 12/85 (14%) had post-op adverse events compared to 34/384 (8.8%) of pTHA. The patient reported outcomes were similar in both groups.

Discussion: Our results show that converting to THA after failed OS, is a more complex procedure than primary THA. The conversion is associated with longer time of surgery, intra- and post-op complications. We conclude that THA including removal of hardware after proximal femoral fractures is not correctly reimbursed in the Swiss DRG system.

Measurement of Lunate Surface Area of the Acetabulum with 3-D MRI and matched CT scans for patients with FAI (9984)

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Introduction: It is unclear if patients with pincer-type FAI with acetabular retroversion should be treated with an anteverting periacetabular osteotomy (PAO) or with acetabular rim trimming. The lunate surface area (LSA) is a new parameter for local planning of the acetabular rim and MRI and the measurement of LSA and fossa acetabuli area (FSA) between 3-dimensional computed tomography (3D CT) and a novel segmentation approach for 3D magnetic resonance imaging (MRI) of patients with symptomatic femoro-acetabular impingement (FAI).

Methods: Twenty-six patients (31 hips, 48% men; age range 17-41 years) were consecutively evaluated who had both CT and MRI of the hip joint for evaluation of hip pain due to FAI. Inclusion criteria were patients with hip pain due to FAI who had an acetabular rim trimming of the left hip performed at the same joint hip. All patients had a positive anterior impingement test and underwent a 3-Tesla 3D MRI with additional volumetric 3D scans and were retrospectively reviewed. Segmentation of patient-specific 3D models of the acetabulum were performed. In face views of the acetabulum for both CT and MRI were evaluated for patient-specific measurement of LSA and FSA with a custom-made software using a novel and fast technique. The size of the LSA compared between two readers. Surgical treatment was performed in 19 hips and included cam resection and/or acetabular rim trimming in 12 hips with surgical hip dislocation or hip arthroscopy.

Results: There were no significant differences of the mean LSA measured by 3D-CT and 3D-MRI (2227±318mm2 vs 2185±341mm2, p value 0.86). The mean LSA was not different among the manual 3D CT of two readers (2227±318mm2 vs 2185±341mm2). Overall regression...
analysis demonstrated excellent correlation between CT and MRI for both LSA and FSA calculation (r = 0.95, p < 0.001 and r = 0.901, p < 0.001).

**Conclusion:** 3D MRI is nearly identical to 3D CT scans for measurement of LSA and FSA, making 3D MRI a reliable alternative for a preoperative evaluation. This is important especially for patients with acetabular retroversion. This study shows that a 3D MRI could be a radiation-free and reliable alternative to a pelvic CT scan.

**Bone segmentation of the pelvis via tin-filtered ultra-low-dose CT compared with standard CT – A Feasibility Study (9972)**

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**Introduction:** Computed tomography (CT) has made it possible to use patient-specific three-dimensional (3D) simulations obtained from medical image segmentation to assist preoperative planning, such as periacetabular osteotomies or subtrochanteric rotational osteotomies. However, radiation exposure of the pelvis is high when using standard CT. In this study, we evaluate the accuracy and quality of 3D-reconstructed models obtained from ultra-low-dose CT with tin filtration as an alternative to standard CT (gold standard).

**Methods:** IRB-approved prospective study with informed consent. Patients obtaining a non-contrast-enhanced standard CT of the pelvis were scanned additionally with tin-filtered ultra-low-dose CT of the pelvis. Both scans were used to create 3D surface model reconstructions of the left and right hemipelvis, and the left and right proximal femur. The reconstructions were performed for each patient independently by two readers. The root mean square error (RMSE) was used to calculate the average error between the surface models of both methods. Volume CT dose index (CTDIvol) and dose length product (DLP) were used as dose parameters. Differences in the radiation dose of both scans were evaluated using Wilcoxon signed-rank test.

**Results:** 23 subjects (9 males and 14 females; mean age 31±8 years) were included. The mean average error for the right hemipelvis was 0.47±0.06 mm (for the left hemipelvis: 0.48±0.06 mm) for reader one, and 0.48±0.07 mm (0.50±0.11 mm) for reader two, respectively. The mean average error for the proximal right femur was 0.52±0.05 mm (0.5±0.06 mm) for reader one, and 0.56±0.08 mm (0.57±0.11 mm) for reader two, respectively.

The average CTDIvol for the standard CT examinations was 8.19±4.45 mGy, and 1.09±0.02 mGy for tin-filtered ultra-low-dose CT exams, respectively. The DLP for the standard CT examinations was 220.45±124.36 mGycm, and 29.12±1.54 mGycm for ultra-low-dose CT exams, respectively. Comparing the radiation dose, the average CTDIvol and average DLP were substantially lower (87%) for ultra-low-dose CT with tin filtration compared to the gold standard (p < 0.001).

**Conclusion:** 3D surface model reconstruction from tin-filtered ultra-low-dose CT is feasible and has similar accuracy as that of the standard CT, with a significantly lower radiation dose. This is of particular relevance for the young patient group undergoing an osteotomy op the hip.

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**The Natural History of Degenerative Hip Abductor Tendon Lesions (9983)**

Pascal Schenk; Stefan Zimmermann; Michael Finsterwaltd; Kai Higashigaito; Reto Sutter; Stefan Rahm; Patrick Zingg Uniklinik Balgrist

**Introduction:** Natural history of degenerative hip abductor tendon lesions remains unknown and has not yet been reported in the literature. The purpose of the present study was to assess the nonoperative clinical and structural outcomes of symptomatic patients with degenerative hip abductor tendon lesions.

**Material and Methods:** A consecutive series of patients suffering of greater trochanteric pain syndrome who underwent magnetic resonance imaging (MRI) of the native hip between January 2003 to November 2015 were identified. All 58 patients (64 hips, 40 females) with a mean age of 66y (range 37-91) were included in this study. Patients were called in after a minimum follow-up of three years (mean 74 months; range 38-138) for a clinical and radiographic examination including Harris Hip Score and MRI of both hips.

MRIs were evaluated for hip abductor tendinopathy, partial and full thickness tears as well as for fatty muscle infiltration (Goutallier, grade 0-4).

**Results:** On initial MR images, there were 14 hips without hip abductor tendon lesions, 15 tendinopathies, 32 partial tears and 3 full thickness tears. Fatty muscle infiltration averaged 1.3 Goutallier grade (range 0-4) and without significant correlation to the degree of tendon lesion.

On follow-up MR images, 15 hips had developed new hip abductor tendon lesions, but two tendinopathies healed. 6 tendinopathies (40%) progressed to partial tears, 2 partial tears (13%) progressed to full thickness tears. The 3 full thickness tears remained unchanged. There was no significant increase in fatty infiltration overall (1.5 Goutallier grade (range 0-4) p = ns) and in hips showing progression of tendon lesions.

Compared to the asymptomatic contralateral hips at follow-up, there was significantly higher degree of degeneration of the lateral section of the greater trochanter (p = 0.034) only, but without significant difference for fatty muscle infiltration.

At latest follow-up, mean HHS of the involved and asymptomatic contralateral hip was 80 and 93pts (p < 0.001), respectively.

**Conclusion:** Progression of symptomatic hip abductor tendinopathy to partial tears seems to be common after a minimum follow-up of 3 years. However, partial tears only rarely increase to full thickness tears. No relevant fatty muscle degeneration did occur in degenerative hip abductor tendon lesion at mid-term follow-up. These findings may support initial conservative treatment.
ASEPTIC LOOSENING OF THE CEMENTED WEBER STEM IN PRIMARY TOTAL HIP ARTHROPLASTY – IS THE ANTERIOR APPROACH ASSOCIATED TO HIGHER RATE OF LOOSENING? A REGISTER-BASED RETROSPECTIVE ANALYSIS OF 483 CASES. (9993)

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Introduction: Aseptic loosening (AL) of the cemented stem is an important indication for revision after primary total hip replacement (THR). The reasons for this are not yet fully understood. Cementing quality, commonly classified by Barrack and Harris (BH), plays a significant role in this loosening and can be influenced by multiple factors. One factor includes bone quality, which can be evaluated according the Dorr classification (DC) and the Cortical Index (CI). Moreover, limited exposure of the proximal femur during minimally invasive anterior approach (MIS) is a common challenge in cemented THR.

The aim of our study was to identify an influence on cementing quality of the stem in MIS compared to the anterolateral approach (ALA) and therefore on the rate of AL. Also, we analyzed if body mass index (BMI) or patient’s health status, described according the American Society of Anesthesiologists score (ASA), may play a role.

Body mass index (BMI) and health status, commonly described as American Society of Anesthesiologists score (ASA) were also analyzed to determine the influence they may have on outcomes.

Methods: Inclusions were cemented primary THR performed at our institution for degenerative hip joint disease between 2012 and 2019 according to the Swiss national registry for hip and knee replacement (SIRIS). We excluded fractures, conversion to THR after prior surgery or insufficient quality radiographs pre- or postoperatively. SIRIS and our own database were searched for revision THR for AL in our cohort. For all patients, surgical approach, BMI and ASA data were noted. DC and CI were measured in preoperative X-rays, while BH and the presence of radiolucency according the Gruen Zones were rated postoperatively.

Results: Among the 483 THR, 314 (65,1%) were performed through MIS and 169 (34,9%) through ALA. 14 out of 483 (2.9%) underwent revision due to AL. Mean interval to revision was 22,9 months (3,6 – 45,9; SD: 45,9). Revision rate was greater for MIS (3.8%) compared to ALA (1.2%) but not significantly (p = 0.1). CI, DC and BH were not significantly related to revision (p = 0,88), (p = 0,86) and (p = 0.48), respectively. ASA and BMI were not significantly higher in the revision group (p = 0,92 and p = 0,89).

Conclusion: Our SIRIS based analysis of 483 primary cemented THR showed that MIS tends to cause a higher revision rate for aseptic loosening of the stem than the anterolateral approach. However, the association was not significant.
The EOS 3D imaging system reliably determines posterior tibial slope (9717)
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Introduction: Planning total knee arthroplasty (TKA) prior to surgery is a mandatory step for success. In many centers routinely anterior-posterior (AP) and lateral standard radiographs of the knee and AP long leg radiographs (LLR) are available for this task. One of the preoperatively determined values is the posterior tibial slope (PTS), which is a proven factor for the success of TKA. It is best measured on CT or at least lateral full tibia radiographs which are routinely not available. Another option that is available in many centers is the EOS 3D imaging system, which provides an AP and lateral LLR with less radiation than a conventional LLR. Therefore, we aimed to investigate its reliability regarding PTS measurements.

Methods: We retrospectively reviewed our radiologic data base between 01/2019 and 12/2019 for patients with an EOS scan and additional rotational CT scan of the lower extremity. 56 knees were included for analysis. Medial and lateral PTS were determined on both EOS radiographs and CT scans. All measurements were done independently by a radiologist and an orthopedic surgeon at two time points and inter-class correlation (ICC) was calculated to assess inter- and intra-reader reliability. Student’s t test and the Pearson correlation were used to compare the results of both imaging modalities.

Results: The mean medial PTS was 8.5° (95% CI, 8.1-8.9°) on EOS and 7.7° (95% CI, 7.3-8.1°) on CT while the lateral PTS was 7.4° (95% CI, 6.9-7.9°) on EOS and 7.0° (95% CI, 6.5-7.4°) on CT. The inter-reader reliability (ICC) was excellent regarding medial and lateral tibial slope on EOS (0.880, 0.765) and CT (0.894, 0.887). The intra-reader reliability of reader 1 (ICC-range, 0.889 to 0.986) and reader 2 (ICC-range, 0.868 to 0.980) were excellent regarding the same measurements.

Conclusion: The EOS 3D imaging system provides reliable and reproducible tibial slope measurements compared to CT measurements as today’s gold-standard. We recommend using this technique in preoperative TKA planning if available, because more information is gathered, compared to conventional LLR, with less radiation.

High inter- and intraindividual differences in medial and lateral posterior tibial slope are not reproduced accurately by conventional TKA alignment techniques (9721)
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Purpose: The purpose of this study was to describe the medial and lateral posterior tibial slope (MPTS and LPTS) on 3D-CT in a Caucasian population without osteoarthritis. It was hypothesised that standard TKA alignment techniques would not reproduce the anatomy in a high percentage of native knees.

Methods: CT scans of 301 knees (male:female = 192:109; mean age 30.1 ± 6.1 years) were analysed retrospectively. Tibial slope was measured mediially and laterally in relation to the mechanical axis of the tibia. The proportion of MPTS and LPTS was calculated, corresponding to the ‘standard PTS’ of 3-7°. The proportion of knees accurately reproduced with the recommended PTS of 0-3° for PS and 5-7° for CR TKA were evaluated.

Results: Interindividual mean values of MPTS and LPTS did not differ significantly (mean (range); MPTS: 7.2° (-1.0°-19.0°) vs. LPTS: 7.2° (-2.4°-17.8°), p=n.s.). The mean absolute intraindividual difference was 2.9° (0.0-10.8°). In 40.5% the intraindividual difference between MPTS and LPTS was >3°. When the standard slope of 3-7° medial and lateral was considered, only 15% of the knees were covered. The tibial cut for a PS TKA or a CR TKA changes the combined PTS (MPTS+LPTS) in 99.3% and 95.3% of cases, respectively.

Conclusion: A high interindividual range of MPTS and LPTS as well as considerable intraindividual differences were shown. When implementing the recommended slope values for PS and CR prostheses, changes in native slope must be accepted. Further research is needed to evaluate the impact of altering a patient’s native slope on the clinical outcome.

The Value of Proximal Transfer of Tibial Tubercle in Patients with Patella Baja after Total Knee Arthroplasty (9739)
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Introduction: One third of the patients after total knee arthroplasty (TKA) presents with anterior knee pain and impaired range of motion due (ROM) to patella baja. Proximal transfer of tibial tubercle is considered a satisfactory solution for this pathology. However, long-term follow-ups are lacking. We therefore aimed to investigate the clinical function as well as the radiographic patella height up to five years postoperative.

Methods: In a single-center study, sixty patients with patella baja after TKA that underwent proximalisation of the tibial tubercle were included. Clinical (ROM, Knee Society Scoring system (KSS), WOMAC questionnaire) and radiographic parameters (Caton Deschamps index (CDI), Blackburne Peel ratio (BP), modified Insall Salvati index (MIS)) were compared at various timepoints over the long-term follow-up.

Results: After a mean follow-up of 57 months, proximalisation of tibial tubercle resulted in a significantly improved ROM (80° vs. 88°). Whereas the KSS Knee Score did not improve postoperatively, patients showed worse results for both the KSS Function Score and the WOMAC questionnaire after the intervention. Immediately postoperative, the mean CDI and the BP were not significantly better than prior to the intervention (CDI 0.72 ± 0.63; p=0.72 respectively BP 0.66 ± 0.61; p=0.72) and even decreased significantly up to the last follow-up so that the mean final values were significantly worse compared to the native joint (CDI 0.59 vs. 0.78; p=0.001 respectively BP 0.58 vs. 0.74; p=0.001). Likewise, the MIS remained unchanged after proximalisation of the tibial tubercle compared to pre-intervention (1.59 vs. 1.55; p=1.00) and decreased further over the time so that the mean value at last follow-up was significantly lower compared to the native joint (1.39 vs. 1.81; p <0.001).

Conclusion: Proximalisation of the tibial tubercle in patients with patella baja does neither lead to a significant improvement of the clinical outcome nor of the radiographic patella height over the long-term follow-up. Through proximal transfer, the ROM can be significantly improved although not to a sufficient value for activities in normal daily life.

Autologous Matrix-Induced Chondrogenesis (AMIC) for Isolated Retropatellar Cartilage Lesions: Outcome After a Follow-up of Minimum Two Years (9775)
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Purpose: To evaluate autologous matrix-induced chondrogenesis (AMIC) for isolated focal retropatellar cartilage lesions and the influence of patellofemoral (PF) anatomy on clinical outcomes at a minimum of 2-year follow-up.

Methods: Twenty-nine consecutive patients (31 knees) that underwent retropatellar AMIC with a mean age of 27.9 ± 11.0 years were evaluated at a follow-up averaging 4.1 ± 1.9 years (range, 2 to 8 years). Patient factors, lesion morphology and patient-reported outcome measures including KOOS, Tegner, Kujala score and VAS score were collected. PF anatomy was assessed on pre- and postoperative imaging, and subsequently correlated to outcome scores and failure to determine risk factors for poor outcome.

Results: At final follow-up, the AMIC graft failed in 4 cases (12.9%) at a mean follow-up of 21 ± 14.1 months. Patients with failed grafts had a significantly smaller patellar and Laurin’s PF angle than patients whose graft did not fail (p=0.008 and p=0.004, respectively). Concomitant corrective surgery for patellar instability was performed in 29 knees (93.5%). Grafts that did not fail presented with an average Kujala score of 71.3 ± 16.9, KOOS of 68.7 and Tegner scores of 4.2 ± 1.8. The
The existing literature reveals ambiguity about the anatomy and radiological diagnosis of Kaplan fibers injuries in ACL deficient knees. To this date, there is no knowledge about the natural evolution of Kaplan injuries after ACL reconstruction. Our purpose was to evaluate the complications and re-admission rates after Kaplan fibers injuries in acute ACL deficient knees and to further observe the healing process of the Kaplan fibers complex in ACL reconstructed knees. Kaplan fibers injuries in acute ACL-deficient knees and ACL reconstructed knees – redefining the structure and risk assessment on routine MRI using injury patterns (9797)

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Background: The existing literature reveals ambiguity about the anatomy and radiological diagnosis of Kaplan fibers injuries in ACL deficient knees. To this date, there is no knowledge about the natural evolution of Kaplan injuries after ACL reconstruction. Purpose: This study aims to evaluate a detailed injury pattern of knee joint structures along torn Kaplan fibers in ACL deficient knees and to further observe the healing process of the Kaplan fibers complex in ACL reconstructed knees.

Materials and methods: A total of 101 knee MRI scans obtained between January 2004 and April 2020 with acute full-thickness ACL tears were retrospectively assessed for visibility and impairment of three Kaplan bundles (proximal, distal and epicondylar band) and for associated knee joint injuries by two fellowship-trained independent musculoskeletal radiologists. Descriptive statistics and Spearman correlation coefficients were used to determine injury patterns. Based on the strongest correlations found with the other knee structures, a risk score was calculated. A subgroup of 33 follow-up knee MRIs after ACL reconstruction was assessed to observe the natural evolution of Kaplan fibers injury.

Results: Kaplan fibers were injured in 43% (43/101) of acute ACL deficient knees. Proximal Kaplan fibers were visible in less than 50% (48/101) of the knees as opposed to the distal Kaplan fibers and epicondylar Kaplan band which were both visible in 97% (98/101) of the knees. Injury to the Kaplan complex was significantly associated with anterolateral ligament (p <0.001), lateral collateral ligament impairment and BME on the extension facet of the medial femoral condyle (p <0.05). After ACL reconstruction, the majority of Kaplan fibers (31/33) were healed with only two cases of torn and 13 cases of scarred distal Kaplan fibers, the other two bundles (proximal and epicondylar) being intact.

Conclusion: When examining the Kaplan complex in acute ACL deficient knees, injury patterns can firstly eliminate the uncertainty of proximal fibers identification and moreover can indicate the severity of the trauma during ACL rupture and orient the physician in actively searching for anterolateral and rotatory instability not only in the acute phase but also after ACL reconstruction.

Level of evidence: IV

Keywords: knee, Kaplan fibers, epicondylar band, anterior cruciate ligament, rotational injury, anterolateral instability.

Unicompartmental knee arthroplasty in outpatient setting: a group control study of 84 cases (9801)

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Introduction: The number of primary knee arthroplasties has been increasing and a key factor in its cost is length of hospital stay. Moreover, given the current pandemic situation, not overloading the hospital system is a priority. Outpatient surgery is a solution. Partial knee arthroplasty (PKA) in an outpatient setting (OS) is little described. The aims of this study are to evaluate the complications and re-admission rates within the first 30 post-operative days, as well as patients’ satisfaction and clinical scores post PKA in an OS and compare it to a control group of inpatients (IP).

Materials and Methods: This retrospective study includes all patients who underwent PKA in an OS and IP between 2014 and 2019 in the same institution. 84 PKA were performed in OS and 200 as IP. Complications and re-admissions within 30 days post-op were reported. Patient satisfaction was assessed using a satisfaction scale. Knee Society Score (KSS) was evaluated at the last control.

Results: In OS, two patients were re-admitted within 24 hours due to hematoma and uncontrolled pain, which did not require surgical revision. One patient had chronic knee pain at 2 years. In the IP group, one patient had a stroke 3 days post-op and one had pain due to conflict with the ACL spine and needed a revision surgery. In both groups over 90% were satisfied (93% in OS, 98% as IP, p =0.42). The mean knee score of the KSS increased from 68.7 to 92.9 in OS and from 60 to 91.7 as IP and the mean KSS function score increased from 69.8 to 93.1 in OS and from 65 to 94 as IP, no statistical signification.

Conclusion: Our study demonstrates that performing PKA in an OS is safe. The clinical scores and satisfaction rate are comparable to the clinical scores of PKA performed in an inpatient setting. However, prospective comparative studies are needed to determine the risk factors that may affect the achievement of PKA in an OS.

Restoration of Native Leg Length After Opening Wedge High Tibial Osteotomy: An Intraindividual Analysis (9803)

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Introduction: This study aimed to assess the pre- and postoperative leg length of the involved lower extremity in patients submitted to opening wedge high tibial osteotomy (OWHTO) and compare it to the unaffected contralateral side. It was hypothesized that patients present with decreased preoperative length of the involved leg when compared to the contralateral side and that OWHTO would subsequently restore native leg length.

Methods: Sixty-seven patients that underwent OWHTO for unilateral medial compartment knee osteoarthritis that received pre- and postoperative full leg length assessment were included in this retrospective study. Patients that presented with varus or valgus deformity (>3°) of the contralateral side were excluded. A musculoskeletal radiologist assessed imaging for the mechanical axis, full leg and tibial length of the involved and contralateral lower extremity. Statistical analysis determined the pre- and postoperative leg length discrepancy and the influence of the mechanical axis.

Results: The majority of patients (62.7%) presented with a decreased length of the involved leg with a mean preoperative mechanical axis of 5.0 ± 2.9°. Leg discrepancy averaged -2.2 ± 5.8 mm indicating a shortened involved extremity (p=0.003). OWHTO significantly increased the mean lengths of the tibia and lower limb by 3.6 ± 2.9 mm and 4.4 ± 4.7 mm (p <0.001), leading to a postoperative tibial and full leg length discrepancy of 2.8 ± 4.3 mm and 2.2 ± 7.3 mm (p <0.001 and p=0.017, respectively). Preoperative leg length discrepancy was significantly correlated with the preoperative mechanical axis of the involved limb (r=0.292, p=0.016) and the amount of correction was significantly associated with leg lengthening after OWHTO (r=0.319, p=0.009). Patients with a varus deformity of ≥ 6.5° (n=14) presented with a preoperative leg length discrepancy of -4.5 ± 1.6 mm (p <0.001) that was reduced to 1.8 ± 3.5 mm (p=0.08).

