ePosters

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The ePoster viewing system contains ePosters submitted on or before June 10, 2011. ePosters are classified in the following order:

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Total Ankle:

Poster # 1
Title: Total Ankle Replacement in Patient with Gouty Osteoarthritis
Author(s):
Alexej Barg, MD - alexejbarg@mail.ru
Markus Knupp, MD
Ashley L. Kapron, BS
Beat Hintermann, MD

Abstract:
Introduction: Gout can cause ankle osteoarthritis and is associated with poor quality of life (QOL). There are no studies addressing orthopaedic treatment of gouty ankle osteoarthritis. Therefore we assessed prosthesis components stability, postoperative pain relief, functional outcome, and QOL in patients with gouty ankle osteoarthritis who were treated by total ankle replacement (TAR).

Methods: 16 patients (19 ankles) with a mean age of 65.2 ± 5.8 years were treated with a non-constrained three-component system because of painful ankle osteoarthritis. The average follow-up was 5.1 ± 2.5 years (range, 2.1 – 9.1 years). Component stability was assessed using weight bearing radiographs. Clinical outcome was analyzed using the visual analogue scale (VAS), a 36-item short-form health survey (SF-36), and the American Orthopaedic Foot and Ankle Society (AOFAS) hindfoot score.

Results: There were no intraoperative complications. In one patient both ankles had to be revised 4.7 years postoperatively because of painful prosthesis loosening. Average pain score (VAS) significantly decreased from 7.5 ± 1.8 (range, 5 – 10) to 1.2 ± 1.3 (range, 0 – 3) (P < 0.001). All eight categories of SF-36 score assessing quality of life (QOL) showed significant improvement (P < 0.001). The AOFAS-hindfoot-score significantly increased from 35 ± 13 (range, 8 – 38) preoperatively to 75 ± 13 (range, 54 – 92) postoperatively (p < 0.001).

Conclusion: TAR in patients with painful gouty ankle osteoarthritis has a low risk of intra- and postoperative complications and leads to significant pain relief, high patient satisfaction, and good functional results.

Poster # 2
Title: Single-step procedure of ankle fracture and non-union with TAA and osteosynthesis
Author(s):
Dan Boack, MD

Abstract:
Introduction: A single-step procedure of ankle fracture and non-union with TAA and osteosynthesis has not been reported before. That's why the operative technique was developed and evaluated in a clinical prospective investigation.

Methods: Study: 2002-2010 Subjects: 18 patients (ORIF and cement-less 3-component-TAA) vs. 512 patients (TAA only) Clinical evaluation: peri- and postoperative up to 12 weeks and after 1 year or longer Parameter: radiological (x-rays, ct-scans) / clinical Classification („TAA - Comprehensive Classification of periprosthetic fractures”) Follow-up (min. 1 y.): 28 (12-80 months) Follow-up rate: 412/412 (100 %)

Results: Types of pre-existing fractures: A1: Stress-Fracture due to deformity 5/530 (0,9%) A1.1: medial (varus arthritis) (3) A1.2: lateral (hindfoot valgus) (2) Careful clinical and neurological examination has been done to eliminate neuropathic cases. After radiological analysis the operative procedure included deformity correction and TAA-Implantation, followed by a clinical and image-intensifier stability check. Stable fractures with sclerosis were drilled und unstable situations were fixed with screw- and plates. A2: non-union after fracture 13/530 (2,5%) A2.1: Lateral (3) A2.2: Medial (3) A2.3: central [Pilon] (4) A2.4: Talus (3) In A2.1 und A2.2 cases (malleolar non union without affection of the prosthesis saddle) the procedure was done with debridement and ORIF. Medial malleolus was achieved by an antero-median approach and the lateral by a fibular straight incision. Pilon-Non-Union cases (A2.3) were treated with non-union resection and osteotomy in the old fracture line, iliacal crest bone block interposition and locking plate osteosynthesis. After fixation
the TAA were implanted. Only for talar non-union (A2.4) a debridement, bone grafting and a primary subtalar fusion was necessary in preparation for the settlement of TAA. There were not any peri-operative complication (wound edge necrosis, infection, thrombosis, bleeding). A functional after care has done with initial partial weight-bearing in an orthosis. The bony healing could be registered within 12 weeks. A partial implant removal has performed in 5/13 Pat., once in combination with an arthrolysis. 12 of 13 patients were satisfied with the functional and clinical result.

Conclusion: Tibial and fibular Stress-Fractures and non-unions in ankle arthritis cases could be treated with TAA an ORIF in a single step procedure, only talar non-union cases should be treated in two steps.

