Salvage Arthrodesis after Failed Total Ankle Replacement vs. Primary Ankle Arthrodesis in Endstage Osteoarthritis – A Matched Case Control Study

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Background: Salvage of a failed total ankle replacement (TAR) still remains a challenge. The conversion into arthrodesis represents a valuable solution with varying results in the literature. The question whether salvage arthrodesis would perform similarly to primary ankle arthrodesis has not yet been answered. The purpose of the current study is to compare the clinical and radiographic results of primary ankle arthrodesis with those obtained after salvage arthrodesis after failed TAR.

Methods: Twenty-three patients who underwent salvage arthrodesis after failed TAR (group SA) were matched with 23 patients who had had primary ankle arthrodesis (group PA) due to symptomatic end-stage ankle arthritis. Statistical matching has been done according to age, indication, nicotine abuse and fusion type. The data (clinical outcome, radiographic union and complications) was retrospectively analyzed.

Results: The follow up time averaged 30 (range 10 to 92) months in group SA and 56 (range 23 to 94) months in group PA. Significant better results were found in group PA. The SFT-36 scores in group SA averaged 47 (range 7-80) points and in group PA 66 (range 14-96; p=0.004) points. The Foot Function Index (FFI; a score with the least pain and the best function when 0 %) in the pain section averaged 57% (range 22 to 82) in group SA and 33% (range 0 to 88) in group PA (p=0.003). The results for the FFI function section averaged 67% (range 42 to 98) in group SA and 48% (range 1 to 92) in group PA (p=0.015). A union rate of 74% (17/23 patients) was found in group SA after a mean time of 51 (range 13 to 106) weeks. The six patients suffering from nonunion received several revision operations and had persistent pain and bad function. In group PA 70% (16/23 patients) achieved a union after a mean time of 23 weeks (range 8 to 115) while three patients had painfree fibrotic nonunion and four needed revision surgery and all but one had a good to very good result. The overall reoperation rate (hardware removal not included) was 48% (11 patients with 35 operations) in group SA and 30 % (7 patients with 12 operations) in group PA.

Conclusion: When compared with primary ankle arthrodesis salvage arthrodesis after TAR shows similar union rates but significantly higher revision rates and unsatisfactory overall clinical outcomes. In the light of the results obtained with the current study the opinion that failed TAR can always be salvaged easily by means of arthrodesis must be questioned.
FM133  Hintegra Total Ankle Joint Contact Pressures are Sensitive to Misalignment in Version

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

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

Results: In the manufacture recommended position for implantation, average Hintegra joint contact pressures were lower than thresholds associated with premature polyethylene wear. In contrast to the Mobility TAR, Hintegra joint contact pressures exceeded these thresholds with one degree of version misalignment. Differences between the two systems were more pronounced (more than 50% difference in average joint contact pressure) in 2 degrees of version. Thus, while the Hintegra implant system yielded smaller contact pressures than the Mobility TAR in a neutral position, edge loading of the Hintegra design was more severe than the Mobility, leading to higher average joint contact pressures in all tested version positions.

Conclusions: Although both considered prostheses represent three component, mobile bearing total ankle designs, they nonetheless responded differently to misalignment in version. The Hintegra total ankle joint contact pressures showed higher sensitivity to version than the Mobility. This implies that the design plays a key role in terms of contact pressure sensitivity to misalignment. As a consequence, special care must be given to the positioning of the implant independent of the design.
Thrombembolic Complications After Total Ankle Replacement: Systematic Literature Review and Our Results in 964 Total Ankle Arthroplasties

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Introduction: Total ankle replacement is becoming an increasingly used treatment for patients with degenerative arthritis of the ankle. However, there is limited literature addressing the incidence of thrombembolic complications after total ankle replacement. Therefore we performed a systematic literature review addressing thrombosis prophylaxis and incidence of thrombembolic complications after total ankle replacement. Furthermore we evaluated the incidence of thrombembolic complications in our clinic.