Conclusion: Patients submitted to OWHTO present with preoperative leg length discrepancy that is directly associated with the varus deformity of the involved extremity. As OWHTO significantly increases leg length, particularly patients with large varus deformity may benefit from native leg length restoration.

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Impact of body mass index (BMI) on improvement of patient-reported outcomes after total knee arthroplasty (9825)

Karfineinand Giesinger; Johannes M Giesinger; David F Hamilton; Jan Rechsteiner; Andreas Ladurner

Introduction: Total knee arthroplasty is known to successfully alleviate pain and improve function in endstage knee osteoarthritis. However, there is some controversy with regard to the influence of obesity on clinical benefits after TKA. The aim of this study was to investigate the impact of body mass index (BMI) on improvement in pain, function and general health status following total knee arthroplasty (TKA).

Methods: A single-centre retrospective analysis of primary TKAs performed between 2006 and 2016 was performed. Data were collected preoperatively and 12-month postoperatively using WOMAC score and EQ-5D. Longitudinal score change was compared across the BMI categories identified by the World Health Organization.

Results: Data from 1565 patients (mean age 69.1, 62.2% women) were accessed. Weight distribution was: 21.2% BMI <25.0kg/m², 36.9% BMI 25.0-29.9kg/m², 27.0% BMI 30.0-34.9kg/m², 10.2% BMI 35.0-39.9kg/m², and 4.6% BMI ≥ 40.0kg/m². All outcome measures improved between preoperative and 12-month follow-up (p <0.001). In pairwise comparisons against normal weight patients, patients with class I-II obesity showed larger improvement on the WOMAC function and total score. For WOMAC pain improvements were larger for all three obesity classes.

Conclusion: Post-operative improvement in joint-specific outcomes was larger in obese patients compared to normal weight patients. These findings suggest that obese patients may have the greatest benefits from TKA with regard to function and pain relief one year post-op. Well balanced treatment decisions should fully account for both: Higher benefits in terms of pain relief and function as well as increased potential risks and complications.

ROLE OF NADPH OXIDASE 4 (NOX4) IN THE PATHOPHYSIOLOGY OF OSTEOARTHRITIS (9935)

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Introduction: Osteoarthritis (OA) is a degenerative disease characterized by damage of articular cartilage, alteration of subchondral bone, and inflamed synovium. Articular cartilage is essentially composed of an avascular matrix produced by chondrocytes. In OA, articular cartilage follows a progressive degeneration, where low-grade inflammation plays a pivotal role through an oxidative stress-dependent mechanism and exposure to reactive oxygen species (ROS). In this study, we evaluated the role of NADPH oxidase 4 (NOX4) during experimental OA in mice.

Methods: Cartilage explants isolated from 9 weeks old femoral heads (wild type (WT) and NOX4-/- mice) were cultured 72 hours with either PBS or IL-1β to induce experimental OA ex vivo. Cartilage explants were then fixed with paraformaldehyde 4% and prepared for histology analysis. In vivo, OA was induced by destabilization of the medial meniscus (DMM) in WT and NOX4-/- mice (n=12 for each group). At day 0, mice were radiographed using a microCT and operated. Eight weeks after surgery, mice were radiographed and sacrificed for histological analysis.

Results: Ex vivo, we demonstrated with safraninO staining that NOX4 deletion protects from the loss of proteoglycans in the cartilage induced by IL-1β. In vivo, histological analysis of the knee joint, 8 weeks post-surgery, demonstrated that DMM induced significant OA damages in WT mice. Large areas of cartilage destruction were observed with matrix loss and surface denudation as compared to sham-operated groups (OARSI score of 2.8±1.2). A significant improvement was observed in DMM-NOX4-/- mice with a reduced OARSI score of 1.5±0.5. We observed thicker cartilage, less osteocytes formation and less synovial....
inflammation in DMM-NOX4-/- mice as compared to DMM-WT mice. By micro-CT, we observed no differences at day 0 between WT and NOX4-/- mice. However, 8 weeks after DMM, a slight increase was observed in the trabecular thickness (Tb.Th) and in the trabecular space (Tb.Sp) as compared to day 0, only in WT mice.

Conclusion: Our results demonstrated that NOX4 deficiency decreases cartilage degradation ex-vivo after IL-1β stimulation and decreases significantly experimental OA severity in mice. Taken together these results underline that NOX4 could be a major target to dampen OA progression.

Distal femoral osteotomy for valgus knees: indications, technical aspects, clinical and radiological outcome (19955)

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Introduction: The aim of this study was to present the indications and technical aspects of medial closing and lateral opening distal femoral valgus osteotomy (MCDFO and LODFO) as well as to report complications, radiological and clinical outcomes.

Methods: Over 6 years 28 DFOs (22 MCDFO, 6 LODFO) were performed in 22 Patients: 6 bilateral, 16 f, 6 m, median (range) age 47 (17-63) y, height 1.68 (1.56-1.98) m, body mass 80 (49-105) kg, BMI 27.4 (16.8-39) kg/m². Clinical outcome measures included complications, presence of pain at rest, during activities of daily living (ADL) and during physical activity, knee range of motion (ROM), patellar tracking and patella instability, presence of unicompartmental or total knee arthroplasty (UKA, TKA) following up time. Radiological outcome measures included time to union, presence of delayed or non-union as well as Kellgren-Lawrence (K/L) arthritis score, hip knee ankle angle (HKA), mechanical lateral distal femoral angle (mLDFA) and mechanical proximal tibial angle (mPTA). The information was retrospectively extracted from clinical notes and radiographs and analyzed.

Results: The indication for DFO was degenerative valgus osteoarthritis (50%), posttraumatic arthritis (28%) and a combination of degenerative valgus osteoarthritis and patellar maltracking/instability (22%). The median (range) clinical follow up was 21 (7–81) months, the need for TKA/UKA was followed up for 59 (7–108) months postoperatively. Preoperatively, HKA (+ denotes varus) was 7.0 (2.0–13.0)°; mLDFA was 83.7 (79.9–88.2)°, and mPTA was 89.0 (86.6–94.5)°. Postoperatively, HKA was -1.3 (-9.0–1.2)° and mLDFA was 90.8 (87.3–97.3)°. Four patients had a major and two a minor complication. The incidence of delayed and non union was 18% and 4%, respectively. At the last follow up 18 % had pain at rest, 25% during ADL and 39 % during physical activity, 71 % of the patients were satisfied with the outcome. One patient received a lateral UKA, one a bilateral patellofemoral UKA and one a TKA.

Conclusion: DFO is a reasonable treatment for lateral osteoarthritis in young patients to avoid disease progression and the need for an early UKA/TKA. However, there is a long rehabilitation time, a considerable risk for complications and a high need for hardware removal. While a great part of the patients experienced symptoms at the long term follow up, the majority were satisfied with the result of the operation. Appropriate patient selection and patient information is essential.

5-year failure rates of established and newer total knee arthroplasty implants: Meta-analysis of data from international registries (9967)

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HUG Hôpitaux-Universités-Genevè

Introduction: Early Total Knee Arthroplasty (TKA) designs, such as NexGen or PFC, demonstrated their effectiveness and are considered as benchmarks. Recently, several new designs have been introduced. Our objective was to assess and compare 5 years failure rates in national and regional registries of established and more recent implants.

Method: From the International Society of Arthroplasty Registries (ISAR) website, we identified all national and regional registries reporting cumulative failure rates (CFR) at 5 years. Our annual reports. We compared the CFR for the following implants: NexGen and Persona (ZimmerBiomet), PFC and Attune (DePuySynthes) and GMK Sphere (Medacta) stratified by constraint: Cruciate retaining (CR), posterior stabilised (PS) and medial pivot (MP). 5 yr revision-free survival probabilities reported by registries were combined using models with random effects (Der Simonian & Laird’s approach). Amount of between registries heterogeneity was assessed with I2 statistics and Cochran Q test for heterogeneity.

Results: Data from four national (SIRIS, Switzerland; EPRD, Germany; AOANRR, Australia; NJR, UK) and one regional registry (RIO, Italy) were included. Total numbers of implants/reports included were: NexGen CR 299186/7, PFC CR 297691/10, Persona CR 15871/3, Attune CR 37310/3, NexGen PS 15463/10, PFC PS 120649/9, Persona PS 16210/4, Attune PS 35692/4, GMK sphere MP 11000/5. 5 yr cumulative failure rates for CR systems were: NexGen CR 2.17 (1.85 to 2.54); PFC CR 2.90 (2.39 to 3.52); Persona CR 2.38 (1.64 to 3.44); Attune CR 2.63 (2.15 to 3.23). 5 yr cumulative failure rates for PS systems were: NexGen PS 2.93 (2.65 to 3.24); PFC PS 3.19 (2.60 to 3.91); Persona PS 3.56 (2.40 to 5.28); Attune PS 3.97 (2.50 to 6.28). For GMK Sphere MP it was 3.71 (2.60 to 5.27). The pooled 5-yr CFRs were 2.55% (95% CI 2.29 to 2.84) for all CR implants combined and 3.26% (95% CI 2.88 to 3.69) for all PS implants. The non overlapping confidence intervals indicate a statistically significant difference between the two.

Conclusion: At 5 years, CR implants had significantly lower failure rates than PS implants. NexGen CR had the lowest rate. Persona CR and Attune CR had CFRs similar to established implants. Among PS implants, NexGen showed lowest CFR. Persona and Attune had a CFR slightly higher than NexGen and PFC. CFR of GMK Sphere MP was similar to newer PS prostheses and slightly higher than established PS implants.

Compressed Lateral and anteroposterior Anatomical Systematic Sequences (CLASS): Creating a Specific MRI Sequence with Identified Tibial and Femoral ACL Footprints (9988)

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Introduction: Both elite and amateur athletes are affected by anterior cruciate ligament (ACL) rupture. ACL reconstruction can improve knee kinematics and reduce the risk of secondary damage to the cartilage or meniscus, even if it does not prevent the early onset of osteoarthritis over the long term.

The aim of ACL reconstruction nowadays is to recreate the anatomic rather than the isometric footprints. The use of intraoperative fluoroscopy is thought to increase the tunnel placement’s accuracy and reproducibility. Therefore, proper pin placement could be improved by patient-specific mapping of the anatomical footprints.

Using specifically developed MRI sequences, a precise definition of the identified footprints is possible. The use of intraoperative fluoroscopy is thought to increase the tunnel placement’s accuracy and reproducibility. Therefore, proper pin placement could be improved by patient-specific mapping of the anatomical footprints.

This study’s primary aim is to assess the feasibility of processing the MRI information with identified ACL-footprints into 2D-images similar to
a conventional anteroposterior and lateral X-Ray image of the knee. The secondary aim is to conduct specific measurements to assess reliability and reproducibility. This study is proof of the concept of this technique.

**Material & Methods:** Five anonymized MRI’s of a right knee were analyzed using an Optima MR360 1.5T Advance. An orthopaedic knee surgeon performed the footprints identification. An ad-hoc software allowed a volumetric 3D image projection on a 2D anteroposterior and lateral view. This specific MRI sequence was named according to the acronym “CLASS” for “Compressed Lateral and anteroposterior Anatomical Systematic Sequences”.

The intraclass correlation coefficient (ICCs), including 95% confidence intervals (CIs), has been calculated to assess intraobserver reproducibility and interobserver reliability.

**Results:** Five MRI’s of a right knee have been assessed (three females, two males, mean age of 30.8 years old). Five 2D-“CLASS” have been generated.

The measured parameters showed a “substantial” to “almost perfect” reproducibility and an “almost perfect” reliability.

**Conclusion:** This study confirmed the possibility of generating 2D-compressed images with the local femoral and tibial ACL footprints from a 3D volumetric model. The “CLASS” also showed that these footprints were easily identified on standard anteroposterior and lateral X-Ray views of the same patient.

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**Modifying stride length could enhance ambulatory knee kinetics of patients with medial knee osteoarthritis (9992)**

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**Introduction:** Gait retraining is gaining in interest in the management of medial knee osteoarthritis (OA). Indeed, modifying the way of walking has the potential to alter the peak value (pKAM) and the impulse (iKAM) of the knee adduction moment and the peak value of the knee flexion moment (pKFM), three variables associated with the disease. Specifically, there is an interest in reducing the pKAM and iKAM without increasing the pKFM in patients with medial knee OA. Recently, a study in young healthy subjects showed that walking with shorter stride length (SL) could increase the pKAM, iKAM and pKFM. Including SL modifications in rehabilitation protocols for medial knee OA could be quite straightforward. Therefore, there is a need to characterize the effects of walking with shorter SL in this particular population.

**Methods:** Fourteen patients with medial knee OA (8 males; 56.1±9.4 years old; 24.1±2.9 kg/m2) underwent gait analysis in a laboratory equipped with an augmented-reality system displaying instruction footprints on the floor. Their normal gait, as well as their gait at similar walking speed but with SL reductions of 15 cm, were recorded. Paired t-tests were used to compare the gait variables between the normal and modified conditions. Significance level was set a-priori at 5%.

**Results:** At the group level, walking with reduced SL resulted in a statistically significant decrease in iKAM (mean change of -8.6%, p=0.006), a trend toward reduction in pKAM (-4.5%, p=0.06), and no changes in pKFM (-3.5%, p=0.59). When walking with SL reduction, 36% of the patients actually reduced their pKAM and iKAM without increasing their pKFM.

**Conclusion:** This study confirmed the potential of SL modifications to enhance the mechanical environment at the knee joint in patients with medial OA. Similar to prior work about modifications in other footprint parameters, the responses were heterogeneous, suggesting that decreasing SL by a fixed amount will not become a universal solution for medial knee OA. The present study rather supports personalized gait retraining efforts where different modifications are recommended to different patients. Further research is necessary to characterize the effects of SL modifications of other magnitudes as well as the effects of SL modifications on the overall gait patterns, as this information will be crucial for proper inclusion of SL modifications in rehabilitation protocols for medial knee OA and potentially other pathologies.

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**Improved Sizing with Image based robotic-assisted system compared to Image-Free and conventional technique in medial Unicompartmental Knee Arthroplasty (9996)**

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**Background:** Ideal component sizing is difficult to achieve in unicompartamental knee arthroplasty (UKA). Anatomic variants, incremental implant size, and a minimized surgical exposure may lead to over- or under-sizing of the components. The purpose was to compare the accuracy of UKA sizing with robotic-assisted techniques versus a conventional technique.

**Methods:** Three groups of 93 medial UKA were assessed. The first group was performed by a conventional technique, the second group with an image-free robotic-assisted system (Navio group), and the last group with an image based, robotic arm-assisted system, using on pre-operative CT scan (Mako group). There were no demographic differences between groups. We compared six parameters on postoperative radiographs to assess UKA sizing. Incorrect sizing was defined by an over- or under-sizing greater than 3mm.

**Results:** There was a higher rate of tibial under-sizing posteriorly in the conventional group compared to robotic-assisted groups (47.3% in conventional group, 29% in Navio group, 6.5% in Mako group; p < 0.0001), as well as a higher rate of femoral under-sizing posteriorly (30.1% in conventional group, 7.5% in Navio group, 12.9% in Mako group; p < 0.001). The posterior femoral offset was more often increased in conventional group, especially in comparison to the Mako group (4% in conventional group, 30.1% in Navio group, 8.6% in Mako group; p < 0.0001). There was no significant overhang of the femoral or tibial implant in any groups.

**Conclusion:** Robotic-assisted surgical techniques for medial UKA decrease the risk of tibial and femoral under-sizing, particularly with an image-based system using a pre-operative CT scan.

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**Patients with a high daily activity level after knee replacement tend to have lower Forgotten Joint Scores compared to sedentary patients (10004)**

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**Introduction:** The Forgotten Joint Score (FJS) is increasingly being used in outcome measurement after knee replacement, as it is known for a low “ceiling effect”. However, the meaningfulness of the FJS in the short postoperative course has already been questioned, as also a high “floor effect” is determined by no specific influencing parameters to the patients’ self-assessment with the FJS are known.

In this context, the hypothesis of our study was that the individual level of activity has a higher impact on the FJS than the objective joint function in the early postoperative course.

**Methods:** 59 patients with the indication for total knee arthroplasty (TKA) (n = 33) or medial unicompartmental arthroplasty (UKA) (n = 26) were prospectively included in the study. All patients underwent robot-carm-assisted knee replacement according to their indication. The Knee Society Score (KSS), the Oxford Knee Score (OKS) and the Forgotten Joint Score (FJS) were recorded preoperatively and 2 months postoperatively. All patients were also equipped with an activity tracker that recorded their daily step count for 4 weeks preoperatively and in the first 2 postoperative months. Based on their average daily activity in the 8th postoperative week, the patients were divided into activity categories and these were then compared with objective functional scores and the FJS.

**Results:** The UKA group was on average younger (64.25 y) and more active (8542 steps/day) than the TKA patients (67.33 y, 4876 steps/day) preoperatively. Also postoperatively the UKA group was always more active and mobility was built up 2 weeks faster, on average. The objective knee function measured with the KSS was significantly higher 2 months postOP for UKA compared to TKA (170 vs. 160 points), with almost identical OKS (34.2 vs. 36 pts.). The FJS, however, shows a significantly better outcome for the TKA group (53 vs. 45 pts.). With regard to the individual activity, a negative correlation between the number of
daily steps and the FJS was seen, with the highest score in sedentary UKA patients (<5000 steps/day, FJS = 50 pts.) and lowest in active UKA patients (>10,000 steps/day, FJS = 41 pts.).

**Conclusion:** In the early postoperative phase after knee replacement, the FJS does not necessarily correlate with the objective knee function or rehabilitation progress and should be interpreted with caution. It will be interesting to consider this relationship further over time.

**Anatomical description of the medial and lateral femoral condyles vascular tree using polyurethane foam in cadaveric knees and potential clinical implication in Hoffa fractures (10017)**

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**Introduction:** Bone vascular supply is a crucial entity that may lead to focal necrosis in case of disruption. A proper understanding of the vascular anatomy may improve surgical approaches by avoiding vascular iatrogenic insult. Hoffa fractures are described as intra-articular fractures of the femoral condyles, in the coronal plane. Different surgical approaches and fixation have been described but no consensus was found in order to significantly increase bone healing. This study aimed to describe the vascular tree of the distal femur and to highlight the safe zone for surgical procedures.

**Methodology:** Ten fresh-frozen knees were used to assess the vascularity around the femoral condyles. Industrial polyurethane foam was used as casting material. After injection, the knees were bathed in a 10% NaOH solution. The corrosion process allowed all the soft tissue surrounding the knee to be subsided, leaving only the bone with polyurethane vascular architecture. An analysis of the vascular tree was performed in order to describe the vessels around the distal femur and deduce the potential disruption of the blood supply in cases of Hoffa fractures.

**Results:** The corrosion casting has shown a vascular network underlying the relationship of the vessels to the bone. Small periosteal arterioles with less than 1 mm in diameter were distinguished. One constant feature was notified, independently of the side of the knee; the nutrient vessel of the condyle (medial or lateral) emerges from the posterior side at the corner where the posterior cortex bend in the posterior direction. From this point, the artery follows an antero-distal direction at around 45° from a vertical line. This artery gives a variable number of vessels running posteriorly at an angle between 45° to 90°. On the medial side, an anastomosis from the nutrient artery with an anterior artery was found in 90% of the casts.

**Discussion:** This study provides a good description of the vascular network around the medial and lateral femoral condyles. This would allow a better understanding regarding the approach and fixation of Hoffa fractures by preventing further vascular damage.

**Conclusion:** This study confirmed the constancy of the medial and lateral distal femoral vascular tree. Because of this reproducibility, a proper anatomical approach may be planned for the surgical treatment of femoral Hoffa fractures. The implication of vascular rupture in the healing of these fractures still need further study.
Fate of the Contralateral Foot in Charcot Arthropathy (9732)

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Background: The contralateral foot in Charcot neuroarthropathy (CN) is subject to increased plantar pressure. The clinical consequences of this pressure elevation are yet to be determined. The aim of this study was to evaluate ulcer and amputation rates of the contralateral foot in CN.

Methods: We retrospectively analyzed the medical records of 130 prospectively followed consecutive patients with unilateral CN. Contralateral CN development and recurrence, contralateral ulcer development, and contralateral amputations were recorded. Statistical analysis was performed to identify possible risk factors for contralateral CN and ulcer development, and contralateral amputation. Mean follow-up was 6.2 (SD 4) years.

Results: After a mean of 2.5 years, 19.2% patients developed contralateral CN. Female gender was associated with contralateral CN development (odds ratio 3.13, 95% confidence interval 1.27–7.71). Overall, 46.2% patients developed a contralateral ulcer. Among the patients who developed contralateral CN, 60% developed an ulcer. Sanders type 2 at the index foot (midfoot CN) was significantly associated with contralateral ulcer development. Ulcer-free survivals (DFS) differed significantly between patients with diabetes type 1 (median UFS 5131 days) and patients with diabetes type 2 (median UFS 2158 days). A total of 25 amputations had to be performed in 22 (16.9%) patients. Three of those 22 patients (2.3%) needed major amputation.

Conclusion: Almost 20% of patients developed contralateral CN. Nearly half of people with CN developed a contralateral foot ulceration. Patients with type 2 diabetes had significantly shorter UFS than patients with diabetes type 1. Every sixth patient needed an amputation, with the majority being minor amputations. The contralateral foot should be monitored closely and included in the treatment in patients with CN.

Tibialis Anterior Tendon Reconstruction using either Autograft or Allograft: A Minimum 2-Year Follow-up with Functional Assessment and MRI Evaluation (9742)

Octavian Andronic; Ines Unterfrauner; Lukas Jud; Benjamin Fritz; Arnd F. Viehöfer; Stefan Fröhlich; Florian B. Imhoff; Stephan Wirth
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Background: In cases of tibialis anterior tendon (TAT) ruptures associated with significant defects, an interposition graft is needed for reconstruction. There is no consensus on the best graft choice, as data on outcomes is limited. It was the purpose of the current study to report on clinical, functional and imaging outcomes of both auto- and allograft reconstructions of the TAT. Our hypothesis was that both graft types would have a good integrity and provide comparable outcomes.

Methods: Patients who underwent TAT reconstruction using either an autograft or allograft were identified from the local database and invited for the study. Of patients with a positive stretch test; B/patients with a negative stretch test. MRI measurements were performed using 3D isotropic T2-weighted SPACE sequences reformatted in the sagittal and axial planes, with the ankle in the neutral position (90°) and included: 1.Distance from the retrotalar pulley to the most distal part of the FHL muscle belly on the sagittal reformat; 2.Cross-sectional area of the muscle belly at 2, 3 and 4 cm proximally to the pulley on the axial reformat.

Results: We recruited 27 patients, 14 M and 13 F with a mean age of 44 years. 18 patients had a positive test while 9 patients had a negative test. The mean length between the pulley and the muscle belly was 6.0±6.4 mm for the positive group and 11.8±9.4 mm for the negative group. (p-value 0.101)

Conclusion: Even though the results are not statistically significant, there is a trend in the negative test group, with a muscle belly that ends more proximally and is smaller in all cross sections. Thus, showing that the pathogenesis of the FHL could be correlated to an FHL entrapment in the pulley due to a lower and broader muscle belly. However, our study is limited by the small sample size and would need larger groups to verify these findings.