Poster # 3
Title: Deltoid insufficiency in total ankle arthroplasty: a cadaver study
Author(s): Brian Clowers, MD - bclowers37@gmail.com
Mark Myerson, MD - mark4feet@aol.com

Abstract:
Introduction: Coronal plane instability is an often encountered entity in the setting of total ankle arthroplasty, considering that ligamentous insufficiency is a common etiology for tibiotalar osteoarthritis. Most often, coronal instability is secondary to lateral ligamentous deficiency, leading to a varus deformity. However, valgus instability with a deltoid ligament tear is also encountered, albeit much less often. The lateral ligamentous complex usually requires reconstruction when instability is encountered during ankle replacement, but the guidelines for reconstruction of the deltoid complex are not clear, nor what the limits may be preoperatively for correction of a valgus ankle with replacement. The purpose of this study was to determine, in a cadaveric model, if deltoid ligament insufficiency requires ligamentous reconstruction in the setting of a total ankle arthroplasty.

Methods: Six fresh frozen cadaver limbs were utilized for the study. Deltoid deficiency was created in all cadavers by completely severing the deltoid ligament, and coronal angular deformity of the ankle joint was demonstrated under load with fluoroscopic control. Total ankle arthroplasties were then implanted using standard anterior surgical approaches. Sequentially larger polyethylene inserts were then inserted, and valgus stress was applied with each poly insert in place until stability to valgus applied stress was achieved. Coronal angular measurements were taken with each poly insert in place. Once valgus angular stability was achieved, each specimen was then loaded axially with 75 pounds, and coronal angular measurements were documented on fluoroscopic images in the loaded state.

Results: A mean of 9.667 degrees (range, 7-12) of valgus instability was created with sectioning of the deltoid ligament. Valgus stability was achieved in all six specimens by increasing the thickness of the polyethylene insert, with three specimens requiring an 11mm poly, and three requiring a 10mm poly. An average coronal angular alignment with valgus stress of 2.167 degrees was achieved with the final thickness of polyethylene. Four of the specimens required lateral ligament releases to balance the ankle. Two of the specimens had pre-existing lateral ligament deficiency and one demonstrated varus instability with the thickest polyethylene insert in place. None of the specimens demonstrated valgus instability under axial load.

Conclusion: In a cadaver model, deltoid insufficiency and resultant mild valgus instability up to 12 degrees in total ankle arthroplasty can be managed by increasing the thickness of the polyethylene. It was not necessary, in this model, to reconstruct the deltoid ligament to restore valgus stability to the ankle mortise when only mild valgus instability was present. However, lateral ligament deficiency and varus instability could not be reliably addressed by simply thickening the polyethylene insert. It was demonstrated that a lateral ligament release may be necessary to balance the mortise once valgus stability was achieved. Further investigation is necessary to determine if more severe valgus instability requires reconstruction of the deltoid ligament, and if these results are also valid in vivo.
**Poster # 4**

**Title:** Hindfoot Motion after STAR TAA  
**Author(s):**  
Scott Coleman, MS, MBA  
Sheryl Smith, MD  
Fabian Polo, PhD  
James Brodsky, MD

**Abstract:**  
**Introduction:** There is resurgence in the popularity of total ankle arthroplasty under the premise of improved survivorship of implants and more normal biomechanical function of the ankle and hindfoot joints than with arthrodesis. However, there is no data documenting the effect of total ankle arthroplasty on motion of hindfoot joints. The purpose of this study was to perform an evaluation of the effect of the Scandinavian Total Ankle Replacement (STAR) on motion of the hindfoot using segmental gait analysis.

**Methods:** This was a retrospective evaluation of 46 patients who underwent unilateral total ankle arthroplasty with the STAR ankle prosthesis. The mean gait analysis time from surgery was 4.9 years ± 1.8 years (range; 2.0 - 9.1 years). Three-dimensional gait analysis was performed using a 12-camera digital motion capture system. Kinematic parameters studied include sagittal plane ankle range of motion and all three planes of motion of the hindfoot. Temporal-Spatial variables examined were percent stance time and step length. Statistical analysis involved a paired Student’s t-test. Significance was set at p < 0.05.

**Results:** A significant difference in the temporal-spatial parameters was found for both percent stance time and for step length between the affected and unaffected limbs. All four measured ranges of motion showed statistical significances comparing the affected and contralateral limbs (p<0.05). The affected ankle range of motion was 16.6 ± 4.5 degrees and the unaffected ankle had an increased range of 23.6 ± 5.0 degrees. Hindfoot sagittal plane range of motion was 12.7 ± 4.2 degrees on the affected side and 17.3 ± 3.5 degrees on the unaffected side. Coronal plane range of motion was 4.7 ± 2.4 degrees on the affected side and 7.5 ± 2.4 degrees on the unaffected side. Range of motion in the transverse plane totaled 4.1 ± 1.5 degrees in the affected side and 4.9 ± 1.6 on the unaffected side.

**Conclusion:** The results of this study demonstrated significant differences in hindfoot kinematic parameters as compared to the unaffected limb. Given the retrospective nature of the study, it is not possible to determine exactly to what degree this represents pre-operative abnormality of the hindfoot joint motion. Although we presume that much, if not most, of the abnormality to be related to the etiology of the associated tibio-talar arthritis, a current prospective study is in progress to examine this. Despite improved ankle joint mechanics, demonstrable abnormalities of hindfoot mechanics persist after total ankle arthroplasty. Quantification of these may be an important measure of the success and limits of total ankle replacement.