Methods: A systemic literature review was performed using established medicine literature data bases: MEDLINE®, Cochrane, Embase™, CINAHL®, ScienceDirect®, and SpringerLink. Following information has been extracted from the literature: 1) method and 2) duration of thrombosis prophylaxis, and 3) deep vein thrombosis/pulmonary embolism as postoperative complication. The incidence of thrombembolic complications has been evaluated in our patient cohort including 964 total ankle replacements performed between 2000 and 2009 using a three-component total ankle arthroplasty. Deep vein thrombosis has been clinically diagnosed based on Wells-score of ≥ 1 and using duplex color Doppler ultrasonography.

Results: A total of 28 clinical studies performed between 1977 and 2012 have been included into the systemic literature review. 11 studies were prospective. Most studies were evidence level IV studies (21 of 28). The medial of included total ankle arthroplasties was 52 with a range between 10 and 701. In most studies (25 of 28) 3-component total ankle design has been used. In 20 of 28 studies the method of thrombembolic prophylaxis has been described. The range of the incidence of thrombembolic complications was between 0.0% and 9.8% with a median value of 0.0%. In our patient cohort including 964 consecutive total ankle arthroplasties the incidence of symptomatic deep vein thrombosis was 3.4%. There were no cases of pulmonary embolism. All patients received low-molecular-weight heparin prophylaxis.

Conclusion: The incidence of symptomatic deep vein thrombosis reported in the current literature is comparable to that in patients undergoing total hip or knee replacement. The incidence of thrombembolic complications in our patient cohort was comparable to that of symptomatic deep vein thrombosis in patients undergoing total knee or hip replacement or ankle fusion. We suggest prophylaxis using low-molecular-weight heparin in patients with total ankle replacement.
Introduction: Gait analysis is used to assess the outcome of ankle arthrodesis (AA) versus total ankle replacement (TAR) and several studies reported better outcome in TAR. The method of assessment often compared the operated foot with the control population, hence focusing only on the operated foot. In this study the outcome of AA and TAR is compared based on the achievement of gait symmetry.

Methods: Intra-subject gait analysis was performed to assess the symmetry between the operated and unoperated foot, 2-9 years post-operatively, for both AA and TAR patients. A healthy population (controls) was involved to define the normal gait symmetry. The study involved 36 participants, including 12 AA patients, 12 TAR patients and 12 controls. Gait Assessment was performed using ambulatory pressure insoles (Pedar-X, novel, DE) and inertial measurement unit (IMU) (Physilog, BioAGM, CH), mounted on the shank, hindfoot, midfoot and great toe. Participants performed a 50 m walking trial, twice, at a normal walking pace. Gait data were analyzed using the algorithms validated at the EPFL (LMAM). Mean, median, standard deviation (STD) and interquartile range of each measured parameter were calculated over the two trials for each foot and compared using the Wilcoxon signed-rank test (p<0.05).

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

Conclusion: AA patients retained a permanent residual effect from having an adaptive gait pattern, whereas TAR patients almost fully recovered, having similar results than the controls.
FM136 The influence of shoewear on functional outcome after Total ankle replacement and ankle-arthrodesis

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

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

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

Results: The AOFAS- and all components of the SF-36-score were equal in both groups as was ASA and Charlson co-morbidity score. Post-operative complication rate was 7% for TAR and 3% for ankle fusions. Long-term complication for TAR was 11% (chronic pain 2, PE wear and osteolysis 1) and 16% for ankle fusions (symptomatic subtalar osteoarthritis 3, nonunion 3, osteomyelitis 1, peroneal tendon tear 1, chronic pain 1, malunion 1). Walking speed and total contact time were consistent either bare feet or with shoes. However, there was a significantly decreased contact time in the forefoot from 84% in bare feet to 77% wearing shoes and COP velocity increased from 0.3m/s to 0.37m/s. Maximum pressures and forces as well as pressure-force-time-integrals in the forefoot did not differ. However ambulating in rocker-bottom shoes resulted in a significantly stronger push-off (~715kPa) than wearing running shoes (~500kPa). Operated patients exhibited approximately 20% decrease in walking speed or contact times compared to healthy subjects.