The Intra-Septal Course Of The Superficial Peroneal Nerve: An Anatomic Study (9884)

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Background: Anatomic and clinical studies show many variants of the superficial peroneal nerve (SPN) course and branching within the compartments and at the supra-fascial layer. The anatomy of the transition muscle (TAM) fatty infiltration was comparable between graft types when compared to the contralateral TAM.

Conclusion: In our patient cohort, reconstructions of TAT achieved good PROs, as well as functional and imaging results with a preserved graft integrity in all cases. There were no substantial differences between allograft and autograft reconstructions.
zoon the compartment to the subcutaneous layer has been occa- 
sionally described in the literature, mainly in studies reporting the in- 
tra-septal SPN variant in 6.6-13.6% of patients affected by the SPN entrap-
ment syndrome.

Despite the little evidence available, the knowledge of the transition 
zone is relevant to avoid iatrogenic lesions to the SPN during fasciomy- 
ectomy, open approaches to the leg and ankle, and SPN decompression.

Objectives: Our anatomic study aimed to describe the SPN transition 
site and to evaluate the occurrence of a peroneal tunnel and of an intra-
septal SPN variant.

Study Design & Methods: According to the institutional ethics commit-
tee requirements, 15 fresh frozen lower limbs were dissected to study 
the SPN course and its branching, focusing on the transition site to the 
infra-fascial layer.

Results: The SPN was located in the anterior compartment in 2 cases 
and in the lateral in 13. An intra-septal tunnel was present in 10 legs 
(66%), at a mean distance of 10.67 cm from the lateral malleolus. Its 
mean length was 2.63 cm. The tunnel allowed the passage of the main 
SPN in 8 cases and of its branches in two. In the remaining 6 legs (33%), 
the SPN pierced a crural fascia window.

Conclusions: In our sample, a higher rate than expected of intra-septal 
SPN variants was found. The knowledge of the anatomy of the SPN 
course and intra-septal variant is relevant to avoid iatrogenic lesions dur-
ing surgical dissection. Further studies are needed to evaluate the effec-
tive prevalence of an intra-septal tunnel in the clinical population, inde-
dependently from the SPN entrapment syndrome, and how to avoid asso-
ciated iatrogenic complications.

Patient specific instrumentation vs. standard referencing in total 
ankle arthroplasty: A retrospective comparison of accuracy
(9911)

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Introduction: Earlier studies suggested that the use of patient-specific instrumen-
tation (PSI) leads to more accurate implant positioning. How-
ever, the need of extensile periosteal stripping in the ankle joint debated 
to increase the risk for impaired osteointegration of the implants. The 
aim of this prospective study was to compare pre- and post-operative radiologi-
cal and clinical outcomes between PSI- and conventional instru-
ment (CI) total ankle arthroplasty. It was hypothesised that the PSI-
group would have more precise implant positioning, shorter operative 
time less perioperative complications but a higher rate of lucency lines 
on the postoperative radiographs.

Methods: 25 consecutive patients undergoing PSI-instrumentation were compared to 25 consecutive patients with CI-instrumentation. Out-
come measures were peri-operative outcomes (operation time, wound 
healing) and post-operative radiological outcomes including the align-
ment of the tibial component, the tibio-talar tilt, and the talar offset on 
the sagittal view. Implant osteointegration was determined by the pres-
ence of radiolucent lines. Postoperative outcome was assessed at 3, 12 
and 24 months postoperatively.

Results: In both groups a reasonable alignment for the majority of pa-
tients could be achieved with angles in the magnitude of 2° and devia-
tions of more than 5° occurring in less than a quarter of the patients. No 
general advantage of one approach could be observed. The duration of 
the surgery did not show any difference between the two methods. 
Three patients showed radiolucent lines at the tibial component. One 
of them in CI group and two in the PSI group. Two patients presented 
with delayed wound healing (both CI group), however, none of them re-
quiring secondary surgery or antibiotic treatment.

Conclusion: The PSI method did not show an advantage over CI in re-
gard of positioning of the components or in the duration of the surgery. 
Radiolucent lines occurred in two cases after the use of PSI. However, 
the number of patients was too low to allow a statement on whether 
periosteal stripping adversely affects bony ingrowth of the implants. The 
authors conclude that PSI is a helpful tool in complex cases whereas no 
advantages over CI are to be expected in a standard total ankle replace-
ment.
ankle deformity (78% = varus compensation; 22% = valgus compen-
sation), whereas 24 of those 72 patients (33%) showed no compensation or a further increase of a supramalleolar/intra-articular ankle deformity (67% = varus deformity; 33% = valgus deformity).

**Conclusion**: Auto-generated 3D measurements of the hind- and midfoot deformities are reliable in both healthy individuals and patients with posttraumatic end-stage ankle osteoarthritis. Such measurements may be crucial for a detailed understanding of the location and extent of hindfoot deformities, possibly impacting decision making in the treatment of end-stage ankle osteoarthrosis.

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### High Reliability for Weightbearing CT Based Automated 3D Measurements to Assess Progressive Collapsing Foot Deformity (9927)

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**Introduction**: In progressive collapsing foot deformity (PCFD), hind- and midfoot deformities are paramount. However, an accurate assessment thereof, using weightbearing radiography, remains challenging. Automated three-dimensional (3D) measurements derived from weightbearing computed tomography (WBCT) scans may provide a more accurate approach for deformity assessment. In this study, automated 3D measurements based on WBCT were compared to two-dimensional (2D) measurements performed on weightbearing radiographs. Furthermore, it was investigated whether various stages of PCFD could be identified using automated 3D measurements.

**Methods**: Twenty patients treated at our institution with either a flexible (N=10) or rigid (N=10) PCFD were identified, retrospectively analyzed and compared to a control group of thirty healthy individuals. Four angles and two distances measured on weightbearing radiographs were compared to the automated 3D measurements derived from WBCT scans.

**Results**: In 5 out of 6 variables, the reliability of the measurements derived from weightbearing radiographs was lower than the automated measurements that derived from WBCT scans. The automated 3D measurements showed: the talo-first metatarsal angle was more valgus in patients with a rigid PCFD when compared to patients with a flexible PCFD; medial facet subluxation was present in all but one patient; patients with a sinus tarsi impingement evidenced a higher overlap between the talus and calcaneus (12.4±2.6 mm) compared to patients without impingement (7.8±3.9 mm; p=0.020).

**Conclusion**: A higher reliability of automated 3D measurements derived from WBCT scans, was evident for most variables when compared to measurements based on weightbearing radiographs. Besides being less prone to errors, automated 3D measurements may provide more reliable information regarding the hind- and midfoot alignment in patients with PCFD. Future studies may show to what extent 3D measurements could contribute to current diagnostic algorithms and treatment concepts of patients with PCFD.

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### Reduced preoperative deep saturation as measured by Laser Doppler spectrophotometry is associated with an increased rate of revision surgery after ORIF of calcaneal fractures through an extensile lateral approach (9969)

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¹ LUKS Luzern und Wohlen

**Introduction**: The extensile lateral approach to the calcaneus is still commonly used to surgically treat calcaneal fractures. However complications thereof, using weightbearing radiographs. These may occur due to impaired perfusion. Preoperative measurement of perfusion could help to decide on the best time point to operate these fractures.

We asked, (1) do the preoperative parameters of Laser Doppler spectrophotometry correlate with wound revisions after ORIF through an extensile lateral approach to the calcaneus, and (2) what are the sensitivity, specificity, positive and negative predictive values of these parameters to predict wound revision after the aforementioned intervention?

**Methods**: All consecutive patients with calcaneus fracture who presented to a single Level 1 trauma center in central Europe were included in the study. This resulted in 37 hindfeet (34 patients). Patients were hospitalized to decrease swelling. After decision for surgery was made, a laser doppler spectrometry device was used to measure oxygen saturation, relative hemoglobin content and blood flow of the skin in 2 and 8mm depth at five different locations along the anticipated incision for the extensile lateral approach to the calcaneus.

**Bi-partite correlation using Spearman rho analysis was performed. Receiver operator characteristics (ROC) curves were calculated to determine sensitivity, specificity, positive and negative predictive values.**

**Results**: The minimal value of the oxygen saturation (SO2) measurements of the five measurement locations in the deep layer as well as the minimal value for flow in the superficial layer correlated negatively with wound revisions (r= -0.367, p= 0.025 and r= -0.343, p= 0.038, respectively).

**Discussion**: A minimal oxygen saturation of 20.5% across the five measurement points at 8mm depth along the anticipated incision of the extensile lateral approach to the calcaneus have a sensitivity, specificity, positive and negative predictive value of 100%, 48.5%, 19%, and 100% to predict no wound revision.

**Revision Surgery After Below Knee Amputations (9973)**

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**Introduction**: Below knee amputations (BKA) are often the last option in surgical treatment for many medical conditions. Performing these radical interventions aim to balance between an amputation at the lowest level with the highest functional outcome and preventing subsequent higher level major amputations. Identifying risk factors could help to better inform patients and facilitate the surgeons’ decision making.

What is the risk to undergo revision surgery after BKA? (1) during same hospitalisation as primary intervention and (2) at later stage, and (3) what are risk factors for a subsequent higher amputation?

**Methods**: Review analysis of all patients undergoing a primary BKA at one of three hospitals of the same public hospital group consisting of two level 2 rural hospitals and one level 3 main hospital between January 2009 and December 2019 resulted in 98 amputations. Cox regression analysis was performed to identify risk factors.

**Results**: 27% of all patients underwent revision surgery during the hospital stay in which the BKA was performed. 19% of all patients underwent revision surgery during a later hospitalization at a mean of 108 days (range 11-813 days). A third of these were higher level amputations (1 through knee and 5 above knee amputations).

When orthopaedic and trauma surgeons performed the primary BKA, age was negatively correlated with revision surgery (R² = -0.391, p<0.001), female gender (R² = 0.210, p= 0.037), higher serum creatinine and CRP levels (R² = 0.208 and 0.325, p-values= 0.044 and 0.002, respectively) were positively correlated with revision surgery.

**Conclusion**: Approximately one quarter of all BKA needed a revision surgery during their hospitalisation for primary BKA. 6% of all patients had a secondary higher level amputation at a mean of 26 days (11-77). Correlating covariates “younger age” and “female gender” may be seen in relation to emotional factors deciding against primary higher level amputations.

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The Role of Magnetic Resonance Imaging in Autologous Matrix-Induced Chondrogenesis for Osteochondral Lesions of the Talus (9899)

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Introduction: MRI imaging is the tool of choice for assessing articular surfaces after cartilage surgery. The MOCART score is a common tool for assessing regenerative cartilage tissue. The score was originally developed for use in the knee joint. Previous literature showed as a clear limitation with the lack of correlation of the score with clinical outcome after AMIC procedure for OLT. The aim of this study was to evaluate the now updated MOCART 2.0 score for use after AMIC procedure for OLT. This retrospective cohort study was approved by our ethics review board.

Methods: Patients who underwent isolated AMIC for symptomatic focal OLT between October 2009 and August 2015, had postoperative follow-up MRI imaging with same-day documentation of clinical scores (American Orthopaedic Foot and Ankle Society, AOFAS, and Tegner Score) were included. Patients with inflammatory arthritis and/or advanced osteoarthritis were excluded. Demographic, clinical, lesion-specific, and data regarding surgical procedure were documented.

Results: 35 patients could be included in the study. Mean: clinical and MRI follow-up was 4.5 ± 1.8 years, age was 34.4 ± 10.7 years and defect size was 0.9 ± 0.6 cm². Of the patients, 14 (40%) were female, 17 (48.6%) were smokers and 27 (77%) received a bone graft to fill the defect. The final AOFAS score was Ø 92.63 ± 8.3 and the Tegner score was Ø 5.1 ± 1.8 which significantly improved from Ø 3.7 ± 2.0 (p=0.002). MOCART scores 1 Ø 59.0 ± 14.9 and 2.0 Ø 65.1 ± 13.9 correlated significantly with each other (r = 0.885; p < 0.001). Patients with shorter follow-up (<4.5 years) showed significantly better MOCART 1 scores (Ø 64.7 ± 10.8 vs. Ø 52.9 ± 16.6, p=0.02) and tended to have better MOCART 2.0 scores ( Ø 69.4 ± 12.4 vs. Ø 60.6 ± 14.3, p=0.058). However, analysis of MOCART 1 and 2.0 showed no correlation with clinical scores (AOFAS, Tegner).

Conclusion: By implication, the MOCART score decreases over time. Neither the MOCART 1 nor 2.0 score can give us clinically relevant information, since the clinical outcome does not correlate with the radiological score. Thus, the MOCART 1 and 2.0 score does not play a relevant role in the treatment of symptomatic OLTs with AMIC procedure.

Talus morphology differs between flatfeet and controls, but its variety has no influence on extent of surgical deformity correction (10030)

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Background: In adult acquired flatfoot deformity (AAFD), there may be valgus angulation of the hindfoot in addition to a decreased arch. The aim of this study was to perform a 3-dimensional (3-D) analysis of the talus morphology between symptomatic AAFD patients that underwent operative flat foot correction and controls, and investigate if there is an impact on the success of operative correction.

Methods: We reviewed all patients that underwent lateral calcaneal lengthening for correction of AAFD between 2008 and 2018 at our clinic. Radiographic flatfoot parameters on preoperative and postoperative radiographs were assessed. Additionally, 3-D surface models of the tali were generated using computed tomography (CT) data. The talus morphology of 44 flatfeet was compared to 3-D models of 50 controls without foot or ankle pain of any kind.

Results: Groups were comparable regarding demographics. Talus morphology differed significantly between AAFD and controls in multiple aspects. There was a 2.6° increased plantar flexion (22.3° versus 26°; p=0.02) and medial deviation (31.7° and 33.5°; p=0.04) of the talar head in relation to the body in AAFD patients compared to controls. Moreover, AAFD were characterized by an increased valgus (difference of 4.6°; p=0.01) alignment of the subtalar joint. Satisfactory correction was achieved in all cases, with an improvement of the talometatarsal-angle and the talonavicular uncoverage angle of 5.6° ±9.7 (p=0.02) and 9.9° ±16.3 (p=0.001), respectively. No statistically significant correlation was found between talus morphology and the correction achieved or loss of correction one year postoperatively.

Conclusion: The different morphological features mentioned above might be contributing or risk factors for progression to AAFD. However, despite the variety of talar morphology, which is different compared to controls, surgical outcome of calcaneal lengthening osteotomy was not affected.
Clinical and radiological long term impact for the knee about a retrograde femoral approach after femoral intramedullary lengthening (9932)
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Introduction: Retrograde femoral approach is an established technique for implantation of nails for leg lengthening/ correction and cases of dis- tal femoral fractures. We clinically and radiologically analyzed the long- term impact (>10 years) to the knee after leg lengthening via a retrograde femoral approach using a motorized nail in comparison to the non- operated contralateral knee.

Methods: In this prospective single-center study 13 patients with an av- erage age of 17.4 years (15.3-19.5) were included who had unilateral retrograde femoral lengthening with a motorized nail performed at least 10 years prior to the initial operation (range 10 – 12 years). Patients were examined (gait, leg length, scars) and analysed with the SF 36, ISKD and Lysholm Score. Further 3T MRI of both knees at all patients were in- cluded The MRI of the contralateral knee of each patient served as a control. The MRI were assessed for the presence and amount of any degenerative changes in the joint like signs of chronic synovitis, pres- ence of cartilage defects (ICRS classification system) – each in compar- ison to the healthy contralateral knee.

Results: 8/13 postoperative knees showed a small amount of joint effu- sion. None of the postoperative or healthy knees showed signs of chronic synovitis. All postoperative knees showed fibrosis of Hoffa’s fat pad, while no fibrosis was found in the control group. At least moderate to severe cartilage defects (Grade II-IV) of the trochlear groove were found in all postoperative knees at the original entry point. One healthy knee showed mild trochlear cartilage damage (Grade I). 6 of 13 of oper- ated knees showed retropatellar cartilage defects, in 2 patients retropa- tellar cartilage defects were found on the contralateral side. 10 of 13 patients showed atrophy of the medial and lateral vastus muscle on the postoperative side in comparison to the healthy side caused by the lengthening procedure. All patients were pain free and showed full range of motion without deficit in comparison to the contralateral knee.

Conclusion: Retrograde femoral lengthening with a motorized nail about retrograde femoral approach can be associated with cartilage defects at the entry point, arthrofibrosis at Hoffa and atrophy of the quadriceps muscle caused by the lengthening procedure. Without corresponding clinical impairment these findings may be normal in long-term follow up.

Severe developing genu recurvatum in adolescence – the dark side of Osgood Schlatter? A review of 5 cases treated by gradual deformity correction and lengthening with the Taylor Spatial Frame (9988)
Hannes Manner; Rafael Velasco
Schulthess Klinik Zürich
Introduction: In general, Morbus Osgood Schlatter is a benign and well treatable condition in the adolescent knee. Only few cases are reported in the literature with increasing genu recurvatum due to premature closure of the anterior part of the proximal tibia physis as a sequela of severe Osgood Schlatter disease, when posttraumatic deformity and fo- cal fibrocartilaginous dysplasia are excluded.

Methods: Between 2009 and 2018 4 male adolescents with 5 affected knees (1 bilateral case) were treated at our institution for severe increas- ing genu recurvatum. No trauma was evident in the past history. The average age at treatment was 14 years and 5 months. The right knee was affected in 3 cases, the left knee in 2 cases. The recurvatum de- formed a average 28° (range 26°-33°), a combined valgus deformity was present with 7° in average and a leg length discrepancy in the unilateral cases of 18mm in average. At least two of the cases were suspicious for focal fibrocartilaginous dysplasia. In all cases the anterior part of the proximal tibial physis was prematurely closed, while the posterior parts were still growing.

Results: All 5 cases were treated with the Taylor Spatial Frame for gradual lengthening and deformity correction in the proximal tibia. Simulta- neously a permanent epiphyseodesis of the proximal tibia was per- formed to prevent recurrent deformity. Besides full restoration of limb axes, a mean lengthening of 26mm (range 10-35mm) was performed (mean overlengthening of 11mm) with the knowledge of prospective limb length at the end of growth. The average time in frame was 134 days (range 102-167) and days with partial weight bearing were 151 days (range 124-181), resulting in a healing index of 58 days per cm lengthen- ing. Complicationwise one premature consolidation of the fibula had to be treated surgically. All deformities were treated successfully with nor- mal limb function at the latest FU.

Conclusions: Severe genu recurvatum deformity may result from prem- ature closure of the anterior part of the proximal tibial physis. Besides Osgood Schlatters disease, focal fibrocartilaginous dysplasia may be the cause, when previous trauma is excluded. Treatment may be sophisti- cated but the Taylor Spatial Frame offers an ideal tool to adress all un- derlying deformities.

Lengthening in Brachymetatarsia with an Internal Fixator (9987)
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Introduction: Brachymetatarsia is a rare disease. Even though the prev- alence in boys is higher than in girls , the latter more often present with the wish of surgical correction due to cosmetical impairment as well as development of metatarsalgia.

Basically, if correction is desired, two methods a currently available: acute lengthening with interposition of bone graft and plating and grad- ual lengthening via an external or internal fixator. Only few reports are listed in the medline concerning the option of internal lengthening.

Methods: In the last two years (2019 and 2020) we carried out 5 internal lengthening procedures in brachymetatarsia with the Genos MT Mini. The interdigital lengthening handle is the only part outside skin level be- tween the fourth and fifth toe. In comparison to external fixators the patient comfort therefore is much higher and well appreciated.

When the desired lengthening is achieved, the handle is removed, while the internal lengthening fixator is left in situ until full bony consolidation is seen on x-rays.

Results: We treated 5 feet with symptomatic brachymetatarsia of the 4th ray in 4 women (1 bilateral case) with an average age of 17 years. The left side was corrected in 3 cases, the right side in 2.

The average lengthening was 15 mm with a mean distraction time of 52 days. The mean lengthening speed was 0.3 mm/day. The time until full weight bearing was 86 days with an average healing index of 55 days/cm, while one patient is still in the consolidation phase with partial weight bearing. Only one internal fixator has been removed so far.

There were no complications or adverse events which influenced the procedure. The aim of the treatment was achieved in every case.

Conclusions: Internal lengthening offers a very safe and comfortable treatment for patients with symptomatic brachymetatarsia. Neverthe- less they should be informed about the longterm partial weight bearing time until sufficient bony consolidation occurs.

The development of muscle strength after femoral leg lengthening – a 10 year follow-up (10008)
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Introduction: Leg lengthening by callus distraction leads to a loss of muscle strength. In a previous study we could show that muscle strength of the knee extensors 2 years after surgery is still decreased. We asked ourselves whether this is a short-term effect or whether this difference in muscle strength would be long-lasting. The present study

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investigates the long-term effect of femoral lengthening on muscle strength with a minimum follow-up of 10 years.

**Methods:** Between 2007 and 2011 thirty patients with a median leg-length discrepancy of 3.0 cm underwent femoral limb lengthening with an intramedullary motorized device. Maximum isokinetic, eccentric torque of the extensors and flexors of the knee was measured with a dynamometer (Cybex Humac Norm®, CSMI Medical Solutions) before surgery (t1), as well as 2 years (t2) and 10 years (t3) after surgery. For the long-term analysis we included all patients with a complete dataset and a minimum follow-up of 10 years (n=9). We investigated the differences between preoperative and postoperative maximum isokinetic torques in the longer leg versus the shorter leg, as well as in comparison to a control group (dominant vs. non-dominant leg) of 10 healthy individuals with equal leg length.

**Results:** Before surgery the median maximum isokinetic torque of the extensor group was 16% higher in the normal leg compared to the shorter leg. After leg lengthening the difference between the normal and the lengthened leg increased to 17.5% at 2-year follow-up and to 25.6% at the 10-year follow-up. In contrast, no alteration was found in the knee flexor group and there was no significant loss of maximum isokinetic torque in the lengthened leg (t1 = 2.4%; t2 = 5.7%; t3 = 1%). In the control group the comparison between the dominant and the non-dominant leg showed a difference in the knee extensor torque of 2.9% as well as in the knee flexor torque of 1.7% in favor of the dominant leg.

**Conclusion:** Muscle strength of the knee extensors after femoral leg lengthening does not recover in the long term. On the basis of the current study we suggest that the distraction of the muscle has a higher effect than previously thought. The alteration muscle properties might be a consequence of changes on the whole muscle level (length, width, depth), the fascicle level (length, orientation) and the fiber level (fiber damage, connective tissue proliferation). These are subject of ongoing research.
In a single-center study, patients with orthopedic surgery during the first Covid-19 lockdown from March 21, 2020 to April 26, 2020 were compared to a cohort that underwent orthopedic intervention in the pre- and post-lockdown phase, respectively from October 1, 2019 to October 31, 2020. Adjusted multivariate analyses were used to investigate the occurrence of surgical site infections, wound healing disorders and other complications in all the three time strata.

Patients who underwent surgery for forearm nonunions were treated with either the IMT or the pedicled VBG, or the IMT. Mean follow-up was 42 months. The average number of previous surgeries in the VBG group was 5.1 and in the IMT group was 2.8. The average defect size was 5 centimeters in the VBG group and 4.6 centimeters in the IMT group. Elbow and wrist range of motion, Visual Analog Scale (VAS) for pain, the QuickDASH questionnaire, and Mayo Elbow Performance Score (MEPS) were assessed. Complications and the need for reoperations were recorded.

The average time to union was 4.5 months (range 3-8) for the VBG group and 6.3 (range 5-11) for the IMT group. At final follow-up, the average VAS improved significantly from presentation to the latest follow-up in both groups. Quick-DASH and MEPS were respectively, 10 and 97 in the IMT group and 16 and 90 in the VBG group. There were three complications. In the VBG group, one patient required implant removal and elbow arthrolysis and in another secondary interventions to treat a wound infection were performed. In the IMT group, one nonunion required autogenous iliac crest bone graft due to a delayed union.

The Impact of SARS-CoV-2 (COVID-19) Lockdown on Surgical Site Infections and other Complications after Orthopedic Surgery (9765)

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Background: In Switzerland, the SARS-CoV-2 (Covid-19) pandemic entailed a first lockdown phase restriction of elective orthopedic surgeries to emergency interventions. While access to the hospital and human contacts were limited, hygiene measures were intensified. The objective was to investigate the impact of those strict hygiene guidelines on the rate of surgical site infections (SSIs), wound healing disorders and other complications after orthopedic surgery during the first Covid-19 lockdown.

Methods: In a single-center study, patients with orthopedic surgery during the first Covid-19 lockdown from March 21, 2020 to April 26, 2020 were compared to a cohort that underwent orthopedic intervention in the pre- and post-lockdown phase, respectively from October 1, 2019 to October 31, 2020. Adjusted multivariate analyses were used to investigate the occurrence of surgical site infections, wound healing disorders and other complications in all the three time strata.

Results: 5,791 patients were included in this study. After a mean follow-up of 7 months, the lockdown cohort showed a significant higher SSI rate compared to the pre- and post-lockdown period (2% versus 1% and 0.5%). The revision rate due to other complications was higher in the pre-lockdown cohort compared to the others (5% versus 3%), whereas there was no difference for wound healing disorders between all cohorts. In multivariate Cox regression analyses, the lockdown phase was unrelated to all SSI (hazard ratio (HR) 1.6; 95% confidence interval (CI) 0.6-4.8), wound healing disorders (HR 0.7; 95% CI 0.1-5.7) and other complications (HR 0.7; 95% CI 0.3-1.5).

Conclusion: The rates for SSI, wound healing disorders and other complications in orthopedic surgery were not influenced by strict Covid-19 lockdown hygiene measures.
**Methods: A comprehensive literature search was performed in PubMed, Cochrane Library, Web of Science, and Embase. Prospective clinical studies, in which adult long-bone fracture nonunions were investigated as main subject, were included in this analysis. Data on nonunion definitions described in each study were extracted and collected in a database.**

**Results: Although 177 studies met the inclusion criteria, only 50% (88/177) provided a definition. Nonunion was defined in these studies based on time-related criteria in 82% (72/88), on radiographic criteria in 64% (56/88), and on clinical criteria in 43% (38/88). A combination of clinical, radiographical and time-related criteria for definition was found in 34% (30/88). The time interval between fracture and the time point when authors defined an unhealed fracture or nonunion showed considerable heterogeneity, ranging from three to 24 months.**

**Conclusion:** In the current orthopaedic literature, we found a lack of consensus with regard to the definition of long-bone nonunions. Without valid and reliable definition criteria for nonunion, standardization of diagnostic and treatment algorithms as well as the comparison of clinical studies remains problematic. The lack of a clear definition emphasizes the need for a consensus-based approach to the diagnosis of fracture nonunion centred on clinical, radiographical and time-related criteria.

**Postoperative fever – Differences between elective vs. traumatic hip, knee and shoulder arthroplasty (8862)**

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**Introduction:** It is unclear whether there is a difference in the incidence of postoperative pyrexia between hip, knee and shoulder arthroplasty. The influence of a trauma setting has not been established either.

**Methods:** A retrospective review was performed on 675 joint replace-ment surgeries (hip, knee or shoulder arthroplasty) in an elective or trauma setting over a two-year-period (2016 – 2018). Patient demographics and several perioperative and postoperative parameters were recorded. Patients with a postoperative fever (POF) were analyzed and the fever curve characterized. The results and costs of any fever-related diagnostic work-up were reviewed.

**Results:** A total of 89 patients (13.2%) experienced a POF ≥ 38.0°C, only 21 patients (3.1%) a POF ≥ 38.5°C. There was a significantly greater risk (OR 3.43) for POF > 38.5°C in trauma patients compared to elective arthroplasties (ρ = 0.0062) and in hip procedures compared to knee and shoulder arthroplasties (ρ = 0.0091). Patients experiencing POF ≥ 38.5°C were more often males (ρ = 0.003), had an increased intraoperative blood loss (ρ = 0.0295), longer hospital stay (ρ = 0.0028). There was only 1/89 POF patients developing an early periarthrosthetic joint infection. The cost of a positive fever work-up (3/27 patients, 11.1%) leading to a new diagnosis and treatment was 2045 US$. A higher cost of a positive fever work-up (3/27 patients, 11.1%) leading to a new diagnosis and treatment was 2045 US$.

**Conclusion:** POF ≥ 38.5°C was more frequent in hip arthroplasty compared to shoulder and knee replacements, and more frequent in the trauma versus elective setting. The risk of developing an early periprosthetic joint infection was, however, not increased.

**Treatment of fracture related infections in the SwissDRG-System – a retrospective cost-benefit analysis (9923)**

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**Introduction:** Fracture related infection (FRI) is one of the most demanding complications in musculoskeletal trauma surgery. FRI’s result in prolonged treatment duration and patient morbidity. FRI has been shown to at least double the median treatment cost. With healthcare systems under pressure, there is a great interest to take measures to control costs. This study aimed to assess costs and remuneration of FRI treatment in the context of the Swiss Diagnosis Related Groups System (SDRG).

**Methods:** We included 156 patients with a FRI treated at the University Hospital Basel between 2012-19 in a retrospective cohort study. The costs and remuneration according to the SDRG of each hospital stay were evaluated. Clinical data including diagnosis and treatment details were collected. SDRG related data were obtained from the controlling department. Clinical and process related variables were examined for their influence on remuneration. The targeted length of stay (LOS) was compared with the actual length of stay (LOS). Subanalysis for the different SDRGs were performed to analyze relative share.

**Results:** Mean costs/patient were 63’967 (SD 74’475) CHF while mean revenue was 58’059 (SD 65’926) CHF, resulting in a mean loss/patient of 5’908 (SD 30’724) CHF. The highest matter of expense was nursing and therapies with a relative share of 48%. This is also evident with the length of stay (LOS) being the main determinant of cost. Cost under-funding occurred in cases of polytrauma (-23.5%), involvement of the femur (-19.5%) and FRI related to fecal bacteria (+12%). Early ortho-plastic flap coverage (c = 72h, n = 10) was more cost effective than late (>72h, n = 28) (p = 0.007). Average hospital stay was 1.4 times longer than targeted by the SDRG. Cases grouped into SDRG 112, which is specific for bone and joint infections, were covered consistently.

**Conclusion:** Our study indicates the enormous financial burden of FRI’s. In our findings only a minor group of patients was responsible for the majority of uncovered costs. The complexity of FRI underscores the need of treatment at multidisciplinary centers with a combined infectious diseases-ortho-plastic approach. This may optimize overall treatment with reduced hospital stay and therefore reduce health care costs.

**Perioperative empiric antibiotic treatment in patients with diabetic foot infections after amputation surgery is equally effective as directly targeted therapy (9931)**

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**Introduction:** Optimal perioperative antibiotic therapy in patients having surgery for diabetic foot infections (DFI) is unclear. It is unknown, if clinically relevant differences between strictly empirical treatment, directly targeted therapy and switched from empirical-to-targeted therapy exist. The current study explores a large cohort of DFI, enquiring if periopera-tive empirical antibiotic treatment is equally effective as directly targeted therapy.

**Methods:** Retrospective cohort study of 716 episodes (565 new episo-des, 151 revision episodes) in 332 patients with DFI undergoing minor foot amputations on 418 extremities between 1996 – 2018. Three dif-ferent antibiotic treatment strategies (empirical, directly targeted and switch from empirical-to-targeted antibiotic therapy) were assessed con-cerning total remission, clinical failure and microbiological failure rates using cox regression analysis.

**Results:** Median follow-up was 4 years, ranging from 0 – 17.5 years (IQR 2 – 9 years). The majority of amputations involved forefoot amputations (88%). In 74.6% of the cases, osteomyelitis was the leading indication for surgery. 194 cases received empiric antibiotic therapy, 291 cases di rectly targeted therapy and in 231 cases a switch from empirical-to-tar-geted therapy was found. 75% (n=534) received intravenous therapy, broad-spectrum antibiotics were used in 69.5% of all cases. In 526 cases, remission was achieved. Clinical failure occurred in 190 (26.5%) cases, microbiological failure in 44 (6.1%) cases.

Cox regression analysis showed no significant effect of antibiotic treat ment strategy on clinical failures. However, use of broad-spectrum antibiotics (Hazard Risk 1.823; 95% Confidence Interval 1.2 – 2.8) and presence of coronary heart disease (Hazard Risk 1.422; 95% Confidence In terval 1.0 – 1.9) identified as statistically significant. For microbiologi cal failure, no statistically significant factors were identified.

**Conclusions:** There is no statistically significant better pharmaceutical treatment strategy in perioperative management of diabetic foot infec tions after amputation surgery identifiable. Empirical-to-targeted treat ment shows similar effectiveness on all outcome parameters as directly targeted therapy. Rather than aggressive antibiotic therapy first with de scalcation over the treatment course, clinicians treating DFI are encour aged to continue to use empirical antibiotic therapy and switch to tar geted therapy as microbiological results come in.
The Risks for Primary and Secondary Major Amputations in Relation to the Initial Anatomical Localization of Diabetic Foot Osteomyelitis (9933)

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Introduction: Diabetic foot osteomyelitis (DFO) is common in diabetic patients. Data on the association between the initial anatomical DFO location and ultimate major amputation are limited. We retrospectively analyzed a possible association between the initial DFO location and other variables on the incidence of major amputation.

Methods: We included 583 amputated episodes in 344 different patients, excluding conservative therapies of DFO. All received a form of amputation (internal resection, minor or major amputation) in combination with antibiotic therapy. To adjust for the large case-mix, we performed a multivariate logistic regression analysis with the primary outcome "major amputation".

Results: Among the 344 diabetic patients (78 females), DFO was located in the forefoot in 465 (79.8%), in the midfoot in 94 (16.1%), and in the hindfoot in 24 cases (4.1%). The mean clinical follow-up period after amputation surgery was 3.7 years. Overall, we performed a major amputation in 63 (10.8%) DFO episodes, of which 47 (8.1%) were due to DFO as primary indication. Sixteen amputations were due to ischemia rather than infection, which we therefore excluded from further analysis. Among the 47 remaining major amputations, 22 (46.8%) were performed as the primary treatment, while 25 (53.2%) were converted into major amputations after failure of a prior minor amputation. Among this latter group of secondary major amputations, the DFO was located in the forefoot in 14/465 (3%), the midfoot in 8/94 (8.5%) and the hindfoot in 3/24 (12.5%); this in contrast to DFO localizations of the forefoot, midfoot and hindfoot in 8/465 (1.7%), 5/94 (5.3%) and 9/24 (37.5%) cases of primary major amputations. Overall, limb loss occurred in 4.7% of forefoot, 13.8% of midfoot and 50% of hindfoot DFO. In multivariate logistic regression analysis, only the initial midfoot DFO (odds ratio (OR) 2.8; 95% CI 1.1-7.3), a hindfoot DFO (OR 8.7; 2.5-30.3) or presence of peripheral artery disease (PAD) (OR 3.8; 1.1-13.2) were associated with a secondary major amputation.

Conclusion: While the majority of DFO occurred at the forefoot level, the percentage of limb loss increased the more proximal the DFO was located. Among those with conversion to secondary major amputations, an association of initial mid- or hindfoot DFO and the presence of PAD was seen. Therefore, mid- and hindfoot DFO need relentless aftercare and frequent clinical surveillance, especially in case of PAD.
An effect of neoadjuvant radiotherapy on surgical resectability, the volume and the necrosis rate of soft tissue sarcomas - a retrospective monocentric analysis (9922)

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Introduction: Soft tissue sarcomas of the extremities are a rare but often highly-malignant disease. The mainstay of treatment mostly includes extremity preserving surgical resection, which is often combined with pre- and postoperative radiotherapy. Advantages of preoperative radiotherapy include facilitated planning, lower radiation dose and thus fewer long-term side effects. The goal of this study is to retrospectively assess the effect of preoperative radiotherapy on the tumor volume and if this change potentially facilitates surgical resection.

Material and Methods: A retrospective analysis of 51 patients who suffered from a localized soft tissue sarcoma of the extremity or the trunk was performed. All patients included were treated by neoadjuvant radiotherapy prior to surgical resection with curative intent and had an MRI before and after radiotherapy.

The volume of the tumor as well as the distance to anatomically relevant structures were measured prior and after neoadjuvant radiotherapy. Patient information was obtained from the files. Tumor type, characteristics and necrosis rate were obtained from the pathology report.

Results: At last follow-up (median 51 months (range 6-113)) 19 (37%) of the 51 patients were deceased. Recurrence-free survival was seen in 29 patients (57%); 3 patients suffered from a local or systemic recurrence at last follow-up. In total 7 patients (14%) suffered from local recurrence and 18 patients (35%) from a systemic metastasis, whereas all but one were lung metastases.

The minimal distance of the tumor to important neurovascular structures was not significantly influenced by volume reduction of the soft tissue sarcoma by neoadjuvant radiotherapy. In 24 patients (47%) the absolute volume of the tumor increased after radiotherapy, in 19 patients (37%) the volume decreased and in 8 patients (16%) the volume remained stable. High-grade tumors showed a significant increase in tumor volume (p=0.03). High-grade tumors showed a significant greater necrosis rate than low grade tumors (p <0.001).

Conclusion: A volume decrease of soft tissue sarcomas inflicted by neoadjuvant radiotherapy does not lead to a significantly increased minimal distance to critical neurovascular structures and thus does not potentially increase resectability. High grade tumors show a significant increase in tumor volume and a significantly greater necrosis rate than low grade tumors.

Patient specific 3D-printed guides in malignant bone tumor resection and reconstruction – analysis in 17 cases (10028)

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Introduction: Customized accurate tumor resection and individualized reconstruction is a challenging in treatment of malignant bone tumor. Three-dimensional (3D)-printing technique is now widely used in the resection and following reconstruction of malignant bone tumor, which included but not limited to tumor model, osteotomy guide and customized implant.

Methods: We retrospectively reviewed 17 patients, who underwent limb salvage surgery by using 3D-printed guide at a single center between August 2014 and October 2019. The median duration of follow-up was 26 months. Osteosarcoma (41.2%) were the predominant diagnosis. The functional outcomes were assessed by Musculoskeletal Tumor Society (MSTS) functional score. We also analyzed survival status, operative data, reconstruction methods and complications.

Results: We totally performed 76 guided osteotomies on affected bone and on allograft in 17 patients. Reconstruction in 13 cases was performed with biological technique: allograft combined with autograft was used in 7 cases, 12 of 13 (92.3%) cases showed a good bone healing in both allograft and autograft. 1 of 13 (7.7%) cases had allograft necrosis. In addition intra-operative extravascular radiation was performed in 3 pelvic cases for reconstruction. 54 of 55 (98%) osteotomies achieved wide resection and negative margin. 1 osteotomy contaminated the tumor tissue because of the swing of sawing, but fortunately there was no recurrence and metastasis till now. All the cases had successful limb salvage result without amputation. At the latest follow up, the mean MSTS Score was 24 (range: 13-30), 12 patients alive with no evidence of disease, 1 patient alive with disease, 4 patients had died of disease and 5 years overall survival is 72.2%. Complications occurred in 9 patients, with wound healing disorder being the most common complication (4 patients).

Conclusion: The 3D-printed resection guide was easy to use and showed promise in the field of orthopedic oncology. It can not only used in primary malignant bone tumor personalized resection but also in shaping structural bone allograft in bio-reconstruction, which can achieve a safety surgical margin and individualized tumor resection at the same time.
Spinal degeneration is associated with the mechanical characteristics of dorsal spinal ligaments (9868)
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Introduction: The ligamentum flavum (LF), the inter- and supraspinous ligament (ISL&SSL) and the intertransverse ligament (ITL) are relevant spinal structures for segmental stability. The biomechanical effect of degeneration and aging on their biomechanical properties remains largely unknown. The aim of this study was to assess the material properties of the ITL, ISL&SSL and LF and to correlate parameters of biomechanical function with LF-thickness, intervertebral disc (IVD) degeneration and age.

Methods: MRI- and CT-scans of 50 human lumbar segments (Th12-L5) were used to assess the ISL (acc. to Keorochana), the grade of IVD degeneration (acc. to Pfirrmann) and to quantify LF-thickness. The ITL, ISL&SSL and LF were resected in the neutral position of the spinal segment with a specifically developed method to conserve initial strain. Ramp to failure testing was performed (0.5 mm/s) to record initial tension, slack length, stiffness and ultimate strength. The relationship between the biomechanical characteristics and age and radiological parameters were analyzed.

Results: With aging, a significant reduction in initial tension ($r = -0.5$, $p <0.01$) and ultimate strength ($r = -0.41$, $p <0.01$) of the LF was observed, while the effect on LF-stiffness and the characteristics of the other ligaments was non-significant. IVD-degeneration was correlated with a significant reduction in stiffness ($r = -0.47$, $p = 0.001$; $r = -0.36$, $p = 0.01$) and ultimate strength ($r = -0.3$, $p = 0.04$; $r = -0.36$, $p = 0.01$) for the LF and ISL&SSL respectively, with a similar, but non-significant trend for the ITL and a significant reduction in initial tension ($r = -0.4$, $p <0.01$) of the LF. Comparing Pfirrmann 2 to 5, this reduction was 40-80 % for stiffness 60-70 % for ultimate strength and 88 % for initial tension of the LF. ISL&SSL-stiffness between Kerorochana grade A and D differed significantly ($p = 0.03$), while all other comparisons were non-significant ($p >0.05$). LF-thickness did not correlate with the biomechanical properties of the LF ($p >0.05$).

Conclusion: Aging is primarily related to biomechanical changes to the LF. IVD-degeneration is related to a relevant reduction in stiffness and ultimate strength of the LF and ISL&SSL, with a similar trend for the ITL. The ISL-specific Kerorochana-grading provides only minimal biomechanical information and LF-thickness does not provide biomechanical information.
Outcome Measurement in Trauma Surgery with a Fracture Database and Clinical and Patient-Reported Outcome Measures (PROMs) (9715)
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Objective: Patient-Reported Outcome Measures (PROMs) gain growing attention. The Food and Drug Administration suggested in 2009 to have PROMs for every new treatment and technology. The use of PROMs was further promoted by the Patient Protection and Affordable Care Act of 2010 in the USA. Recommendations from other national and international organizations include the OECD’s Project of Patient-Reported Indicator Surveys (PaRIS) and the International Consortium for Health Outcomes Measurement (ICHOM). Our development and initiation of a Fracture Database started early in 2018. We orientated our database on the role model of the Swedish Fracture Registry.

Methods: REDCap (Research Electronic Data Capture) is a web interface for a SQL (Structured Query Language)-Database. We used it to program the Fracture Registry. We collect data about demographics, diagnosis, treatment, adverse events, clinical outcomes, and PROMs. The PROMS are recorded with the Software ‘Heartbeat ONE’ vs. 6.15.4. Inclusion criteria are all patients with fractures of the upper and lower extremity, including the pelvis and multiple injuries, treated surgically. Excluded are all patients with fractures of the hand as monotrauma and non-surgical treatment. We established questionnaire sets for each anatomical region. Every hospitalized patient is screened for inclusion criteria to get the baseline PROMs. Follow-up PROMs are collected at 3-months and 12-months in our outpatient clinic.

Results: In five months of collecting PROMs, we have evaluated 599 patients, 521 fulfilling the inclusion criteria. 329 (63%) questionnaire sets were completed. The mean time for answering the questions was 11-20 minutes. The input rate of 63% for PROMs accounts for the start of the process, with 22 (4%) patients being dismissed before answering the questionnaires. 93 (18%) patients denied participation. 52 (10%) patients were not able to participate (dementia, delirium). Other causes for missing data were language barriers (n=28; 5%), medical reasons like polytraumatized patients (n=4; 0.8%), and deceased patients (n=15; 2.9%).

Conclusion: Most Orthopaedic Trauma centers publish data about PROMs from surgically treated patients. Starting in the first quarter of 2021, we will include non-surgically treated patients. We have optimized the process of including patients. Our aim is a response rate of more than 80% within this year to get representing data.

Pain localization matters – Do pain locations and pain intensity correlate? (9842)
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Introduction: Orthopedic questionnaires are a common tool to assess pain intensity. A critical argument about pain intensity is its subjective character and that it cannot be objectivated. Pain locations on the body surface might be a new approach but have been poorly investigated. Dave et al. could demonstrate better outcome for TKA in patients with only knee pain compared to patients with pain at multiple sites (Dave et al., 2016). The aim of this study was to investigate pain locations on the body surface and correlate it with pain intensity.

Methods: Included were orthopedic patients with pathologies of large joints (shoulder, hip, knee) and/or spine. At each consultation the pain score and the pain locations on the body surface were assessed with a standardized patient questionnaire (paper and pencil). The locations were marked on a special 2.5dimensional figure with a front and back view.

Pain locations were classified with a grid of 111 elements representing defined regions on the body (e.g. thigh: trochanter, front, lateral, dorsal, medial). The mean symptom score was calculated, the number of locations with the 111-element grid and their frequency. To visualize the “symptom-streams” all figures were digitally superposed and analyzed (by TO and MP; ETHZ).

Results: 712 assessments were included completed by 348 patients (56% female, mean age 67.3 years). The mean symptom score was 28/100 and two thirds of the patients had a score between 10 and 40. In the mean 3 locations were marked (maximum of 23). 33% of all assessments had more locations (3,3 vs 2,6; p <0.001). The five most frequent locations were: knee right (19%), knee left (19%), ventral right thigh (17%), sacrum (16%), lateral thigh left (15%). The digital views superposed demonstrated two combinations of “symptom streams”: 1. sacrum, groin, thigh, knee and 2. neck, shoulder, arm. Up to 6 pain locations correlated positively with pain intensity (pearson’s correlation r=0.997).