Conclusion: In shoes TAR and AA have the same functional results. The inferiority of AA compared to TAR is not measurable. We conclude that ankle arthrodesis and Total Ankle Replacement are equal operations regarding functional outcome.
FM137  Stress fracture of the malleolus medialis after implantation of an ankle prosthesis

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Background: Stress fracture of the malleolus medialis is a complication, which can occur after implantation of an ankle prosthesis. Purpose of this study was to analyze this complication in a consecutive serie of total ankle arthroplasty (TAA).

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

Results: Between 2003 and 2009, 323 TAA have been implanted in 323 patients. Mean age at the time of surgery was 62 (27-87) years, 160 (49.5%) patients were females, 163 (50.5%) males. 199 (61.6%) TAA were implanted on the right side, 124 (38.4%) on the left side. Stress fractures have been detected in 19 (5.9%) ankles at an average postoperative time of 24 (5-104) weeks. None of those fracture showed a serious displacement. The fracture lines were in 12 (63%) vertical, in 5 (32%) cases horizontal and in 1 (5%) case diagonal. The bridge tibial component (TC) – malleolus medialis cortex (MMC) is the distance measured between TC and MMC was in fracture group 10.77 mm (6.5 to 14.7) and 12.57 mm (4.8 to 18.5) in non-fracture group. The fracture incidence was 3 x higher in females (13 (70%)) with a significant higher mean age in comparison to the male population (67.9 versus 61.3 years). The body weight was higher in the fracture group (mean 79 kg versus 72 kg). All fractures healed uneventfully, for 9 (47.37%) patients without specific treatment, for 5 (26%) under protection of a walker and partial weight bearing and for 5 (26%) after ORIF with 2 percutaneous screws. Patient with screw fixation had a less good ROM after 1 year 20.18° compared with the group without any treatment 23.74°.

Conclusion: Stress fractures of the malleolus medialis can occur after TAA implantation. Since those fractures were found more frequently in females, heavier patients, and with small bridge TC-MMC in our serie, so less aggressive postoperative regime for this population might reduce their incidence. Stress fractures can heal without specific treatment. ORIF of this medial malleolus fracture does not seem to improve the ankle ROM.
Introduction: Revision surgery after a failed total ankle arthroplasty (TAA) may become challenging due to extensive bone loss, poor soft tissues, and hindfoot pathologies. Revision ankle arthrodesis may result in substantial shortening of the lower extremity and impaired functional results. With the availability of a wide spectrum of implants, however, revision arthroplasty may become a viable alternative. The study presents a treatment algorithm for revision TAA with bone augmentation, and revision implants in patients with aseptic loosening of ankle prosthesis associated with large bone defects.

Methods: There were 4 male and 6 female patients with a mean age of 51.7 years (range, 29-71 years) who underwent revision TAA due to aseptic loosening of TAA associated with extensive bone loss. We used iliac crest autografts depending on size, localisation, and configuration of bone loss. Pre- and postoperatively, x-rays and/or CT-scans were analysed and the patients were evaluated clinically including the AOFAS ankle score, visual analogue scale for pain (VAS, 0-10), range of motion (ROM), ankle stability, and ability of daily life activities. Intra- and postoperative complications were recorded. The mean follow-up was 47 months (range, 24-62 months).

Results: One ankle in a patient with chronic pain syndrome had to be converted into an arthrodesis. The AOFAS ankle score for the remaining patients significantly increased from 39 points (range, 18-56) to 83 points (range, 70-97; p<0.05). The VAS for pain significantly improved from 6.0 (range, 5-8) to 1.0 (range, 0-3; p<0.05). The postoperative ROM of the ankle joint was in average 24.4° for flexion (range, 10-30°) and 4.4° for extension (range, -10-15°). Two patients underwent arthrolysis and ossification removal. Postoperative radiographs showed stable integration of iliac bone blocks and no loosening signs around prosthesis components.

Discussion: Revision TAA with structural bone augmentation according to the proposed treatment algorithm shows to be a viable treatment option in the armamentarium of revision surgery for failed TAA with aseptic loosening associated with large bone defects. Cases have to be carefully selected and preoperative planning is crucial. Further clinical studies are needed to address the long-term results of this procedure.
FM139  Isolated Tension-Bending Fusion for Stage 3 and 4 Muller-Weiss Syndrome

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

Introduction: In MWS there is evidence of progressive avascular necrosis of lateral aspect of navicular. MWS is a progressive destruction of the navicular that starts with a collapse (stage 2), to get fractured (stage 3) and later on fragmented with expulsion of its dorso-lateral flake (stage 4). Complete collapse occurs in stage 5. Most patients seen by orthopedic surgeons suffer from a MWS stage 3 or 4. There are still controversies with regard to the surgical approach for reconstruction. Most authors advocate fusion of the subtalar (ST) and naviculo-cuneiform (NC) joints in order to achieve reliable healing. As by this procedure delayed or non-unions of the NC joint are observed, we started to perform isolated talonavicular (TN) fusion. The purpose of this study was to assess 1) the effectiveness of the strategy and 2) to assess the radiological and clinical outcome.

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

Results: At 8 weeks, solid fusion at arthrodesis site was found in all but 2 cases. In those 2 cases, fusion was achieved after 12 weeks, as confirmed by CT scan. All patients were satisfied with the obtained result.

Conclusion: The tension bending technique from lateral side is an efficient and successful method to get a stable construct for a TN arthrodesis in MWS. With the obtained results in this preliminary series of 10 feet, we continue to consider this isolated TN fusion technique as sufficient for treatment of patients with stage 3 and stage 4 MWS.
Freie Mitteilungen X / Communications libres X
Fuss / Pieds (FM 132 – FM 148)

FM140 Quantitative evaluation of the cartilage height using high-resolution MRI of the talocrural articulation from non-, recreational- and professional athletes

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Keywords: Cartilage, squad Athletes, MRI, Ankle

Purpose: To evaluate the cartilage height at 20 NonTathletes, 35 recreationalT and 40 squad athletes by MRI, in the age of 16 to 56 years and training/week with 0 h/week for Non athletes, 2 – 10 h/week for recreational athletes and 7-22 h/week for professional athletes.

Material und methods: The professional athletes are in the squad A, B and C from the German National Olympic Committee (DOSB) from the sport table tennis, badminton, hockey and Volleyball. The examinations were performed used a 1,5 Tesla MRI (Sonata, Siemens) (FLASH-3D-sequence in sagittal and coronal orientation). The bilateral measurement of the cartilage is based on the evaluation of the volume of tibia and talus is cut into 9 areas, sectional in the coronal level in anterior, intermediate and posterior portion, and in the sagittal level in medial, intermediate and lateral portion.

Results: The evaluation of the cartilage height proved that athletes had a higher cartilage in the talocrural articulation than the nonTathletes. Professional athletes had an average height in the main area of the cartilage with 3,31mm (min. 2,73mm – max. 4,26mm), recreational athletes 3,14mm (min.2,20mm – max. 4,49mm) and nonTathletes 2,75mm (min. 2,21mm – max. 3,15mm). There were differences until to 19% in the cartilage height between both sides in groups of table tennis and badminton. The cartilage of the ankle on the same side from the racket holding arm was in most cases higher than his counterpart. NonTathletes had a sharp border between cartilage and bone, for the recreationalT and professional athletes presented this border unsharp. No abrasion in the main area of exposure in athlete’s cartilage was seen similar to the nonTathletes.

Conclusion: Sportive activity has a positive benefit of the cartilage volume and height in the talocrural articulation. There was no abrasion in the main area of exposure in the group of athletes. Cartilage-bone-border is unsharp by athletes, by non-athletes sharp.
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**Purpose:** A limited open technique to treat displaced intra-articular calcaneal fractures was used since 1998, and exclusively since 2002 in our institution. Its equivalence in ultimate function was shown in a single surgeon study against a control group of lateral plating via extensile approach. The aim of this study was to assess its results with multiple surgeons of the same institution over 10 years.