Conclusion: Pain locations can be analyzed with a grid of 111 clinically defined elements on the body surface. In orthopedic patients two thirds had up to 3 pain locations. Pain location and pain intensity correlate up to 6 localizations with a high correlation coefficient. Symptom locations seem to have the potential to objectivate the “subjective” pain intensity.
Novel surgical technique of capsule-labral closure in the open Latarjet procedure (9750)
Marko Nabergoj¹; Alexandre Lädermann²; Sidi Wang³
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Surgical treatment of anterior glenohumeral joint instability can be challenging and carries the inherent risk of recurrent instability, dislocation arthropathy and postoperative loss of external rotation. We are presenting a novel and easy technique for combined reconstruction of anterior labrum and capsule, with concomitant reduction of the humeral head during anterior capsule reconstruction in open Latarjet procedure. Analogous to other techniques, the coracoid graft is fixed on anteroinferior part of the glenoid between 3 to 5 o’clock position. However, for this technique, during the preparation of the coracoid, two additional transosseous holes are drilled through the coracoid below the acromioclavicular ligament attachment, where the released labrum is later attached. Additionally, during the reconstruction of the anterior capsule, while the operated arm is held in abduction and external rotation to avoid the postoperative deficit of external rotation, the humeral head is reduced in the center of the glenoid. By doing so, the inherent risks of residual microinstability and dislocation arthropathy are believed to be decreased. Further studies are needed to clarify the long-term consequences of this novel surgical technique in the clinical setting.

Novel surgical treatment of an excessive medial clavicle resection (9751)
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Medial clavicle excision is a rarely indicated procedure performed in different pathologies affecting the proximal part of the clavicle. Excessive medial clavicle resection with an injury to the costoclavicular ligament often leads to poor postoperative results. The exact surgical treatment that should be used in this kind of pathology when conservative treatment is unsuccessful remains questionable. Our preferred surgical treatment of this condition is to fix an autograft from the iliac crest on the medial end of the clavicle with a plate. Stabilization of the newly reconstructed medial part of the sterno-clavicular joint is performed with a gracilis allograft shuttled through the medial part of the autograft and the lateral sternal part of the sterno-clavicular joint in a figure-of-eight configuration. The final costoclavicular stabilization reconstructing the costoclavicular ligament is performed with the high-strength sutures passing through the first rib and around the plate fixed on the remnant of the medial clavicle and multiple knots are performed on the superior surface. The end result is an anatomic reconstruction of the sterno-clavicular joint. Further long-term studies should show, whether the proposed surgical reconstruction and stabilization adequately restores normal shoulder mechanics and function, in the setting of symptomatic excessive medial clavicle resection.

Extended anterior approach to the humerus shaft – Cadaveric Study (9768)
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Introduction: Selection of surgical approach for humeral shaft fracture depends on fracture location. Extended anterior approach to the humerus is difficult because neurovascular structures converge on the anterolateral aspect of the elbow. Many surgeons are unfamiliar with the specific anatomical features of this region. The purpose of the present study was to clarify the anatomy of the anterior approach to the entire humerus and to investigate how far distally an anterior plate can be placed safely without jeopardizing neurovascular structures.

Methods: An extended anterior approach was performed on 30 cadaveric upper arms. A plate was adjusted helically to the entire humerus from the greater tuberosity to the coroid fossa. Distally, the plate was placed underneath the brachialis muscle. Thereby, brachialis splitting was limited to the plate holes by blunt dissection. At determined levels, distances from the plate edges to adjacent neurovascular structures at risk (musculocutaneous nerve [MCN], lateral antebrachial cutaneous nerve [LACN], radial nerve, median nerve and brachial artery) were measured. The innervation pattern of the brachialis muscle was revealed and the potential risk of its denervation during surgery was analysed.

Results: Safe anterior plating of the entire humerus without damage to neurovascular structures occurred in all 30 specimens. Where the radial nerve pierced the lateral intermuscular septum its distance to the plate was >1.7cm. On the level of the coroid fossa safe plate distances were: ≥1.1cm for the radial nerve, ≥1.4cm for the LACN, and ≥1.7cm for the median nerve and brachial artery. The brachialis muscle showed in 90% a dual innervation by the MCN and the radial nerve. The brachialis muscle regularly consisted of 3-4 intramuscular crossing neurovascular pedicles. The most proximal pedicle was always heavy-calibrated and constantly found in all specimens.

Conclusion: Extended anterior approach to the entire humerus can be safely performed. Identification of the brachialis muscle crossing neurovascular pedicles may prevent damage to muscle innervation. Since the radial nerve runs at a safe distance to the helically shaped plate, identification is not compulsory. Anterior plate osteosynthesis of the humerus represents an advantageous alternative to the posterior or two incision approaches to the humerus.

Transhumeral amputation in brachial plexus lesion patients. A multicenter case series. (9836)
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Introduction: A flail limb can be the result of a traumatic complete brachial plexus lesion. An elective amputation has a place in the rehabilitation, however long-term follow-up is unknown. The aim of this study is to evaluate the outcome of this rare and life changing operation 10 years postoperatively.

Methods: 8 Patients with a mid-humeral amputation executed in 2 specialized medical centers were included. Psychological disorders were ruled out and all patients had a persisting wish for amputation. Postoperatively, the functional- and psychological outcome and the quality of life was evaluated with PROMs and standardized questionnaires (DASH, SIP-68, EQ-5D-5L and HADS).

Results: After 9.7 years follow-up 7 patients would undergo the operation again and were satisfied with the results. At latest follow-up the median DASH score was 37.3 (range 8.3-61.7), the median SIP-68 score was 6.5 (range 0-43) and the median HADS score was 3.0 (range 0-14) for anxiety and 3.0 (range 1-19) for depression. In the EQ-5D-5L patients had most difficulties in self-care, usual activities and pain/discomfort. The median overall health status was 69 (range 20-95).

Conclusion: A mid-humeral amputation has a place in the rehabilitation for traumatic complete brachial plexus lesion with satisfying long-term results. However, setting the right indication is essential.


**Biomechanical analysis of arthroscopic single anchor repair techniques of upper third subscapularis tears (9866)**

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**Introduction:** Upper third tears of the subscapularis tendon can be repaired successfully with a single anchor according to previous literature. The aim of the present study was to compare three single anchor repair techniques regarding fixation strength, footprint coverage and contact pressure in a biomechanical test setup on human cadaveric shoulders.

**Methods:** Eighteen human cadaveric shoulders were randomized in three groups with respect to the repair technique: group 1: knotted lasso-loop mattress, group 2: knotted mattress and group 3: knotless technique. Upper third tears of the subscapularis tendon (Lafosse type 2) were created and repairs were performed with additional contact pressure and area measurement using a pressure mapping system. Cyclic testing was performed by loading the subscapularis from 10 to 100 N for 300 cycles. A position-controlled ramp protocol up to 30 N and 50 N was used to allow for pressure measurements. Finally, specimens were loaded to failure and failure modes were recorded.

**Results:** The three groups were not significantly different regarding age, gender, bone mineral density at the lesser tuberosity, subscapularis footprint size and defect area created at the upper subscapularis insertion. A significant difference was detected between group 1 (48.6 ± 13.8 mm) and group 2 (25.9 ± 5.7 mm) regarding pressurized footprint coverage (p = 0.028). Ultimate load to failure was 630.8 ± 145.3 N in group 1, 586.9 ± 220.7 N in group 2 and 678.2 ± 236.5 N in group 3, respectively. Cyclic displacement was similar in all three groups with an average displacement of 1.2 ± 0.8 mm. The highest stiffness was found in group 1 with 98 ± 30.3 N/mm, which was not statistically significantly different to group 2 (85 ± 27 N/mm) and group 3 (83.9 ± 32.9 N/mm). The most common mode of failure was suture cut-through at the suture-tendon interface (44%). Failures in group 3 were less commonly associated with suture cut-through (33% vs. 50% in group 1 and 2), but no significant differences were found.

**Conclusion:** All three tested single anchor repair techniques of upper third subscapularis tears were able to provide sufficient biomechanical stability. Knotted lasso-loop mattress and knotless tape repair were superior regarding pressurized footprint coverage compared to a knotted horizontal mattress technique.

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**Treatment of medial clavicle epiphysiolysis associated with medial clavicle fracture: a case report (9899)**

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**Introduction:** Fractures of the medial third of the clavicle are rare (only 2-4% of clavicle fractures). This type of fractures is due to high-energy trauma associated with multiple organic injuries and a high mortality rate. In case of posterior dislocation of the clavicle, serious complications can occur: compression/injury of vascular and nerve structures, trachea, esophagus, and pneumothorax. In young patients, epiphysiolysis is more common than fracture. The physis in fact does not close until the age of 20-25 years. In case of posterior dislocation or relevant instability,
the treatment of the lesion can be surgical. We present here a case report of a rare case of simultaneous epiphysiolysis and medial fracture of the clavicle, treated surgically.

**Methods**: A 17-year-old patient fell from his bicycle onto his right shoulder, complaining of pain not only in the shoulder but also in the sternum area. He had no skin lesion, dysphagia, dyspnea, or sensory-motor deficits, and vital signs were normal. Imaging (standard RX and angio-CT) demonstrated a posteriorly displaced medial clavicle fracture with a dislocation of the sternal clavicle joint, with compression of residual thymic tissue. We proposed open reduction and internal fixation of the fracture to the patient. Under general anesthesia was inducted in dorsal decubitus. A transverse incision centered on the fracture was made. After the fragment was released and anatomic reduction achieved, a grade III locking plate (1.0 mm) was attached. Intraoperative imaging after fixation, the clavicle remained elevated with respect to the contralateral, due to epiphysiolysis found after further exploration of the intact periosteum. We reduced the epiphysiolysis by reducing the clavicular in its periosteal sleeve and fixed with transosseous suture. The periosteum was closed to cover the plate.

**Results**: The clavicles are symmetrical, and the patient has resumed a normal lifestyle. At 5 months post-operatively, one patient of nine (11%) showed a fixation device failure. Overall, seven of the nine patients (77%) had satisfactory results. As excellent in five patients, good in two and fair in one at the final follow-up. The mean CS score was 94 points (range, 75 to 100 points) the result was evaluated as excellent in five patients, good in two and fair in one at the final follow-up. The mean Broberg and Morrey score was 12/60. The radiological result was satisfactory without signs of displacement.

**Conclusions**: Medial clavicle fracture-dislocations are rare but potentially serious injuries. Posterior dislocation always requires surgical intervention. In our particular case, surgical treatment allowed us to diagnose epiphysiolysis. Even in case of a confirmed fracture, the suspicion of a lesion of the physiologic plate must be considered, to avoid malunion.

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**Surgical technique for radial head fractures with more than 3 fragments: A new concept of fixation (9905)**

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**INTRODUCTION**: The treatment of comminuted radial head fractures (RHF) type III/IV of the Mason Johnson’s classification still remains controversial. According to the current literature, RHF with more than three parts are not suitable for repair. Therefore, most authors suggest a primary radial head arthroplasty (RHA). Nonetheless, in case of unstable elbow injuries, the management of multifragmentary RHF with radial head replacement seems to have 25% risk of reoperation due to stiffness and painful loosening. Under this scenario, given the improvement of reduction and fixation technique we enlarged the indication of osteosynthesis before RHA. The purpose of this retrospective study is to determine the functional results in terms of the Broberg and Morrey score and radiological failure rate following open reduction and internal fixation (ORIF) with headless compression screws and/or 1.0-2.8 plates of RHF with more than three articular fragments.

**METHODS**: A retrospective single-center case series. Between 2012 and 2019, patients who had undergone ORIF of RHF with more than three articular fragments were included. We standardized some critical steps of the surgery in all our cases: we used a ventralized approach using extensor split, respected the annular ligament, and used low profile implants (headless screws, plates with a thickness of 1.3mm). Nine patients, with an average age of 52 years had a clinical and/or radiological average follow-up of 47 months.

**RESULTS**: The preoperative radiographs and CT scans identified 8 fractures with 4 fragments and 1 with 5 fragments. Four fractures were classified as Mason III and 5 as Mason IV. Four patients underwent osteosynthesis with plate and screws while 5 patients with screws only. For the 9 patients with RHA of the radial head, the mean Broberg and Morrey score was 94 points (range, 75 to 100 points) the result was rated as excellent in five patients, good in two and fair in one at the final follow-up. Overall, seven of the nine patients (77%) had satisfactory results. Postoperatively, one patient of nine (11%) showed a fixation device failure after 6 weeks and sustained a RHA. All other patients showed radiological healing of the fracture with an average of 3 months.

**CONCLUSION**: According to our results, there are many occasions, where ORIF can be successfully applied in case of RHF with more than 3 fragments.

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**Risk Factors for Dislocation after Reverse Total Shoulder Arthroplasty: A Systematic Review and Meta-Analysis (10008)**

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Instability after reverse total shoulder arthroplasty (RTSA) is a dreaded complication. Risk factors for developing postoperative instability are uncertain. The aim of this systematic review was to quantitatively and qualitatively analyze the risk factors of instability after RTSA. Of 1183 studies identified, twelve studies involving 3810 patients were included. The mean age was 68.8, and the mean follow-up was 46 months. The pooled rate of dislocation after RTSA is 4.0%. Several patient-specific and implant-specific risk factors have been identified and especially implant-specific risk factors appear avoidable with the current knowledge, implant design and technology.

**Level of evidence**: Systematic review of minimum level IV studies

**Keywords**: Reverse total shoulder arthroplasty, complication, dislocation, instability, systematic review

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**Conversion to Reverse Total Shoulder Arthroplasty With and Without Humeral Stem Retention: Mid-to Long-Term Results (10010)**

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**Background**: Over the past decade, conversion to reverse total shoulder arthroplasty (RTSA) has become the preferred treatment for revision of an anatomic hemi (HA) or total shoulder arthroplasty (TSA). However, conversion of failed stemmed shoulder arthroplasty to RTSA is still a highly demanding procedure and carries unique technical challenges and risks.

**Questions/purposes**: This study aimed to analyze the mid- to long-term results after conversion of failed anatomical shoulder arthroplasty to RTSA and investigate whether preserving the humeral stem offers advantages over revisioning the humeral stem.

**Materials and methods**: Between 2005 and 2018, 99 hemiarthroplasties and 62 total shoulder arthroplasties (total = 161 shoulders; 157 patients) were revised to RTSA without (n = 47) or with (n = 114) stem exchange. Complications and revisions were documented from medical and surgical records. Longitudinal pre- and postoperative clinical (Constant-Murley (CS) score, Subjective Shoulder Value (SSV)), and radiographic outcomes were assessed. Complete clinical and radiographic follow-up was available on 80% of shoulders (127 patients; 128 of 161 procedures, 46 without and 82 with stem exchange) at a minimum of 24 months and a mean of 70 months (range, 24–184 months).

**Results**: Humeral stem revision was associated with a significantly reduced surgical time (193 minutes vs 227 minutes, p=0.001, less blood loss (591 mL vs 753 mL, p=0.037), less intraoperative complications (13% versus 19%; odds ratio (OR), 1.4, p=0.32) and fewer subsequent reinterventions (19% versus 28%; OR, 2.3, p=0.06). The complication/revision rate leading to drop out from the study was considerable in the stem revision group (ten patients; ten of 114 shoulders (9%)), but there were no complication-related dropouts in the stem-retaining group.

**Conclusion**: Our findings suggest that humeral stem revision is associated with decreased surgical time, less blood loss, less intra- and postoperative complications, and a lower revision rate compared to humeral stem retention. Based on these findings, a shoulder arthroplasty system modularity offers substantial benefit if conversion to reverse total shoulder arthroplasty becomes necessary.

**Level of evidence**: Level III, therapeutic study

**Keywords**: Reverse total shoulder arthroplasty, Revision shoulder arthroplasty, Failed shoulder arthroplasty, Hemiarthroplasty, Anatomic total shoulder arthroplasty, Conversion
A Report of Three Cases of Intra-Articular Corrective Osteotomies for Distal Humerus Malunion (10022)
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Background: The incidence of distal intra-articular fractures of the humerus is 2% in the adult population and even less in the pediatric population. Especially in pediatric population the misdiagnosis of intra-articular lesions is frequent and conservative treatment may evolve into malunion.

If left untreated, the natural history is characterized by early arthrosis. Posttraumatic intra-articular malunion of the distal humerus represents a major challenge when considering its surgical reconstruction. Few cases are described in the literature.

Methods: We included 3 consecutive patients, treated with corrective osteotomy for distal articular humerus malunion. The patients underwent the surgical reconstruction at 9, 15 and respectively 37 months after the initial trauma. The age at the time of the osteotomy was 26, 13 and 16 years old. The patients were followed postoperatively for 31 and 28 months, latest case being operated 2 weeks before the study began. The initial injuries were treated conservatively in all patients. The average preoperative arc motion was 102, 125 and 120 degrees.

Results: Due to the fact that the third patient was operated short before the study started, we’ll present the clinical outcomes of the first two patients. The clinical and radiological outcomes were satisfactory with a postoperative arc of elbow motion of 150 and 135 degrees. The patients could return to all their daily and sport activities without any limitations. No osteoarthritic changes were seen on the postoperative x-rays. One patient presented a delayed wound healing after the initial intervention probably due to the tension at the surgical site. Later on, the same patient underwent a partial implant removal and cubital nerve release due to the discomfort.

Conclusion: This case emphasizes the importance of adequate initial management of intra-articular distal humerus fractures. Surgical reconstruction of a malunited distal humerus fracture is technically challenging, but can improve function and relieve pain in the young active adult by restoring intrinsic anatomy of the elbow.

Risk factors and intraoperative complications during revision of shoulder prostheses (10028)
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Background: The increase in the number of first-line shoulder arthroplasties has led in recent years to an increase in the number of shoulder replacement procedures. Revision surgery is technically more difficult, with often more consequent complications. Few data are published on the occurrence and risk factors of these complications.

Objective: The objective is to evaluate 1) the prevalence of intraoperative humeral fractures (FHP) during prosthetic shoulder revision and 2) to identify these risk factors.

Materials and Methods: Between 2008 and 2020; 89 patients having undergone shoulder prosthesis revision were included in a monocentric retrospective study. In all of these patients, the glenoid and/or humeral implant had been changed. Five groups of patients were enrolled:
1. fracture prevalence in the study population (10/89)
2. fracture occurrence by age (more than 70 years=3 and less than 70 years=7)
3. fracture occurrence by infection (7 patients)
4. fracture occurrence by stem length (10 long and 0 short stems)
5. fracture occurrence by cement (6 cemented and 4 uncemented stems).

Results: Out of 89 patients with an average mean age of 69.5 years (28-99), 10 fractures (11.2%) occurred at revision. All fractures (100%) occurred during stem extraction (long (n=10), short (n=0), cemented (n=6) or uncemented (n=4)). The risk of intraoperative fracture was associated with long primitive stem (p=0.0001) and statistically insignificant at advanced age (p=0.41); infection of the primitive prosthesis (p=0.07); female sex (p=0.58) and cemented primitive stem (p=0.378).

Conclusions: Humeral fracture is a frequent phenomenon during shoulder prosthesis revision. The main favoring factor was mainly the length of the primitive stem.
Impact of operations under WALANT type anaesthesia on the operating time for carpal tunnel and spring finger surgery by doctors in training (9787)

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Introduction: Wide Awake Local Anaesthesia No Tourniquet (WALANT) is a commonly used operating technique in hand surgery. Adrenaline mixed with the locally injected anaesthetics limits bleeding during the procedure, but does not completely eliminate it, as a tourniquet would do with endovenous anaesthesia (EVA).

The aim of this study is to evaluate the operating time for carpal tunnel and spring finger releases of assistant physicians in training for the title of specialist in orthopaedic surgery and traumatology, under the supervision of a hand surgeon. Our hypothesis being that the operating times are slightly longer with a WALANT anaesthesia technique compared to an endovenous anaesthesia (EVA) technique but that the rate of early complications is similar.

Method: This is a retrospective study comparing patients operated on by assistant physicians, in training for the title of specialist in orthopaedic and trauma surgery, with isolated carpal tunnel release or isolated spring finger release under endovenous anaesthesia, performed by an anaesthesiologist, and under WALANT, performed by the surgical team. Operations involving other simultaneous procedures were excluded. The operating time was measured from incision to closure. Patients were followed up at 2, 6 and 12 weeks post-operatively and the following complications were investigated: wound dehiscence, infection, neurological lesion and incomplete neurolysis (persistence of symptoms).

Results: Between January 2017 and January 2021, 34 carpal tunnel releases (18 under EVA and 16 under WALANT) and 44 spring finger releases (24 under AEV and 20 under WALANT) were completed. The mean operating time for carpal tunnel release was 14.6 and 20.1 minutes, under EVA and WALANT, respectively (p-value <0.05). The mean operative time for spring finger release was 16.0 and 15.8 minutes under EVA and WALANT, respectively (p-value 0.49). There were no complications in either group.

Conclusions and perspectives: The WALANT makes it possible to continue to teach assistant physicians in training for the title of specialist in orthopaedic surgery and traumatology, in hand surgery. Compared to endovenous anaesthesia, the operating time is increased by about 25% for carpal tunnel release but unchanged for spring finger, while not increasing the complication rate.
A03 – SPINE

The 16-item version of the SRS-instrument shows better structural validity than the 20-item version in young patients with spinal deformity (9884)

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Introduction: Previously, in patients with adult spinal deformity, 16 of the non-management items of the SRS-instrument showed a significantly better fit to the theoretical four-factor model (pain, function, self-image, mental health) than did all 20 items. The worst-fitting item per domain was recommended for exclusion (Q17, sick days; Q15, financial difficulties; Q14 personal relationships; Q3, nervous, respectively). Whether the same phenomenon is observed in data from younger (<20y) patients, for whom the questionnaire was originally designed, is not currently known.

Methods: This was a cross-sectional evaluation of the SRS-instrument’s factor structure and its equivalence across different language versions in young (<20y) deformity patients. Confirmatory factor analysis was performed on the 20 non-management items of the questionnaire completed by 3440 adolescents with spinal deformity (2746 English-speaking, 206 Spanish, 223 Italian, and 265 German; 70% female; mean age, 14.9 ± 2.2 y), to compare the relative fit of the data to a 20-item single-factor structure, a 20-item 4-factor structure, and a 16-item 4-factor structure. Item loading and the goodness of fit were determined from the root mean square error of approximation (RMSEA) and the comparative fit index (CFI). Equivalence of item-loading was compared across languages.

Results: Compared with the 20-item version, the 16-item solution significantly increased the fit (p < 0.001) across all language versions, to achieve good model fit (CFI=0.96, RMSE=0.06; Figure 1). For both 16-item and 20-item models, equivalence across languages was not reached, with some items showing weaker item-loading for some languages, in particular the German-language version.

Conclusion: Also in patients with adolescent idiopathic scoliosis, the shorter version of the SRS-instrument shows a better fit to the intended 4-factor structure. The wording of some of the items, and/or their equivalence across language versions, may need to be addressed. Questionnaire completion can be a burden for patients; if a shorter, more structurally valid version is available, its use should be encouraged. This shorter version of the SRS-instrument, with removal of ill-fitting items, should deliver more meaningful information on patient-reported outcomes and may also serve to improve compliance with questionnaire completion.