**Method:** Hundred and nineteen patients were treated for isolated intraarticular calcaneal fractures with a Sanders classification II to IV from 1999 to 2004. The study group included 78 patients with 81 fractures, of those 61 had intraarticular calcaneal fractures Sanders classification type II, 26 type III, and five type IV. Thirty-four patients with additional fractures of the talus, luxation fractures, non-operative treatment, and primary arthrodeses were excluded. Seven patients were lost for follow-up. At minimum follow-up of two years patients were assessed clinically and radiographically, the functional outcome was evaluated by the AOFAS ankle hindfoot score.

**Results:** The average follow-up was 34 months, SD 22.5, average age 41.9, SD 12.7. The average hospital stay was 13.5 days, average time to union 3.1 months; SD 0.38. Four patients had delayed wound healing requiring debridment and irrigation but healed without any further complications. Further complications were a traction of the medial neurovascular bundle in one patient that was successfully treated by an open neurolysis and slight to severe CRPS in four patients. Thirty-eight patients claimed at least a partial implant removal (mostly of the tuberosity screws). At latest follow-up average AOFAS score was 84.4, SD 14.3. Average subtalar motion was 37% of the healthy contralateral side. On the radiographs the postoperative average Böhler-angle measured 30.6°, SD 7.3°. Twenty-eight (22.7%) subtalar joints presented at least some degree of posttraumatic arthritis, whereas four patients needed a subtalar fusion (Sanders type II: 1; III: 2, IV: 1).

**Conclusion:** The overall functional results remain good, comparable to other large series. The advantages of the limited approach – less operative time, less wound healing problems – are maintained. This technique can successfully be taught and practiced in a single institution.
Freie Mitteilungen X / Communications libres X
Fuss / Pieds (FM 132 – FM 148)

FM142 Arthroscopically assisted mini-invasive fracture treatment of Hawkins Type I talar fractures

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

Introduction: Important challenge with Hawkins Type I fractures of the talus is ensuring that anatomic reduction is obtained with no varus rotation. Surgical treatment is often conflicting with regard to exposure and ORIF. Extended approach or an additional second approach may result in damages of the surrounding soft tissues which may compromise the functional outcome and increase the risk of avascular necrosis (AVN) of the talus. We thus started to use an arthroscopically assisted mini-invasive approach. The purpose of this preliminary work is 1) to describe the technique, 2) to assess the obtained result by CT scan and 3) to determine the clinical outcome.

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

Results: Anatomic reduction and stable fixation was obtained in all four cases. All fractures healed within 8 weeks and there were no signs of AVN in any case. All patients were highly satisfied with the results obtained and showed functional outcome similar to the contralateral foot.
Conclusion: Arthroscopically assisted, mini-invasive reduction and fixation of Hawkin Type I fractures yielded in excellent early results. As we see a main benefit in minimizing additional damages to the soft tissues, thereby also minimizing the risk of AVN, we continue to use this technique in the future.
FM143 Corrective supramalleolar osteotomy in malunited pronation-external rotation fractures of the ankle joint

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Introduction: After fractures of the ankle joint - besides cartilaginous damages and soft tissue problems - the congruency and the position of the articulating bones are crucial to the further healing progress. A posttraumatic malalignment after pronation-external rotation fractures often results in degenerative changes of the ankle joint due to the asymmetrical load distribution. Malunited fractures of this type show a valgus deformity of the joint surface of the distal tibia which is often accompanied by a shortening or a malrotation of the fibula. The objective of this study is to analyze the results after corrective supramalleolar osteotomies of the tibia and the fibula.

Methods: Between 1995 and 2008 48 Patients (25 female, 23 male, mean age 45 years (21-69 years)) who had a malposition of the ankle after a pronation-external rotation fracture were treated by a supramalleolar osteotomy of the tibia and the fibula. The fracture type was weber type C in 43 cases (8 of them maisonneuve type) and type B in 5 cases. The mean time interval between the trauma and the corrective surgery was 20.2 (3-98) months. The correction of the tibia was either performed by means of a medial closing wedge osteotomy or of a lateral opening wedge osteotomy with interposition of an allograft. The correction of the fibula was performed by the use of an oblique osteotomy that was fixed by a 6-hole-plate with locking screws. During a postoperative period of 8 weeks an immobilization of the ankle in a splinting vacuum boot with only partial weight bearing was arranged.

The patients were reassessed in regular clinical and radiological follow up-examinations including a survey of the range of motion and of the stability of the joint. In addition the AOFAS-Score was assessed. The radiological examinations were evaluated according to Takakura's classification.

Results: A medial closing wedge osteotomy was conducted in 45 cases, and an intraarticular lateral opening wedge osteotomy in 3 cases to correct the tibia. To achieve a neutral position of the hindfoot there was additionally performed a corrective procedure of the calcaneus in 19 cases (16 medial sliding osteotomies and 3 lateral lengthening osteotomies). The mean corrective angle of the joint surface of the distal tibia was 5.2°, which resulted in a postoperative valgus position of 2.8°. A complete osseous consolidation of the tibia was seen after a mean of 2.4 months, in 2 cases a delayed consolidation occurred after 6 respectively 7 months.

After 7.1 (2-15) years 42 of the patients were satisfied or very satisfied. 41 patients were completely free of complaints. The mean value of the AOFAS-Score was 86 (64-100) points. In 1 case a total ankle replacement was implanted after 26 months due to persisting pain and progressive osteoarthritis.

Radiologically there was seen no increase of the degenerative changes in 30 cases, moderate increase of the degenerative changes in 14 cases and advanced increase of the degenerative changes in 3 cases.
Discussion: The results show that malunited pronation and external rotation fractures can successfully be treated by a corrective supramalleolar osteotomy. Osseous balancing of the hindfoot is essential to prevent degenerative changes of the ankle joint.
Summary: This prospective observational study present three patients with substantial peritalar dislocation after isolated tibiotalar arthrodesis.

Introduction: Arthrodesis of tibiotalar (ankle) joint is still considered the golden standard for treatment of the end-stage osteoarthritis associated with difficult conditions such as unmanageable misalignment and instability. In this context, many surgeons may consider isolated tibiotalar arthrodesis for the unstable ankle with severe valgus deformity where the medial ligament complex has become incompetent, as seen typically in the stage IV posterior tibial tendon (PTT) dysfunction. The idea behind this procedure is to stabilize the talus within the ankle mortise, and to compensate the loss of motion in the sagittal plane at peritalar joints which are typically unstable due to inefficient ligaments. However, whether increased mechanical load of peritalar joints can further destabilize the hindfoot is not known. Most recently, we have seen 3 patients after an isolated tibiotalar fusion for treatment of a valgus unstable osteoarthritic ankle presenting a peritalar dislocation beneath the successfully healed tibiotalar fusion. This complication after tibiotalar fusion has, to our knowledge, not been reported in the literature yet. The purpose of this paper was therefore 1) to present these case series and 2) to assess the underlying causes that may be responsible for this unfavorable evolution.

Methods: This patient series included a 70 year-old male patient 28 years after isolated tibiotalar arthrodesis, a 55 year-old male patient 3 years after tibiotalar and calcaneocuboid arthrodesis, and a 72 year-old male patient 1.2 year after isolated tibiotalar arthrodesis. Preoperatively, all patients presented a valgus osteoarthritic ankle associated to a flatfoot deformity (stage IV PTT dysfunction), with a valgus tilt of 12°, 14°, and 13° within the mortise.