An Atypical Complication of Anterior Cervical Discectomy and Fusion: Sulcal Artery Syndrome (10007)

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Introduction: Anterior cervical discectomy and fusion (ACDF) is a frequent intervention in spine surgery. Neurologic worsening, vocal cord paralysis and Horner syndrome are among the known complications. Here we describe the first case of a sulcal artery syndrome after such an intervention.

Methods: We report the case of a 47-year-old woman who underwent ACDF with plating from C3 to C5 for degenerative cervical disc disease. Intraoperatively, while the C4/C5 cage was positioned, a sudden loss of MEPs on the right side was noted while SSEPs stayed unaltered. Though inspection did not show any neural compression or vascular damage. After an uneventful immediate postoperative course, the patient developed a progressive anesthesia on the right side with a sensory level at Th3, associated with impaired hot/cold discrimination about 7h after the surgery. On the left side, a slight hemiparesis with strength M4/5 was noted. Two days later, the symptoms worsened with stinging sensations and hypoaesthesia in the territory of the right maxillary nerve.

Results: A CT-scan showed no displacement of the material and no hematoma. The MRI of the brain and cervical spine showed a spinal cord ischemia at the level of C3-C4, in the territory of the sulcal artery. Oral steroids and acetylsalicylic acid were started. After worsening of the symptoms, a second MRI showed a progression of the edema, potentially involving the caudal part of the spinal nucleus of the trigeminal nerve. At one year after the intervention there is residual impairment of hot/cold discrimination and position sense in the right side of the body.

Conclusion: We report the first case to our knowledge of sulcal artery syndrome after ACDF with the clinical correlate of an incomplete Brown-Séquard syndrome. No evidence of direct damage to the spinal cord was found. The probable cause is vessel occlusion, but the exact mechanism cannot be ascertainment. In these circumstances, even though the prognosis is mostly favorable, further work-up in search of possible vascular pathology (arteriosclerosis, dissection) and/or hypercoagulable states may be warranted.

Paraspinal intramuscular Schwannoma arising from posterior dorsal ramus of D1 (10009)

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BACKGROUND: A pure intramuscular paraspinal schwannoma is an extremely rare condition, with only few case reports in the literature. Due to low frequency and lack of specific clinical signs and symptoms, presurgical diagnosis is difficult. Only at the pathological analysis the lesion is usually clearly identified. We report here a case in which pre-surgical imaging was highly suggestive for a diagnosis of paraspinal Schwannoma.

CASE PRESENTATION: A 69-year-old female patient present unspecific right paravertebral numbness, associated with a swelling homogeneous subcutaneous mass, right-sided, without skin reaction. No neurological signs or pain were assessed. At levels D3-D5, the MRI showed a 5x2x1 cm right-sided intramuscular paravertebral isolated mass, with circumscribed margins and heterogeneous component, partly cystic. No surrounding edema was found. At the upper pole of the lesion, it was possible to identify a paraspinal nerve coming down from D1, from which the mass arises. According to clinical and radiological findings, first hypothesis was a paraspinal schwannoma arising from a right dorsal ramus of D1. An elective surgery was performed. Histopathology confirmed a rare OMS I “ancient schwannoma”. The lesion was encapsulated inside a perineural sheet, with no residual tumor at the upper and lower extremity, confirming a complete resection. A clinical and radiological follow up was performed at 6 weeks postop, 6 and 12 months, with no evidence of tumor recurrence.

DISCUSSION: As underlined, a paraspinal intramuscular schwannoma is very rare, especially because rarely symptomatic. Besides, it is often impossible to give a clear pre-operative suspicion of these lesion, which are usually misdiagnosed in favor of more common back masses like lipomas or hemangiomas. It is mandatory to check specifically, at MRI and intraoperatively, for an eventual hypertrophied nerve ramus from which the schwannoma could arise, in order to perform a complete resection: although benign on 99% of cases, schwannomas present 1% of malignant degeneration into neurofibrosarcoma.

CONCLUSION: A schwannoma, although rare, should always be considered in the differential diagnosis when a patient with paraspinal mass lesion comes at our attention and a specific investigation with contrast enhanced-MRI is required before surgery. A complete “en bloc” resection with nerve identification is recommended, according to the rare but still possible malignant degeneration of a schwannoma.
Angiosarcoma can be mistaken for metal-on-metal related pseudotumor (9586)

David Windischbauer1; Sonja Cronenberg1; Martin Claus2; Christoph Schwaller1

Although a pseudotumor is a known complication of metal-on-metal (MoM) total hip arthroplasty (THA), a malignant process should be ruled out before surgical intervention.

We present a case of a 62-year-old patient, who was believed to have a MoM related pseudotumor for years turning out to be an angiosarcoma.

After primary implantation, the patient presented 16 years later with a cup loosening, which was diagnosed by performing a SPECT CT. Prior to revision surgery in January 2017, we performed a CT scan of the hip, which showed a new solid mass, likely a MoM related pseudotumor, reaching from the left hip into the pelvis.

In 02/2019, a prosthesis joint infection (PJI) was suspected, due to new pain in the upper leg and a suspect SPECT-CT scan and a joint sample showing Staph. Epidermidis. A revision surgery was performed with no confirmation of an infection.

In 08/2019 the patient presented with recurrent posterior dislocation and requiring inlay change. 3 weeks later the patient was readmitted with massive exudation of the wound and a hemoglobin of 45 g/L. The performed CT scan showed only the known mass believed to be a MoM Pseudotumor. The patient was treated as a PJI with debridement and implant retention, no active bleeding was found intraoperatively. After continuing secretion, even with negative pressure wound dressing another revision was necessary.

Prior to surgery CT-Angio was obtained, showing again no active bleeding. Our hematologists could not find a disorder explaining the bleeding. After the second revision, the bleeding continued, and with an active blood loss of unknown origin, the patient was referred to the University Hospital of Basel (USB).

After several further revisions without stopping the bleeding the pseudotumor was suspected to be the origin of the blood-loss, the mass was excised en bloc as R2 resection showing an angiosarcoma. Post R2 resection there were no further surgical options. Palliative radiotherapy was performed, stopping the bleeding.

It is discussed that long-existing MoM pseudotumors can transform into a malignant process. Angiosarcoma are rare with >1% of all soft tissue sarcoma. Survival rates post diagnosis range from 6-16 months.

After this case, we recommend to confirm the diagnosis of a pseudotumor with with MARS-MRI and histological analysis of every unknown mass resected in joint replacement surgery.

Successful osteoanabolic treatment with Teriparatide for symptomatic stress concentration at the tip of a tapered, fluted, uncemented hip arthroplasty stem: A case report (9761)

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Introduction: Since cementless stems have been introduced for total hip arthroplasty (THA) thigh pain can be a relevant issue. Its main cause is believed to be a mismatch in stiffness between the implant material and the bone leading to pathological stress transfer, but it can also depend on implant design, sizing, surgical technique, component malpositioning and patient anatomy as well as bone mineral density.

Methods: A 79-year-old female patient with severe osteoporosis, already treated with bisphosphonates, sustained an intertrochanteric fracture of the left femur after a fall. Due to fracture comminution, osteopenosis and concomitant advanced osteoarthritis of the hip joint, THA was preferred over internal fixation. The patient therefore underwent THA over a transfemoral approach with an uncemented, curved, modular, tantalum-alloy stem. Postoperatively, the patient showed good improvement of hip function but started to develop exertional thigh pain 6 months after surgery. Radiologic follow-up studies showed a correct position of the implant, without any subsidence, and the osteotomy as well as the trochanteric fracture consolidated. However, cortical thickening developed around the tip of the stem along with proximal stress shielding. With the hypothesis of a load transfer in the anchoring area of the stem exceeding resistance of the cortical bone, subcutaneous teriparatide therapy was started for 24 months.

Results: 6 months later the patient was already completely pain free and ambulating without discomfort. Conventional radiographs showed increased bone density in her femur. Within months after discontinuation of teriparatide, the symptoms gradually reappeared. Scintigraphy confirmed relapse of pathological activity at the tip of the stem. The treatment was subsequently changed to denosumab, with moderate improvement of the pain.

Conclusion: Stem tip pain is a well known complication of distally engaging hip implants. Various surgical options have been suggested over the years to address this condition if conservative treatment fails. Pharmacological treatment has never been tested. Teriparatide is one of the rare truly osteogenic substances available. Its use is restricted to 24 months because of induction of neoplasia. This successful off-label use has not been described so far and might be of interest for the future treatment of this biomechanical complication.

First case of bilateral, simultaneous, acute on chronic, unstable slipped capital femoral epiphysis (SCFE) treated with modified Dunn procedure (9827)

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Introduction: Bilaterality of slipped capital femoral epiphysis is reported in 18 – 50% in literature, whereby sequential occurrence is more often seen than simultaneous SCFE. Almost 50 – 80% of children with bilateral SCFE presents a simultaneous involvement but they are often stable. In literature as well as in our database we could not found any case which should a bilateral, simultaneous, acute on chronic, unstable slipped capital femoral epiphysis. We would like to present such a case which we recently treated.

Methods: A 15 years old adolescent, African origin, addressed by the family doctor, with bilateral inguinale hip pain since 2 – 3 months showed an acute pain exacerbation after weeks of physiotherapy without pain relief. The clinical examination showed a painful, bilateral reduced flexion, internal/external rotation of 70-0-0°, limited abduction. Radiological assessment presents a bilateral severe slipped capital femoral epiphysis. Based on that we performed a bilateral modified Dunn procedure. The more severe SCFE was operated as first case. The contralateral side was temporary fixed with a k-wire and was definitively treated at the fifth postoperative day.

Results: Intraoperatively the typical anterosuperior chondralabral lesion could be seen. The hips showed a hinged abduction. The epiphysis was in both hips unstable. Callus formation of the metaphysis was visible and reduced during modified Dunn procedure to reduced tension of the vessels. On both sides the epiphysis was vascularized before and after reduction and showed bleeding after we performed a drill holes at the level of the epiphysis. Intraoperatively an impingement free range could be obtained.

Conclusion: This patient is the first case in which we see a bilateral, simultaneous, unstable, slipped capital femoral epiphysis treated with the modified Dunn procedure. Long-term follow-ups and evaluations will be interesting to evaluate avascular necrosis, quality of life and clinical function of the hip joints.
CORRECTION OF COMPLEX THREE-DIMENSIONAL DEFORMITIES AT THE PROXIMAL FEMUR USING INDIRECT REDUCTION WITH ANGLE BLADE PLATE AND PATIENT-SPECIFIC INSTRUMENTS (9851)

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Introduction: Corrective osteotomies in complex proximal femoral deformities can be challenging wherefore subsidies in preoperative planning and during surgical procedures are considered helpful. Three-dimensional (3D) planning and patient-specific instruments (PSI) are already established in different orthopedic procedures. This study gives an overview on this technique at the proximal femur and proposes a new indirect reduction technique using an angle blade plate.

Methods: Using computed tomography (CT) data, 3D models are generated serving for the preoperative 3D planning. Different guides are used for registration of the planning to the intraoperative situation and to perform the desired osteotomies with the following reduction task. A new valuable tool to perform the correction is the use of a combined osteotomy and implant-positioning guide, with indirect deformity reduction over an angle blade plate.

Results: An overview on the advantages of 3D planning and the use of PSI in complex corrective osteotomies at the proximal femur is provided. Furthermore a new technique with indirect deformity reduction over an angle blade plate is introduced.

Conclusion: The understanding of complex deformities at the proximal femur is enhanced by the use of preoperative 3D planning and the additional PSI allow an accurate intraoperative execution. Further advancements in this technique, such as indirect deformity reduction over an angle plate, allow complex corrections with fewer surgical steps and less harm to the surrounding soft tissue.

Massive metallosis in ceramic-on-metal bearing (9896)

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Introduction: Ceramic-on-metal (CoM) bearings show significantly lower particle wear compared to metal-on-metal (MoM) in laboratory settings. FDA approved CoM bearings in 2011. More recent in vivo studies found serum ion levels (Co and Cr) lower in CoM compared to MoM bearings three years after implantation, but an increase after 5 years. The reason for increased wear rates remains debated. Nevertheless, only few case reports exist describing implant loosening due to metallosis for CoM bearings.

Case report: We present the case of a 50 year old female patient who after 18 previous surgeries due to bilateral high hip dislocations received a total hip prosthesis in 2010 with a ceramic-on-metal bearing. For the past 2 years she suffered of constant hip pain and was only able to ambulate with crutches. Radiographs showed an eccentric position of the head in the cup with position of implants in a normal range. Revision surgery was performed using a stepped trochanteric flip osteotomy as approach. Intraoperatively black liquid filled the joint and massive metallosis stained bone and surrounding tissue. The anterior bony half of the acetabulum was missing, leaving half of the metal back hanging free with the psosas tendon rubbing over the metal. After removal of all implants, a thorough debridement was performed. The acetabular defect was reconstructed with a shell formed from a femoral allograft head held in place with an acetabular reinforcement ring with hook. The new bearing is ceramic-on-polyethylene, the stem uncemented.

One year postoperatively the patient has little to no pain and is able to ambulate without assistive devices for short distances.

Discussion: Eccentric wear of the liner as well as metallic marks on the ceramic head were visible after removal. We therefore hypothesize that despite acceptable position of the implants edge loading was the main cause for the metallic wear. The age of the bearing may be of less importance.

Conclusion: CoM bearings are still FDA approved to this day, but have never been widely used in Switzerland. Due to the negative experience with this case without a clear cause being identifiable, we recommend monitoring of all these patients especially as recent findings show a possible increase in serum ion levels (chromium) after five years. Therefore, regular controls of serum ion levels and in case of elevated values or clinical symptoms MRI imaging to rule out pseudotumor formation seems mandatory to us.
A05 – KNEE

Chylous Joint Effusion of the Knee – A case report and literature review (9679)

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Introduction: Chylous or milky joint effusions are extremely rare. Here we describe a patient with accelerated ipsilateral anterior knee pain after inserting a total hip prosthesis and chylous effusion in the knee joint.

Case: A 54 y/o female patient suffered knee pain three months after an ipsilateral hip prosthesis was inserted. The patient denied any trauma of the knee, while she detected a painful swelling of the knee directly on the first day after surgery. Initially the swelling was assumed as a postoperative suffient hematoma and treated with oral analgetics. A week before the patient was seen in the orthopedic follow up, her knee was punctured by the general practitioner, showing "milky fluid". No fever or shivering. The examination revealed a tender knee with a large effusion, no erythema/warmening. The knee motion was decreased with ext./flex. 0/0/100°. The knee was punctured again in our clinic showing white, milky fluid. The laboratory investigation revealed massive lymphocytes with inflammation or crystals and we made the diagnosis of a chylartrhros. After exclusion of a lymphfistula the patient underwent conservative treatment. Eight months after first symptoms the patient was symptom-free without any deficits. The cause of the chylous effusion couldn’t be determined.

Discussion/Conclusion: Increased lipid content of joint fluid, presenting as a macroscopically milky fluid is equivalent to a very rare chylous effusion 1,2. These cases are reported with a traumatic joint injury involving the lymphatic system, or in patients, who suffer a systemic lupus erythematosus, RA, filariasis or pancreatitis with fat necrosis. The largest series was described by Das and Sen4, who screened 25 patients with filariasis who suffered acute knee pain with inflammation but sterile effusion, all self limited. Synovial biopsies in these patients showed inflammatory changes and the lymphangiogram (n=5 patients) showed particular lymphangiectasia, varicosities of the popliteal system with a blind channel, ending in the knee joint which suggests a lymphfistula. Diagnostic fluid aspiration and its laboratory investigation (oil staining) is mandatory to make the diagnosis (lipid concentration >800 mg/100 ml (8pg). Signs of systemic illness (fever, shivering) or pathological blood results. Elevated WBC, CRP may be seen, but are usually absent. Additional imaging for detecting insufficiency fractures (MRI, CT) or other bone pathologies are recommended.

Avoiding unconscious injection of vial-derived rubber particles during orthopedic intra-articular drug administration (9716)

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Background: Vial coring describes the occurrence of small rubber particles, which are formed by needles when piercing vial stoppers. These particles may be aspirated from the vial into the syringe along with the drug. Unconscious injection of rubber particles may increase the risks associated with intra-articular injections, in particular septic arthritis.

This study aimed to analyze the frequency of this phenomenon and possibilities to avoid its occurrence. We hypothesized that coring can be significantly reduced by using a thinner needle for injection than the one used to withdraw the liquid from the vial. We also hypothesized that the use of needles with a filter may avoid vial coring completely.

Methods: 600 vials of 2mL, filled with sodium chloride, were divided into 3 groups (n=200 each). In group one, aspiration from the vial was performed with a standard 18-Gauge needle and the same needle was used to eject the aspirated fluid onto a 10 µm filter paper. In group two, an 18-Gauge needle was used for aspiration. The needle was then replaced for a 23-G needle through which the fluid was ejected onto the filter paper. In group three, aspiration was performed using 18-G needles with implemented 5 µm filters. Afterwards the needle was removed and the fluid ejected onto the filter paper directly out of the syringe. Subsequently, a microscopic analysis of the filter papers was performed.

Results: In none of the 600 specimen, a rubber particle was detected by naked eye. Microscopically, 20 (10%) rubber particles were detected in group one. In group two, 21 (10.5%) particles were found. In group three, no particles were visualized. The detected particles were mostly cylindrical with a mean length of 77 µm ranging from 29 µm to 214 m. The mean width was 36 µm with a range from 14 to 83 µm.

Conclusion: Our study shows the occurrence of rubber particles in the injection fluid in 10% of the cases when standard needles are used for aspiration and injection. Using a thinner needle for injection did not reduce the number of particles whereas this phenomenon could be completely avoided when a filter needle with a 5 µm filter was used. We recommend withdrawing drugs for intra-articular injections with such a needle if possible.

Clinical and Patient-Reported Outcomes after Customised Individually Made Total Knee Arthroplasty (9729)

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Introduction: Classical knee arthroplasty is subject to different problems that can negatively influence the clinical outcome. Rotational and coronal malalignment, implant overhang and non-anatomic implant design with altered knee kinematics are only some causes discussed in literature. The idea behind customised individually made total knee arthroplasty (CIM TKA) is to avoid such problems and improve clinical outcome. The purpose of this study was to assess the clinical and patient-reported outcome measures (PROMs) of CIM TKA.

Methods: Since January 2017, we prospectively collect PROMs from patients scheduled for a primary cruciate-retaining CIM TKA (Total CR, ConforMis, Inc., Bedford, MA). The surgeon completed the objective Knee Society score (KSS) before the surgery and after 12 months.

We collected the following PROMs before the surgery, after 12 and 24 months: Knee injury and Osteoarthritis Outcome Score (KOOS), Forgotten Joint Score (FJS-12), EuroQol (EQ-5D-3L) and patient satisfaction.

We analysed pre-post data with paired t-tests and calculated the proportion of patients whose results improved at least by the minimal important difference (MID).

Results: We analysed data for 70 CIM TKA after 12 months (61 patients, 48% female) and 42 CIM TKA after 24 months (35 patients, 54% female). Mean patient age at surgery was 67 years (SD 8.7, range 48 to 83), mean KSS was 52 points (SD 11.6, range 19 to 85).

Complete follow-up data will be available in June 2021. We present preliminary results of the first 63 CIM TKA (12 months) and 37 CIM TKA (24 months).

Complete follow-up data will be available in June 2021. We present preliminary results of the first 63 CIM TKA (12 months) and 37 CIM TKA (24 months). Mean KSS improved to 94 points (SD 7.9, range 63 to 103, p <0.001).

All PROMs improved after 12 and 24 months (p <0.001). The proportion of patients with results above the MID ranged from 69% to 90% after 12 months and from 78% to 92% after 24 months. Most patients were very satisfied or satisfied after the surgery: 86% after 12 months and after 24 months, respectively. Complications occurred in three patients: a quadriceps tendon rupture (after 18 months), an arthrofibrosis that required arthrolysis (after 12 months) and one complete revision (after 18 months).

Conclusion: The data on CIM TKA showed very good clinical and patient-reported results including a high patient satisfaction. Future studies have to confirm these in long-term. It will also be of major interest to investigate, if CIM TKA show better postoperative PROMs in comparison to off-the-shelf implants.

Plate-free correction of highly symptomatic genu recurvatum (20 degrees of hyperextension) caused by a negative tibial slope: a case report (9779)

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Introduction: Genu recurvatum (extension >5°) can be caused by increased posterior joint laxity or by a primary or secondary bone deformity. More common in females, it can be the cause of unspecific anterior
Consecutive patients undergoing arthroscopic knee surgery have reported outcome (ePRO) assessment has become more widespread. In this meta-analysis of eight RCTs on 434 patients, no statistically significant differences were observed. Full length a.p. and lateral radiographs of the lower left limb showed good osseous consolidation and no signs of loosening. The knees were assessed immediately after surgery, and at 12-month follow-up. The primary outcome was the Lysholm Score 3), which was able to participate in long hiking tours without any pain. A pathological negative posterior tibial slope can be the main cause of a symptomatic Genu recurvatum. A plate-free correction through an anterior open-wedge osteotomy can improve life quality of patients without the need of further surgery.

Methods: Results: Conclusion: Feasibility Of Web-Based Patient-Reported Outcome Assessment After Arthroscopic Knee Surgery: The Patients’ Perspective (9793)

Feasibility Of Web-Based Patient-Reported Outcome Assessment After Arthroscopic Knee Surgery: The Patients’ Perspective

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Introduction: Methods: Results: Conclusion:

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Importance: Home-based programs vs standard rehabilitation following knee meniscectomy (9828)

Home-based programs vs standard rehabilitation following knee meniscectomy

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Importance: Home-based programs vs standard rehabilitation following knee meniscectomy

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Main Outcomes and Measures: The primary outcome was the Lysholm score and secondary outcomes were subjective IKDSC score, knee extension and flexion RoM, thigh girth, horizontal and vertical hop test, and days to return to work, as indicated in the previous PROSPERO registration.

Results: In this meta-analysis of eight RCTs on 434 patients, no statistically significant difference was found between the two groups. However, it was observed that the mean difference in the Lysholm score was 0.78 (95% confidence interval CI [-0.53, 0.11]), and that the mean difference in the vertical hop test score was -0.67 (95% CI [-0.95, 0.18]). A sensitivity analysis was performed, and the study findings were validated.

Conclusions and Relevance: No intervention demonstrated to be more effective in terms of physical outcomes as well as work-related and patient-reported outcomes, both at short- and mid-term follow-up. IOP showed only a slightly more favorable functional outcome in the short-term. Overall results showed HBP to be an effective management after AM in the general population.
Coronal alignment, outliers and operative time in total knee arthroplasty with navigation, patient specific guides or standard instrumentation: a single surgeon series on 274 cases (9915)

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Introduction: Neutral alignment in total knee arthroplasty (TKA) is defined as a hip-knee-ankle angle (HKA) within 3° from neutral and is associated with improved implant survival and function. Several studies reported higher rates of inaccurate positioning and alignment outliers when using standard instrumentation and technique. However, single surgeon clinical series comparing implant positioning and alignment with standard technique (STD), patient-specific instrumentation (PSI) and navigation (NAV) are lacking. Therefore, this study aimed to compare coronal alignment and implant positioning as well as operative time when the three techniques are performed by the same surgeon.