Results: All patients reported a progressive destabilization of the hindfoot complex into valgus and pronation with flattening of the arch, and free ambulation has become impossible despite of wearing orthopedic shoes. There was a substantial valgus misalignment of the hindfoot, with lateral offset of 54mm, 16mm, and 40mm in the Saltzman alignment view. Tibiotalar fusion was achieved in all patients with a remaining valgus position of the talus of 4°, 6° and 5°, respectively. The talus was slipped medially, and the fibula was pressed into lateral wall of tilted calcaneus. In two patients, the talar head was dislocated completely towards medially. No patients showed evidence of entrapment of tibial nerve.

Conclusions: Although not common, peritalar dislocation can potentially result from tibiotalar fusion of a valgus unstable hindfoot as typically the case for stage IV PTT dysfunction. The inefficient peritalar ligaments may not be able to withstand the increased mechanical load. This may be particularly true for the fused tibiotalar joint in valgus, e.g. where the talar position was not corrected to neutral position. This may increase the translational forces, with slipping of talus on calcaneus towards medially. Tibiotalar fusion should thus be indicated with caution in the valgus unstable osteoarthritic ankle; if so, special attention should be paid to achieve fusion of talus within the ankle mortise in a neutral position.
**FM145 Safe Zones for Percutaneous Pin Placement in the Calcaneus.**

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

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

**Results:** The area for safe pin placement at the calcaneus is restricted to a narrow band dorsal of the calcaneal tuberosity. Medially this band widens proximally (close to the insertion of the achilles tendon), and laterally it widens distally until the lateral calcaneal process.

**Conclusion:** Compared to other studies, the safe zones for calcaneal pinning are significantly smaller than described. Conventional pinning techniques risk damaging important neural structures. Consequently these results indicate a direction of pin placement that differs from previous investigations, whereby the insertion of the achilles tendon and the lateral calcaneal process corresponds to a reliable landmark.
Purpose: To assess the cartilage quality after repair of osteochondral lesions of the ankle joint with autologous matrix induced chondrogenesis (AMIC) using delayed gadolinium-enhanced magnetic resonance imaging of cartilage (dGEMRIC).

Materials and methods: A 3D SGE sequence at 3T was used to obtain quantitative T1 values before and after Gd-DTPA2- (Magnevist, 0.2 mM/kg) application to assess 23 cases after AMIC-aided repair of osteochondral lesions of the talus. Delta relaxation rates (∆R1) for reference cartilage (RC) and repair tissue (RT), and the relative delta relaxation rate (r∆R1) were calculated. Morphologic appearance of the cartilage RT was graded on sagittal DESS views according to the MOCART protocol. The study as approved by the IRB. Written patient consent was obtained.

Results: The AMIC cases had a precontrast mean T1 of 1.194 s (SD 0.207 s) in RC and 1.470 s (SD 0.384 s) in RT. Postcontrast T1 decreased to 0.480 s (SD 0.114 s) in RC and 0.411 s (SD 0.096 s) in RT. There was a significant difference (p>0.05) between the ∆R1 in RC (1.372 x 10^-3 s T1, range 0.526-3.201 x 10^-3 s T1, SD 0.666 x 10^-3 s T1) and RT (1.856 x 10^-3 s T1, range 0.93-3.336 x 10^-3 s T1, SD 0.609 x 10^-3 s T1). The mean r∆R1 was 1.49 SD 0.45). The mean MOCART score at followup was 62.6 points (range 30-95, SD 15.3).

Conclusion: AMIC-repair in the ankle yields repair tissue with GAG content differing from healthy hyaline cartilage. However, cartilage quality is comparable to other established cartilage repair techniques.
**Introduction**: Complex midtarsal (Lisfranc) fracture-dislocation is a challenging injury, characterized by loss of contact of the midfoot bones as well as fracture of one or more bones surrounding the Lisfranc ligament. The principle of treatment of such injuries involves stable fixation of fractures, anatomical reduction of the displaced midtarsal bones with temporary or permanent arthrodesis to maintain their position. The aim of our study was to evaluate the functional, clinical and radiological outcome of patients managed surgically during the last twenty years at our institution.