Methods: A single surgeon series of 274 patients who underwent TKA via standard instrumentation (STD), patient-specific guides (PSI) and computer assisted surgery (NAV) was analyzed at a one-year follow-up. The three groups (STD, n = 89; PSI, n = 94; NAV, n = 91) were matched for pre-operative coronal alignment. Pre- and post-operative HKA angles were retrospectively assessed analyzing stereoradiographic images of patients in functional position as obtained through the EOS® System.

Alignment outliers were defined as having a deviation of more than 3° from neutral (HKA < 177° or HKA > 183°). Operative times were retrospectively assessed on patients’ operative reports.

Results: Coronal alignment as measured through the HKA was significantly different between STD and NAV groups (p = 0.001), but not between STD and PSI (p = 0.4) nor between PSI and NAV (p = 0.1). There were 20 (23%) outliers in the STD group, 15 (17%) outliers in the PSI group and 8 (9%) outliers in the NAV group. The operative time was significantly lower in STD procedures (129 ± 3 min) and PSI procedures (126 ± 5 min) when compared with navigation (134.8 ± 9 min) [NAV: PSI p = 0.03, NAV: STD p = 0.04, STD: PSI p = 0.06].

Conclusion: In the present single surgeon series, TKA performed with navigation resulted in a significant improvement in implant positioning and coronal alignment when compared to standard technique. Moreover, use of navigation resulted in a significant reduction of alignment outliers. No relevant difference in terms of alignment or operative time existed between standard and patient specific instrumentation technique. However, because of the significantly longer operative time and the uncertain clinical benefit, use of navigation is still to be questioned.

CLINICAL AND RADIOLOGICAL OUTCOMES IN PATIENTS AFTER TROCHLEOPLASTY AND MEDIAL PATELLO-FEMORAL LIGAMENT RECONSTRUCTION WITH A MINIMUM 2 YEAR FOLLOW-UP (8948)

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Introduction: Trochlear dysplasia is a common risk factor predisposing to recurrent patella dislocation. This pathological morphology leads to a lack of congruence with the patella that occasionally needs to be surgically corrected by deepening the trochlear bone underneath the cartilage, the so-called trochleoplasty. The aim of our study was to evaluate the clinical and radiological outcomes after combined trochleoplasty and medial patello-femoral ligament (MPFL) reconstruction in patients with a minimum two-year follow-up.

Methods: Patients who underwent a combined trochleoplasty and MPFL reconstruction in our institution between January 2014 and July 2018 were eligible for a clinical and radiological assessment. Clinical examination included patellar apprehension test, Kujala and Tegner score and isometric measurement of quadriceps and hamstring strength. Radiological studies included radiographs and MRI of the operated knee. Wilcoxon test was used for comparison of numeric values. Fisher’s exact test was used for comparison of frequencies.

Results: Sixteen patients (16 knees) with a mean follow-up of 2.5 years (range 2.0 to 5.5 years) after the operation were available for clinical and radiological assessment. Median age at the time of the operation was 18.5 years (range 13 to 47 years) and trochleodyplasia was classified type B in 3 patients and type D in 13 patients.

Three patients presented a persistent positive patellar apprehension test, but none complained of a recurrent patella dislocation. Postoperative median Kujala and Tegner score were 85 (range 67 to 100) and 4 (range 2 to 10), respectively. Strength of the quadriceps and hamstring of the operated leg was lower than the contralateral side (17% and 9%, respectively). However, this difference did not reach statistical significance.

Post-operative MRI did not show any chondrolysis or subchondral necrosis. However, chondropathy worsened on both patellar and trochlear side compared to pre-operative MRI.

Conclusion: Combined trochleoplasty and MPFL reconstruction is a safe and efficient treatment for patellar instability in patients with high grade trochlear dysplasia. However, increased cartilage deterioration of the patella and trochlea has been identified on MRI performed minimum two years after the operation.
Anterior Intraosseous Dislocation of the Posterior Tibial Tendon: A Case Report (9772)
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Introduction: A 69-year old female patient sustained a twisting low-energy injury to her right ankle. She presented with pain and tenderness to her medial malleolus. Conventional radiographs showed a cortical irregularity over the medial malleolus without any typical fracture signs. CT scan demonstrated an osseous avulsion involving the flexor retinaculum with displacement of the posterior tibial tendon (PTT) underneath the fragment.

Methods: The patient underwent surgical exploration of the PTT 4 days after the injury. The tendon was exposed proximal to the medial malleolus and followed distally along its course. It was running anteriorly of the groove and disappeared underneath the periosseous into the cortical bone. After elevation of the osseous fragment the PTT could be reduced back into its anatomical position in the retromalleolar groove. Examination revealed an intact tendon with only mild fraying. The osseous fragment was anatomically reduced and fixation was performed using two 2.0 mm screws and transosseous sutures. The flexor retinaculum showed no signs of injury.

Results: The postoperative course was uneventful. Full weight bearing in a walking boot with 15° of plantar flexion for 6 weeks was allowed. Ankle X-ray examination 6 weeks postoperatively showed complete consolidation of the avulsed fragment. 12 weeks postoperatively the patient was ambulating without pain. Range of motion of the ankle joint was symmetric. No clinical sign for PTT insufficiency could be detected.

Conclusion: Dislocation of the PTT in absence of an ankle fracture is a rare injury with only a few case reports found in the literature. So far two different types of dislocation are described: a subcutaneous dislocation where the PTT dislocates anteriorly after rupture of the flexor retinaculum, and a subperiostal dislocation where the retinaculum is avulsed with a periosteal sleeve and the tendon is trapped underneath it. We report the case of a novel type of PTT injury: the anterior intraosseous dislocation. In this case the tendon dislocates anteriorly elevating an osseous fragment and leaving the retinaculum and the medial malleolus intact. Dislocations of the PTT need to be recognized and addressed surgically since they do not qualify for conservative treatment.

Z-lengthening Plasty of the Extensor Hallucis Longus (EHL) Tendon Proximal to the Retinaculum Extensorum to Repair a Chronic Rupture of the Distal EHL Tendon. (8985)
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Background: Extensor hallucis longus (EHL) tendon injuries are rare. End-to-end suture is used in acute lacerations or in chronic cases when the tendon stumps are close enough to be attached without excessive tension. If a non-reducible gap exists between the tendon edges, a reconstruction with a graft or a transfer may be necessary to remove the hallux alignment and active dorsiflexion. We present the surgical technique and the post-operative follow up of our method to repair a traumatic EHL rupture with a non-reducible gap by using a Z-lengthening of the EHL tendon proximal to the superior retinaculum of the extensors.

Method: We used two incisions, one at the level of the rupture and the other proximal to the retinaculum of the extensors. After the preparation, we measured the distal gap between the stumps. We then identified the EHL tendon through the proximal approach and lengthened it with a Z-shaped incision to gain the needed length distally. End-to-end suture could then be performed at the level of the rupture, without tension. Full weight bearing in a lower leg cast was allowed 24 hours after surgery. After two weeks, the patient received a dynamic splint with a dorsiflexion counter spring for another 4 weeks. After 6 weeks, normal shoes were allowed and physical therapy was started consisting in sessions with progressive active training twice a week for another 6 weeks. The muscle strength was estimated clinically at 6 weeks and 3 months in comparison to the healthy side. AOFAS, FAAM and EQ 5D 5L scores were administered at 3 months postoperatively.

Results: At 3 months, our patient recovered an active hallux extension of 50° at the metatarsophalangeal joint (60° on the healthy side). There was no loss of active or passive plantarflexion in the metatarsophalangeal or interphalangeal joint. There were no wound complications. We observed no dysfunction and no secondary deformities of the foot at follow up. The FAAM score was 88/84 (activities of daily living) and 12/12 (sports). The AOFAS was 90/100 and the EQ-5D was 0.8.

Discussion: This repair of the EHL using a Z-lengthening plasty of the tendon proximal to the retinaculum has not been previously described. Based on our case this technique appears safe, simple and affordable to treat the EHL ruptures if the end-to-end direct suture is not possible, thus eliminating the need for an allograft or the risk of secondary dysfunctions potentially associated with tendon transfer procedures.

Below Knee Amputations in Central Switzerland Between 2009 and 2019 (9970)
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Introduction: Primary below knee amputations (BKA) are often the last option in surgical treatment for many medical conditions and are performed by different surgical subspecialties. Amputations are often times performed in order to save a patient’s life. We thererfore asked, (1) what is the survival rate of BKA amputees in Switzerland, (2) how do these rates differ between different surgical subspecialties, and (3) how did these rates change over time?

Methods: Retrospective review of all patients undergoing a BKA at one of three hospitals of the same public hospital group consisting of two level 2 rural hospitals and one level 3 main hospital between January 2009 and December 2019 resulted in 98 BKA. Survival rates were calculated according to Kaplan-Meier and Cox regression analysis performed to identify risk factors.

Results: Thirty-two patients died at a mean of 1.1 years (range 0-4.2 years) after BKA at a mean age of 74.3 years (50.9-98.9). The half year, 1-year, and 2-years survival rate of patients undergoing BKA is 82.0% (95% confidence interval [CI] 74.3-89.8%), 75.2% (95% CI 66.0-84.3%), and 71.9% (95% CI 62.1-81.7%) respectively. The main reason for Burgess amputation was ischemia in 53%, diabetes in 19%, infection (v/o diabetes) in 15%, trauma in 9%, and other causes in 4%.

Burgess amputations were performed by vascular surgeons in 42%, by orthopaedic and trauma surgeons in 41%, and general and visceral surgeons in 17%.

Risk factors for death after BKA are secondary wound closure (hazard ratio [HR]= 7.986, p-value = 0.011), ASA score (HR= 5.405, p-value = 0.001), and high diastolic A. brachialis blood pressure (HR = 1.096, p-value = 0.041).

Conclusion: Survival of patients undergoing BKA is low. There was no relevant change of survival rate over the course of the observation period. Several risk factors for death after BKA were identified.

Clear cell sarcoma of the anterior tibial tendon: A case report (10027)
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Introduction: Clear cell sarcoma (CCS) is a rare malignant tumor few described in the literature, with a predilection for lower extremities and a tendency to involve tendons and fascia. Patients usually present late while the disease is progressing without them noticing it. Late symptom because of the slow progression of the disease. Clinical and radiological
findings are not sufficient. Histological and immunohistochemical analysis are necessary to make the diagnosis. The effective treatment is surgical by carcinological tumor resection.

**Case presentation:** We report the case of a 47 years old male patient undergoing initial biopsy-excision surgery of a lesion labeled tenosynovial giant cell tumor on MRI. After histological and immunohistochemical analysis, the diagnosis showed a clear cell sarcoma of the anterior tibial tendon. The patient underwent an extensive revision surgery.

**Results:** The immunohistochemical results correspond to a high-grade clear cell sarcoma with translocation of the EWSR1 gene. The extension workup after initial excision showed no tumor residue or lesions suspicious of distant metastasis. The pathology results of the post-relapse are favorable and consistent with resection in a healthy area.

**Conclusion and outlook:** The patient did not present any local or systemic recurrence and showed a good function of his anterior tibial tendon plasty at the 1-year follow-up.

Key words: clear-cell sarcoma, soft tissue tumor, anterior tibial tendon
A new subtype of Galeazzi-equivalent injury? Case report (9790)
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**Introduction:** Displaced distal metaphyseal ulnar fractures and distal radial buckle fractures are quite common among children but their association has never been reported in literature to our knowledge. Thus, classification and management of this pattern remain challenging especially in young children. A Galeazzi-equivalent injury should be suspected.

**Methods:** We report the case of a 2-year-old boy who presented the above-mentioned association of forearm fractures with a certain displacement between both bones. We compare our management with actual recommendations through a literature review. Informed consent was obtained.

**Results:** Initial clinical assessment of our patient was difficult because of his age and pain. He needed a closed reduction of the ulnar fracture under general anesthesia. Immobilization was maintained for 8 weeks. Clinical and radiological evolution were good. No residual pain, no range of motion limitation and no distal radio-ulnar joint (DRUJ) instability were observed after a five-month follow-up.

**Conclusion:** Galeazzi-equivalent injury combines an ulnar epiphyseal avulsion associated with metaphysis displacement and a radial fracture in children. This pattern is infrequent although probably underestimated. The initial clinical assessment of the DRUJ could indeed be complicated in young patients, by pain and swelling. Most of these injuries are treated by closed reduction and immobilization. Reported results in literature are quite good but misdiagnosed lesions or improper treatment could also compromise the DRUJ stability, the wrist and forearm range of motion, and generate chronic pain. We would recommend a low suspicion threshold for DRUJ instability in young children presenting a displaced distal metaphyseal ulnar fracture associated with a distal radial buckle fracture. That suspicion should impact treatment and follow-up.

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**A rare Case of Brucellosis in Switzerland: Osteomyelitis of the Pediatric Foot (9806)**
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**INTRODUCTION:** Brucellosis is one of the most common zoonotic bacterial infections in developing countries. Transmitted mainly by drinking unpasteurized milk, children seem to be more often affected than adults. Undulating fever, fatigue, musculoskeletal pain are common symptoms. Osteoarticular involvement is the most frequent complication; affecting most frequently the sacroiliac and spinal joints. Diagnostic measures include physical examination, laboratory tests, radiological imaging, and biopsies for microbiological and histological analysis. Treatment of osteoarticular brucellosis is by antibiotic therapy; however, surgical treatment is necessary in case of non-responsiveness to antimicrobial therapy.

**METHODS:** A case presentation of an 8-year-old boy admitted to our hospital due to increasing left foot pain and swelling. Known for recurrent episodes of polyarticular arthritis, he was being treated by a rheumatologist with analgesics and corticosteroid infiltrations for approximately six months. On clinical examination, he presented with swelling and erythema of the ankle and of the midfoot and associated with pain and limited range of motion. Laboratory findings showed normal inflammation parameters. Standard radiographs and ultrasonography of the foot demonstrated signs of osteomyelitis of the navicular bone with a concomitant abscess around the talonavicular joint confirmed by magnetic resonance imaging (MRI). Treatment was started with intravenous gentamicin and oral gentamicin-impregnated foam was performed. Initially, the intraoperative microbiological biopsies were negative; however, the Brucella-specific agglutination test, IgM-IgG combined antibody test and the eubacterial PCR resulted positive. The initial treatment with co-amoxicillin (amoxicillin + clavulanic acid) was replaced after 3 days by gentamicin. After two weeks, the gentamicin substituted by oral rifampicin and doxycycline for a total therapy of 3 months.

**CONCLUSION:** Brucellosis is a rare cause of osteomyelitis in children in Switzerland, but its consequences may be disastrous if missed. Brucellosis should be considered as a differential diagnosis in patients, especially immigrants, with unexplained symptoms, including joint pain and fever. We also recommend PCR analysis in case of negative microbiological cultures.

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**Extensor pollicis longus (EPL) tendon laceration after elastic stable intramedullary nailing (ESIN) of shaft fractures of radius in children with nail insertion at Lister’s tubercle: we report four cases. (9820)**
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**Introduction:** ESIN is an established method for treatment of unstable forearm shaft fractures in children. Two entry points for retrograde intramedullary nailing of the radius are described: proximal to the growth plate in line with the styloid process or to second at the Lister’s tubercle. The latter is commonly chosen for metaphyseal distal fractures. A lesion of the EPL tendon as a complication after ESIN is reported at a rate of 1.5% to 1.9%. As the tendon passes ulnar to the Lister’s tubercle it is prone for lesion as it has direct contact with the ESIN.

**Methods:** We report 4 cases operated from February 2019 to October 2019 of children aged 11 years and 1 month and 14 years and 3 month (mean 12.8 years) who underwent reduction and stabilization of forearm fractures with ESIN where the entry point of the nail was chosen at the Lister’s tubercle, who subsequently developed an EPL lesion in zone 7. The lesions were diagnosed before hardware removal and in one case intraoperatively during hardware removal thus 12 to 32 weeks after osteosynthesis on average 22.8 weeks. In three patients a 100% tendon rupture was present and in one case a 90% lesion. We suppose the lesions to be caused by friction, as the nails were introduced by an open approach. One EPL was reconstructed by extensor indicis-transfer and one with a palmaris longus transplant. The incomplete EPL lesion was sutured and reinforced with an extensor carpi radialis brevis graft. The forth patient demonstrated some active retropulsion and extension at the interphalangeal joint. An ultrasonography showed adhesions between the ruptured EPL and the intact extensor pollicis brevis. This explains the remaining function of the thumb. As the patient was not bothered he denied revision together with his parents. During the same period, a total of 24 children underwent operative stabilization with ESIN of the radius.

**Results:** Over a period of 10 months there was a significant number of EPL tendon lesions in our department of 16.7% as the entry point for the ESIN was chosen at the Lister’s tubercle.

**Conclusion:** The entry point ulnar to the Lister’s tubercle for ESIN for osteosynthesis in diaphyseal radius fractures in children must be avoided in order to prevent laceration of the EPL tendon.
First humerus lengthening osteotomy with a magnet-operated intramedullary nail in Switzerland – a preliminary case report (9944)

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Introduction: Distraction osteogenesis is an appreciated technique to correct limb shortening of various etiologies. An external fixator is commonly used to ensure 3D dimensional correction and lengthening. However, intramedullary devices have been showing similarly good results over the last decade providing a more comfortable distraction procedure with reduced risk of infection at the same time.

Purpose: To present the first case of humeral lengthening and operative technique using a magnet-operated intramedullary nail in Switzerland.

Methods: A 13-year-old girl with humeral shortening of 5 cm resulting from traumatic upper plexus palsy of the right arm during birth was treated with humeral osteotomy and implantation of a motorized intramedullary nail (PRECICE® magnet-operated Internal Bone Lengthening Nail, Ellipse Technologies, Inc, Irvine, CA, USA) for gradual lengthening. Individualized lengthening was performed using varying distraction rate in support of nervous tissue.

Results: The humeral lengthening of 5 cm was successfully achieved without complications 78 days after the beginning of distraction. The range of motion for the elbow and shoulder did not decrease during the lengthening or the current follow-ups. Implant removal will be performed after consolidation. Distraction and consolidation rate was analyzed.

Conclusion: This is the first case of an intramedullary motorized femoral nail which was used for humeral lengthening in Switzerland. No intra- or postoperative complications occurred and the patient could perform lengthening in an out-patient clinical setting. Intramedullary lengthening of the humerus with a motorized nail might be an appropriate alternative to external fixators.

Level of evidence: IV

Key words – humerus, lengthening, intramedullary, motorized nail, pediatric, Precice
A072 – INFECTIONS

Low-gerade implant infection with Brucella melitensis (9587)
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Introduction: In Switzerland Brucellosis is a rare zoonotic infection that may present with atypical symptoms, delaying diagnosis and treatment. Cases are generally associated the consumption of unpasteurized dairy products in endemic regions. A detailed patient history including a travel history is a crucial part in clinical routine.

Case: A 65-years-old patient originating from Turkey presented with pain in the left knee and lower limb for the past 4 months. The patient had a history of a car accident 20 years ago with a fracture of the proximal tibia requiring internal fixation and the implant still in situ. The clinical examination only showed a slight pain over the scar on the proximal lateral tibia. In the laboratory analysis CRP (32 mg/l) was slightly increased. A haematogenous low-grade implant-related infection was suspected. In a Single-Photon Emission Computed Tomography (SPECT/CT) a focal accumulation was detected at the tibial implant. Blood cultures drawn initially to detect a endocarditis lenta showed the growth of Brucella melitensis. The presence of treatment. There are no similar reports available in the medical literature. A transoesophageal echocardiography was unremarkable. The implant was removed after two weeks of antibiotic treatment. In the sonication of the implant specific polymerase chain reaction (PCR)–analysis for Brucella melitensis was positive. In a detailed anamnesis, the patient reported consumption of unpasteurized milk during her last travel to Turkey, 1 months prior to the symptoms onset and 5 months prior to diagnosis.

Conclusion/Discussion: The presented case is representative for the classical features of brucellosis associated with a rare but relevant complication. Brucellosis is a zoonosis endemic in many parts of the world including the Mediterranean Basin. The most common mode of transmission is the consumption of unpasteurized dairy products. The incubation time ranges from 5 to 60 days. Most (90%) infections are asymptomatic. Symptoms include undulating fever, malaise, headache and fatigue. The infection may spread to the liver, spleen or bone. Cardiac involvement is rare. In the presented case with persistent bacteremia, Antibiotic therapy was started. A transoesophageal echocardiography was unremarkable. The implant was removed after two weeks of antibiotic treatment. In the sonication of the implant specific polymerase chain reaction (PCR)–analysis for Brucella melitensis was positive. In a detailed anamnesis, the patient reported consumption of unpasteurized milk during her last travel to Turkey, 1 months prior to the symptoms onset and 5 months prior to diagnosis.

Epidural abscess related to Streptococcus mitis in a 57-year-old immunocompetent patient (9706)
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Introduction: Spinal epidural abscess, a collection of pus or inflammation between the thecal sac and surrounding tissue, is a rare condition in healthy adult patients, known for an incidence of 2.4 cases per 100 000 persons. Around half of the cases are due to a haematogenous spread, and almost a third because of a discitis spread. The most frequent microorganism is Staphylococcus aureus for 50 to 65% of cases, followed by gram negative bacilli such as Escherichia coli (18%) and Pseudomonas species in intravenous (IV) drug users. Usually seen in adults aged more than 60 years, risk factors include: immunodeficiency, HIV infection, malignancy, immunosuppressive treatments and IV drug abuse. Adequate timely diagnosis of spinal epidural abscess is crucial because around one fourth of patients may develop motor deficit or paralysis. We describe here the case of a healthy patient who presented a lumbar spinal epidural abscess related to a dental infection, without any risk factor.

Methods: A 57-year-old immunocompetent male patient presented himself to our emergency department because of a ten-day duration lumbar pain, after a lumbar torsion. He was neurologically intact, but showed a biological inflammatory syndrome. A lumbar MRI found a spinal epidural abscess from L3-L4 to L5-S1 levels. The patient was operated early before occurrence of neurological deficit. The abscess cultures found a Streptococcus mitis infection.

Results: The patient presented good recovery after surgical decompression, washout with samples and targeted antibiotic therapy for six weeks.

Conclusion: In the present case, we think that, considering a pain-free period before the lumbar torsion of the patient, an insidious onset of L5-S1 spondylodiscitis related to Streptococcus mitis spreading from a dental caries may have been compensated during the torsion and have released bacteria around the dura mater, leading to abscess formation. The final collapse of the L5-S1 disc on lumbar MRI at the 6-week follow up argued in favour of this hypothesis.

Vertebral osteomyelitis due to anaerobic bacteria Veillonella parvula: Case Report and literature review. (9854)
Daniele Gianoli; Michal Ziga; Frederike Waldeck; Cyrill Dennler; Thomas Forster; Benjamin Martens; Roman Schweizer
Study design: Case report and literature review.

Objective: Presentation of a case report of a Veillonella vertebral osteomyelitis in a 79-year-old man and review of literature.