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

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

**Conclusions**: According to the scientific literature, an acceptable outcome depends on achieving and maintaining a well-aligned and well-reduced joint. Primary arthrodesis may lead to better short term functional outcome.
The radiological position of the talus after a supramalleolar osteotomy in varus tilted ankle

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

Introduction: The goal of supramalleolar osteotomy in varus ankle is to realign the hindfoot and to unload the overstressed medial part of the ankle joint. This surgery has already shown to improve clinical function and radiological signs of ankle arthritis. The radiological measurement results of the plafond tibia and the hindfoot alignment on the frontal plane are significantly well corrected. Instead of adductors procedures, the frontal position of talus remain sometimes unless corrected and still tilted. Nosewicz and al. have demonstrated on varus tilted ankle that the talus was also endorotated in the transversal plane and dorsiflexed in the sagittal plane. Little is known about the effect on the talar position after a supramalleolar osteotomy. The hypothesis is that (1) the correction of frontal alignment of the ankle has also an effect on the talar position in 3D and (2) patients with insufficient correction of the talar tilt have also sagittal or horizontal misalignment already present.

Material and Methods: Between 2006 and 2012, 55 consecutive patients (age 54 years, range 27-74) with a varus tilted ankle of more than 5° underwent a correcting osteotomy at our institution. Weight-bearing radiographs (mortise ankle view, lateral, AP-view and Saltzmann view of the foot) were used to assess the 3D radiological of the talus pre- and postoperatively. Patients with neurological disorders, or adductors procedures distal to the ankle (subtalar fusion, calcaneum osteotomy) were excluded. 50 cases were corrected with a medial opening wedge and 5 cases with a lateral closing wedge. The congruency of the ankle joint was restored with fibula shortening osteotomies in 14 cases. Radiographs were analysed pre- and postoperatively to measure the alignment and the 3D position of the talus with the talar tilt (TT) (according to the difference between the talar dome and the tibial-ankle surface angle (TAS)) on the mortise view. The position of the talus on the lateral view was determined measuring the sagittal talocalcaneal inclination angle (TCI). In the horizontal plane the rotation of the talus was assess with the talometatarsal 1 angle (TMT1). Calcaneum offset was assessed using the saltzmann view. Sagittal and horizontal data were compared with a normal cohort. The neutral position was defined within two standard deviations of the mean of the control group (30,5° (SD=4,5) for TCI and 3,7° (SD=7,9) for TMT1).

Results: The mean preoperative measurement was TTA=74,9° (SD=5,7); TT=11,5° (5,9) on the frontal view; TLS =81,9° (4,1), TCI=17,8° (7,4) on the lateral view; TMT1= 8,8° (14,1°) on the dorsoplantar view; calcaneum offset = 26,1mm (11,1). At one year a statistical difference was found between the preoperative and postoperative results for the calcaneum offset, the TTA, TCI (P<0,05). The mean postoperative measurement was TTA= 82,5° (5,9); TCI=21,4° (7,1); Calcaneum offset = 11,8mm (10,6). No statisticals differences were found for the TT and TMT1 between pre and postoperative. The mean postoperative measurement was TT=9,7° (5,1); TMT1=8,5 (11,6).
Discussion: In this study the 3D position of the talus preoperatively in varus tilted ankle was also malaligned in additional planes, it was more dorsiflexed and endorotated than the normal cohort. The correction of the varus tilted ankle deformity by a supramalleolar osteotomy induces also a modification of the talus position on the lateral view but no statistical difference on the dorsoplantar view. The lack of correction of the endorotation on the horizontal view of the talus could be explained by a contracture of the medial structures. In conclusion the talus position in a varus-tilted ankle is also dorsiflexed and endorotated. Realignment correction of a varus deformity change also the coronal position of the talus, but the patients with a talar tilt still presents have also a lack of correction of the talar position in the horizontal plane. Further studies are necessary to elucidate if a complete correction of talar position is needed to have a balanced and congruent ankle joint.