Asymptomatic periprosthetic joint infection of the hip with high-virulence pathogens: report of two cases (9803)
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Introduction: We report two cases of periprosthetic joint infection (PJI) after total hip arthroplasty (THA) with highly virulent pathogens but asymptomatic clinical and radiological presentation over years despite the absence of treatment. There are no similar reports available in the literature.

Methods: A 72 year old female with severe anorexia underwent staged bilateral THA for avascular necrosis. 1 month postop on the left side she developed acute PJI with S. aureus. Low volume aspiration allowed no cell count. The patients anorexia was poorly controlled with impending liver failure and severe hyponatraemia. Revision surgery was not possible due to prohibitive general conditions. The patient refused antibiotic treatment. Over the next weeks the patient became afebrile and denied further symptoms. At the 1 year mark she is ambulating without discomfort. X-ray show well fixed components without signs for loosening. A 74 year old obese and diabetic female underwent right sided mini- stage revision THA for an acute polymicrobial PJI. 6 years later the patient complained about persistent right sided hip pain. Blood works were normal. Joint aspiration showed pathological cell count (226’300 leucocytes/ml) and grew S. lugdunensis. Revision surgery was scheduled but could not be performed due to an in-hospital fall which caused an open ankle fracture necessitating multiple procedures. After 3 months the patient was asymptomatic. Revision was therefore indefinitely postponed. 4 years later the patient still denies symptoms to her hip. X-ray show a well fixed cup. The uncentimented stem shows a radiolucent line around its shoulder but has not subsided in 10 years. In absence of hip and/or thigh pain we conclude that the implants are properly integrated.

Results: The cases described are neither representative for classic manifestation nor for state of the art final management of PJI.

Conclusion: The fact that high-virulence pathogens can colonize implants over time without causing symptoms or mechanical failure is a rarity so far and both cases need further observation. Both PJIs reported have not been treated surgically following standard guidelines because of adverse clinical circumstances. When surgery is not a viable option suppressive antibiotic therapy can be considered. Therapeutic absence however might be an alternative to long-term antibiotic suppression in selected cases, despite not being mentioned as an option in any guideline.
The success rate of our open DAIR procedures are inferior. Ureaplasma urealyticum is an intra-cellular bacterium frequently found colonizing the genital tract. Known complications include localized infections, which can result in premature deliveries. Septic arthritis due to U. urealyticum in healthy patients is exceptionally rare, although opportunistic septic arthritis in agammaglobulinemic patients have been reported. However, there are no reports of septic arthritis due to U. urealyticum following caesarean section or in the post-partum period.

Case presentation: A 38-year-old immunocompetent woman presented with severe right shoulder pain, 1 month following emergency caesarean section at 26 weeks of gestation for pre-eclampsia and spontaneous placental disruption with an uncomplicated post-operative recovery.

An 18-week gestation female was transferred to our department for the evaluation of increased joint pain of the right shoulder. One month after the index caesarean section at 26 weeks of gestation for preeclampsia and spontaneous placental disruption with an uncomplicated post-operative recovery, the patient presented with increasing right shoulder pain and fever. Examination revealed a tender right shoulder with limited ROM. Laboratory tests showed a white blood cell count of 18,000 cells/mm³, elevated ESR, and CRP. Antibiotic treatment was initiated for a presumed septic arthritis.

Discussion: The case highlights the importance of prompt diagnosis and appropriate treatment of septic arthritis following caesarean section. Early recognition and timely intervention can prevent complications and improve patient outcomes.

Results: A total of 47 patients (48 knees) were included (42 TKA and 6 rTKA). Fourteen patients (14 knees; 29%) were treated with arthroscopic DAIR. Of these, 7 patients (50%) were successfully treated after initial surgery. The remaining 7 patients (50%) returned to the operating room because of persistent/uncontrolled infection. Two had another arthroscopic DAIR while 5 were converted to open DAIR.

Conclusions: We report the first case of septis arthritis due to U. urealyticum following caesarean section. We hypothesize that the breach of the genital mucosal barrier during the caesarean section led to hematogenous spread resulting in purulent septic arthritis. The initial beta-lactam based antibiotic treatment, initiated for a purulent arthritis, did not provide coverage for cell wall deficient organisms. Detection of 16S rRNA allowed for a correct microbiological diagnosis in a patient with an unexpected clinical course.
Internal hemipelvectomy through a peri-acetabular osteotomy combined with an extraarticular (proximal) femur resection using a single posterolateral approach – a new surgical technique (9601)

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Introduction: To reach the best oncological perspective in intra-articular, periacetabular- and/or proximal femur tumors, a radical extra-articular periacetabular resection is necessary. In this case report we present an extra-articular periacetabular resection technique through a posterolateral approach to the hip. This surgical technique is relatively unknown in tumor surgery of Enneking type II lesions.

Cases: Three patients with malignant tumor growth in the hip joint were treated with a wide, extra-articular resection of the hip joint, conducted through a posterolateral approach. Reconstruction was realized in 2 cases with a Burch-Schneider reinforcement cage, in the other case with a LUMIC prosthesis. In all three cases, the short follow-up showed excellent functional outcome and only one minor complication; a subcutaneous hematoma for which transfusion was necessary.

Conclusion: This approach to the hip joint shows promising results in treating tumors of the periacetabular region. Further research to discover long term functional outcomes is necessary.

Gluteal flap coverage for sacrectomy to compensate for biopsy induced soft tissue contamination (9708)

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Introduction: Sacral chordomas are locally aggressive tumors that grow slowly causing subtle symptoms usually. Surgery of these tumors aims at complete en bloc resection, which because of its close relation to neural elements, may be associated with important functional consequences for bowel and bladder continence. The placement of the biopsy is therefore extremely important not to contaminate further tissues to be resected.

Methods: A 49 year-old patient presented with a history of 8 year long sacral pain. She did not note any reduced sensation and muscular weakness, no bowel or bladder incontinence. Preoperative MRI guided us in identifying a 52x55mm sacral chordoma of S3 and S4 body in close contact to S3 roots right. Staging studies with CT showed small two lung nodules. A biopsy was performed from laterally to reach the anterior portion of the tumor, potentially sparing the neural elements. Preoperative underwent the patient photon therapy.

Results: A posterior midline skin incision with inclusion of the entire biopsy tract from laterally was performed necessitating on the left side the mobilization of the gluteus maximus muscle. Wound was exposed to the tip of the coccyx and pelvic ligament (sacroctuberous and sacrospinous) were found and sectioned, lower border of pyriformis muscle was identified and dissected. We identified the dural sac with exiting sacral nerve roots, especially S2 and S3 bilaterally. The identified sacral nerve roots were traced laterally outside the sacral foramen and we resected the S3 root right which direct in relation with tumor was. The osteotomy level was decided based on the tumor extent and performed; the sacrum was gently lifted up with tumor and the removed bone with tumor was sent for histopathological examination. A left gluteus maximus advancement muscle flap was used to fill the defect. At 6 month-follow-up, the patient was pain free and no local or distal recurrence after 29 months follow-up.

Conclusion: Surgery is the mainstay for local control of sacral chordoma. Biopsies need to be performed strictly from posteriorly in the midline. If mistakenly it is carried out from laterally, additional soft tissue resection requires the usage of additional tissues to reconstruct the large posterior sacral defect. This may lead to increased morbidity, should be avoided and highlights the importance of defining the biopsy tract preoperatively in a multidisciplinary team.

Novel surgical technique to reconstruct a large soft tissue defect of the Adductor Compartment after sarcoma resection (9712)

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Introduction: Sarcomas of the adductor compartment are particularly prone for postoperative, specifically wound complications. Resection of this type of tumors requires wide margins, and the large defects usually are associated with compromised perfusion, specifically subsequent to preoperative radiation therapy. These resulting defects are usually deep and frequently expose the femoral vessels without any possibility to cover with healthy tissue, reason why it is usually advocated to bring in fresh tissues. However, there is continued debate of what reconstruction technique is preferentially used.

Methods: A 85 year-old male noticed a history of painless progressive swelling in the left thigh of 11x9,7x8,2 cm. MRI demonstrated a mass located in adductor magnus muscles. Staging studies with PET-CT showed lung metastases. A biopsy revealed an undifferentiated pleomorphic sarcoma (UPS) G3 and the patient underwent preoperative radiation therapy with 5x5=25 Gy. It was decided to surgically resect this lesion with a limb-sparing resection and using pedicled DIEP flap coverage.

Results: We performed the incision from posteromedial aspect of thigh to the inguinal region; this is followed by careful dissection to identify pectineus, adductor longus muscles and then the interval between femoral vessels. The adductor longus, brevis and magnus muscles were carefully detached from their insertions on the femur throughout its length to the adductor hiatus. The sciatic nerve was identified and preserved. The tumor was exposed and completely removed after resection of adductor from their origin (superior and inferior pubic rami) and along the obturator foramen. The coverage of the inguinal region was created with a deep inferior epigastric (DIEP) flap; with a lymphovenous anastomosis (LVA) onto the flap with confirmation of its patency with ICG. Postoperative course was uneventful without any sign of infect. Postoperative underwent the patient adjuvant chemotherapy with Doxorubicin.

Conclusion: Soft-tissue sarcomas arising within the adductor muscle group represent a specific challenge, and wound healing complications are frequently observed, reason why flap coverage is often used. Herein, we present the use of a pedicled DIEP sandwich technique in combination with LVA onto the flap. This represents a novel concept of coverage, not only addressing the coverage of a large defect but also simultaneously the reconstruction of lymph vessels.

Salvage of massive Giant Cell Tumor of the Proximal Tibia using a fresh osteochondral Allograft (9726)

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Introduction: The transplantation of osteochondral allografts is a joint preserving procedure for large combined defects of the subchondral bone and cartilage that furthermore facilitates the reestablishment of hyaline cartilage. Indications include posttraumatic defects, osteonecrosis, osteochondritis dissecans and tumors, mainly of the ankle and knee. Herein we present a case of a patient with a massive Giant Cell Tumor (GCT) of the proximal tibia, treated with resection and reconstruction with fresh osteochondral allograft.

Methods: A 35 year old male patient presented with left medial knee pain for 4 months. Imaging revealed a 64x57x55 mm expansive, heterogeneous, partially liquid lesion with cortical erosions of the left proximal tibia. Biopsy showed multicellular giant cells of the osteolytic type. Curettage of the meta- and diaphysis including the subchondral bone but preserving the joint cartilage as well as cementation was performed. Postoperatively denosumab treatment was used. During the following 24 months, progressive destruction of the articular surface occurred. To...
postpone arthroplasty the decision was taken to transplant a fresh osteochondral allograft and medial meniscus.

Results: The medial collateral ligament was separated and kept in the soft tissue sleeve en bloc. The cement was completely removed and the cartilage of the medial tibial plateau together with the meniscus resected. The defect of the proximal tibia was prepared and the allograft adjusted so that a proper axis in extension and medial stability was achieved. As the allograft was 3-4 mm underdesigned the intercondylar region was slightly widened. To correct the slope a small wedge was placed in the dorsal diaphysis. The osteochondral allograft was reduced, the meniscus secured to the capsule with sutures, the medial collateral ligament fixed and a Tomofix plate placed. At 2 years follow-up, the patient showed a remarkable functional outcome being able to walk without crutches, impained only by residual medial instability, and was fully reintegrated to his standing profession.

Conclusion: Giant cell tumors of the bone are characterized by aggressive growth. Joint involvement often ends in arthroplasty. Especially for young patients, transplantation of an osteochondral allograft might delay joint replacement and can provide good functional outcome in selected cases.

Accuracy of the sarcoma diagnosis in a swiss referral center A comparative Analysis from the SwissSarcomaNetwork (9809)
Hanna Wellauer¹; Beate Bode-Lesniewska²; Bruno Fuchs³; Alexander Vogtsseder³
¹ Kantons spitale Winterthur; ²Pathologie Institut Enge, Zürich; ³Kantons spitale Luzern
Introduction: Soft tissue tumors are rare tumors and histological examination remains a challenge. The diagnostics and treatment planning of soft tissue tumors are critically dependent on the pathological examination. The French sarcoma network has established the importance of expert review. The French sarcoma network has established the importance of expert pathologist compared to the diagnosis from the reference pathologist.

Method: We examine retrospectively all pathology reports from a Swiss referral center between January 2019 and December 2020. All reports were presented at the SwissSarcomaBoard and were reviewed secondarily by the reference pathologist. Patients with incomplete records were excluded. We categorized the accuracy in groups A, B and C, according to the classification which was presented 2014 in “sarcoma” (1). Cases without no discrepancy in diagnosis were classified under category A. Category B includes cases with minor discrepancy in diagnosis with no therapeutic consequences. Category C contains all cases, where the diagnosis from the reference pathologist changed the treatment.

Results: 196 patients with a biopsy as a prime diagnosis were included in the study. Overall, category A comprised 149 patients (76.4%), category B 21 patients (10.8%) and C 25 patients (12.8%). Analysis of malignant tumors, makes the discrepancies even more pronounced compared to the overall results.

Conclusion: The pathological examination of soft tissue tumors by an expert pathologist is highly recommended, as in 16% from all malignant biopsies there is a significant change in the therapy after expert review.


Intraarticular Nodular fasciitis of the hip joint (9873)
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Purpose: We present a case of an intra-articular nodular fasciitis (NF) of the hip, which is a rare benign lesion usually arising from subcutaneous, fascial or subfascial sites of the upper extremities, followed by the head and neck, trunk and lower extremities. To our knowledge, there is only one other report in the literature of an intra-articular occurrence in the hip.

Case: A 50-year-old man complained of groin pain on the right side for 3 months. The clinical examination of the hip revealed a positive anterior impingement sign and a moderate tenderness on palpation in the groin. The MRI of the hip showed an extensive synovialitis and joint effusion and an increased alpha angle 64° (norm <50°) as a correlate for a Cam impingement. A diagnostic and therapeutic arthroscopy was performed for biopsy, complete synovectomy and offset correction. The histological result revealed an unspecified aspect with mucoid changes comparable to ganglion cysts, no sign of malignancy. 4 month after the arthroscopy the symptoms still remained. The new MRI showed a significant growth of the intra-articular tumor around the neck of the hip. To obtain a new histology, a CT aided biopsy was performed. As a NF kept in mind, molecular-genetic next generation sequencing detected a MYH9-USP6-gene-fusion.

Discussion: Most cases in the literature describe a joint involvement of the knee. The symptoms vary from pain in the affected joint to joint effusion, painful mass, catching sensation and limited range of motion. The MRI usually identifies a lesion with an iso- to hypointense signal in T1- and a hyperintense signal in T2-weighted sequences. Histologically, it is defined as a benign proliferation of fi broblasts and myofi broblasts, abundant spindle-shaped cells, which are arranged within a variably loose myxoid to collagenous stroma. Immunohistochemically, the spindle cells are positive for alpha-smooth muscle actin (SMA). The identification of a MYH9-USP6 gene fusion by RT-PCR is described as a useful tool to corroborate the diagnosis. The therapy consists of arthroscopic resection with good result. The published case reports showed no recurrence after resection, in our case we observed a re-growing mass after about 4 months. After 1 year we haven’t performed a reoperation with a sub symptomatic patient.

Conclusion: We describe a rare intra-articular NF of the hip, which, in contrast to the published cases, presented with a recurrence after arthroscopical resection.

Downgrading Giant Cell Tumor of the bone with Denosumab (9834)
Andreas Kattner¹; Tobias Bühler²; Ulrich Exner³
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Introduction: Giant cell tumor of bone (GCTB) is a benign, locally aggressive, giant cell-rich neoplasm that commonly affects young adults. GCTB may be locally aggressive and local recurrence is challenging. Denosumab is a human monoclonal antibody that specifically inhibits osteoclast by preventing RANKL-mediated formation and activation of multinucleated osteoclasts or giant cells from RANK-positive mononuclear preosteoclasts and macrophages. Indications for Denosumab (Prolia) are treatment/prevention of idiopathic osteoporosis, osteoporosis induced by hormonal treatment and in higher dose as XGEVA for metastatic bone tumor problems and benign GCTB.

After initial widespread use of XGEVA for GCTB about 10 years ago, euphoria has waned and indication, dosage and duration of treatment are discussed controversially. Our index patient received 6 injections of XGEVA over 4 months with 120 mg injection. He showed a local recurrence one year after surgical therapy. We decided to start the therapy with a short neoadjuvant use of XGEVA with the aim of less tumor regression and improved tissue quality when surgical curettage is performed.

We wish to share our experience with a short neoadjuvant treatment protocol hoping to learn more from discussion with the audience.
Methods: 3 patients with biopsy proven diagnosis of GCTB (locations distal radius; proximal fibula; neck of the femur) received neoadjuvant XGEVA weekly over 30 days with 120 mg/injection.

After completion of above XGEVA protocol, local treatment consisted in curettage and cement filling in 3 patients. In a 68 year old lady with GCTB of the distal radius the cement spacer was left in place and she is asymptomatic at 3 years F/U. In the other patients, the cement spacer was removed and the defect biologically reconstructed with autologous or homologous bone transplant.

Results: A total of 3 patients were treated. The mean follow up was 48 months. 2 of the 3 cases showed no local or systemic recurrence.

One case with recurrence of GCTB at the proximal fibula underwent a wide resection.

At the time of the last follow up all 3 cases were without recurrence.

Conclusion: The short time application showed a satisfactory macroscopic re-modeling which made the curettage easier and enhanced the quality of tumor resection. The local recurrence rate was 33% in our small cohort which seems to be encouraging. We would like to discuss if a shorter application time of XGEVA is superior to a longer treatment protocol.
Bildbasierte Analyse der Ultrastruktur des-humanen Kniegelenk-Knorpels mittels Synchrotron-Radiation-µCT (9731)

Kevin Ralf Beutler¹; Marina Danalache²; Imke Greving³; Stefan Fischer⁴; Bernd Rolauffs⁵; Ulf Krister Hofmann²
¹ Kantonsspital Münsterlingen; ² Universitätsklinik Tübingen; ³ Helmholtz-Zentrum Geesthacht, Außenstelle am DESY; ⁴ Universität Tübingen; ⁵ Universitätsklinik Freiburg


Methodik: Humane, arthrotisch veränderte Femurkondylenresektate wurden zu Zylindern (20x3x3 mm) präpariert; mit röntgenkontrastverstärkenden Antikörpern gefärbt und mittels SR-µCT digitalisiert, segmentiert und qualitativ analysiert. Histologische Aufnahmen vor und nach der µCT dienten der quantitativen sowie der vergleichenden qualitativen Analyse.


Use of Aspirin versus Rivaroxaban in postoperative thromboembolic prophylaxis after primary total hip and knee arthroplasty (9936)

Simon Donkerwolke; Jean-François Fischer; Philip Deslarzes; Sami Abou-Khail; Thibaut Royon
eHnv Hôpital Veyron Les Bains

Goal of the study: To compare the efficiency of Aspirin and Rivaroxaban in the thromboembolic prophylaxis after Total Hip (THA) and Knee (TKA) Arthroplasty: a multicenter comparative retrospective study.

Introduction: The Total Hip and Knee Arthroplasties have seen an increase in recent years due to population aging, leading to more thromboembolic post-operative complications. Different drugs are effective in preventing these complications, but none of them stands out. To this date, we are not aware of any Swiss studies comparing the effectiveness of Aspirin with that of Rivaroxaban. The main objective of the study is to find out whether Aspirin is as effective as Rivaroxaban in thromboembolic prophylaxis in primary THA and TKA.

Patients and methods: Multicenter comparative retrospective study including all patients who underwent primary THA or TKA between January 2017 and November 2020, in two different hospitals. Patients who presented previously thromboembolic event, admitted for fracture or revision surgery, or under preoperative therapeutic anticoagulation were excluded.

All included patients received postoperative thromboembolic prophylaxis for a total of 4 weeks, with Heparin during hospitalization period followed by Rivaroxaban 10 mg once a day or by Aspirin 100 mg twice a day. The rehabilitation protocol was the same for all (full load bearing from day zero or day one). We used our computer database files to search thromboembolic events and deaths occurring within 90 days after surgery. SPSS statistical software and the Chi² test were used.

Results: 828 patients were included (58 % THA: n = 481; 42 % TKA: n = 347). 54,5 % (n = 451) took Rivaroxaban and 45,5 % (n = 377) took Aspirin. Two cases of Deep Vein Thrombosis were observed with Aspirin (0.53 %), none occurred with Rivaroxaban. The difference was not significant (p = 0.125). We did not observe any deaths or pulmonary embolism. The two cases of deep vein thrombosis belong to the THA group, none occurred in TKA.

Conclusion: Aspirin and Rivaroxaban both appear to be effective in preventing thromboembolic events after primary THA or TKA. Aspirin offers the possibility of rapid surgical revision in the event of post-operative hematoma or early acute infection, does not require laboratory monitoring and has very few side effects. Its low cost and availability are also advantages. The exact dosage and the minimum prescription period remain controversial, requiring further randomized studies.
Titanium trabecular 3D electron beam melting implants: A new promoting bone growth material (10003)
Fatos Ramadani; Cristina Goga; Daniele Valsecchi; Timo Miesbach; Philippe Otten; Gianluca Maestretti
HFR – hôpital fribourgeois

Introduction: Bone growth is an important entity in the process of fracture healing and bone fusion. Spinal fusion is the major procedure in order to obtain stability in degenerative or traumatic conditions. The ideal material should be osteoinductive and osteoconductive leading to rapid bone growth. The aim of this study is to present the new porous trabecular titanium (PTT), 3D electron beam melting (EBM) designed, and the perspective of use in orthopedic and spine surgery.

Methodology: Description of the basic research on porous trabecular titanium and the different derived product already used. The porous trabecular titanium 3D EBM is nowadays used in cervical and lumbar cages (MT Ortho, Aci Sant’Antonio, Sicily, Italy). This material is actually under investigation in the form of titanium microspheres as cement replacement. The safety, biomechanical proprieties, risks and benefits of each products are analyzed.

Results: In vitro studies have shown that porous trabecular titanium 3D EBM are osteoinductive and osteoconductive. It was demonstrated in the cervical cages that the bone matrix could rapidly adhere and grow in the cage, leading to quick segmental stabilization. Preliminary studies show a fusion rate in 83.3% of the patients and bony growth through the cage in 100% at 3 months. For the titanium microsphere, a preclinical study has shown good biomechanical stability. A first phase clinical study on 15 patients has confirmed the biomechanical stability and demonstrates less risk such as cement leak, temperature damage or pulmonary embolism.

Discussion: Porous trabecular titanium 3D electron beam melting is a promising material in bone growth stimulation. It can be used in a large variety of implants. In spine surgery, it allows rapid bone growth which is an imperative condition for fusion and segmental stability. The same material is also used in fractures as a cement replacement leading to greater stability and better bone healing with fewer complication risks. The osteoinductive and osteoconductive properties of the PTT 3D EBM can be exploited in orthopedic surgery, such as in important bony defects, avascular necrosis of bone or traumatic bone loss.

Conclusion: Porous trabecular titanium can be widely and safely used as a bone growth stimulator. The potential of product development based on porous trabecular titanium is encouraging for further therapeutic use in pathology needing a rapid bone growth.
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