**Poster # 5**

**Title:** Outcomes following revision total ankle replacement  
**Author(s):**  
Kent Ellington, MD, MS - kentellington@yahoo.com  
Mark Myerson, MD

**Abstract:**  
**Introduction:** Total ankle replacements (TAR) are becoming more common, thus TAR failure will likewise follow suit. Surgical options for TAR failure are limited and most consider bone-block arthrodesis the standard. The purpose of this study was to report radiographic and clinical outcomes of patients undergoing revision TAR.

**Methods:** We performed a retrospective review of 53 patients treated with revision TAR of at least one component and minimum 2 year follow-up. Postoperative evaluation included weightbearing radiographs with range of motion (ROM), physical examination, and chart review. Outcomes were assessed with VAS, AOFAS hindfoot score, SF-12, Revised Foot Function Index (RFFI), Ankle Osteoarthritis Scale (AOS), as well as a questionnaire and a satisfaction survey.
Results: Mean followup was 49.1 months after the revision TAR. Twelve did not return, 4 were converted to an arthrodesis, 2 were undergoing staged revision for infection, 1 had an amputation, leaving 34 patients available for followup. Time from primary TAR to revision TAR was 50.7 months. The most common indication for revision TAR was talar subsidence (85.3%; 29/34). Twenty-one patients (61.8%) had a subtalar arthrodesis performed at the time of the revision TAR, with 17 of those having a custom-designed talar component placed simultaneously. Five patients (14.7%) underwent a second revision at a mean of 32.1 months following their first revision. The mean radiographic measurements of component position remained unchanged postoperatively. The mean postoperative pain VAS was 4.4. The mean postoperative AOFAS hindfoot score was 64.5, SF-12 score was 93.5, and RFFI was 137.9. The mean postoperative AOS score was 64.4. The mean preoperative radiographic arc ROM was 18.1 degrees and postoperatively it was 23.4 degrees, with all improvement obtained in plantarflexion. Using a multivariable linear regression analysis, preoperative talar subsidence was a significant predictor of a good outcome based on AOFAS (p<0.03) and AOS (p<.01). The majority of patients (73.5%) reported good to excellent results at final followup, 85.3% said they would undergo the surgery again and 79.4% were able to return to work. Those patients that reported improved physical activity had better SF-12 and RFFI scores (p<.01); and those patients that were able to return to work and were satisfied had better RFFI scores (p<.05).

Conclusion: Revision TAR may be considered as an alternative to arthrodesis when treating patients with failed TAR.

Poster # 6
Title: Osteolysis after Total Ankle Arthroplasty
Author(s):
Ji Youn Kim, MD
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Abstract:
Introduction: To analyze radiolucency and osteolysis around components of total ankle arthroplasty using the HINTEGRA prosthesis and to suggest adequate management of radiolucency and osteolysis.

Methods: Ninety-five arthroplasties using the HINTEGRA prosthesis from September, 2004 to April, 2009 were included in this study. There were 51 (53.7%) men and 44 (46.3%) women with a mean age of 63.8 years (33 to 84). A mean follow-up period was 34.7 months (13 to 68). The initial position of components after arthroplasty and a change in the position of components during follow-up was measured radiologically. Radiolucency and osteolysis around components was assessed and the mean detection time of osteolysis was checked during follow-up.

Results: The initial and change in the position of components were within normal range. Radiolucency around a tibial loading plate in AP radiograph was detected in 20 (21.1%) arthroplasties. Radiolucency behind a tibial anterior shield and continuous radiolucency of the interface between a tibial loading plate and the distal tibia in lateral radiograph were detected in 19 (20.0%) and 15 (15.8%) arthroplasties at each. Osteolysis around tibial screws was detected in 8 (9.4%) out of 85 arthroplasties using tibial screws. Osteolysis around a tibial posterior edge was detected in 25 (26.3%) arthroplasties. Osteolysis under a talar anterior shield was detected at 10 out of 40 arthroplasties (25%). On average, osteolysis was detected at 13.5 months after arthroplasty. Radiolucency around a tibial loading plate in AP radiograph was significantly related to continuous radiolucency of the interface between a tibial loading plate and the distal tibia in lateral radiograph (p<0.043). There was no statistical relation between osteolysis around a tibial posterior edge and size of the tibial component (p=0.704). Tibial component loosening was seen in two arthroplasties with severe pain above VAS 7, osteolysis around tibial screws and radiolucency around a tibial loading plate in AP and lateral radiograph. Three arthroplasties with progressive tibial osteolysis and two arthroplsties with progressive osteolysis under a talar anterior shield without components loosening needed autologous iliac...
bone graft. Progressive osteolysis was confirmed with CT scan. These arthroplasties with autologous iliac bone graft had no pain in comparison with two arthroplasties with tibial component loosening.

**Conclusion:** Severe pain above VAS 7 and radiolucency around a tibial loading plate during follow-up can be significant clues to suspect tibial component loosening. If progressive tibial osteolysis is suspected in plain radiograph, CT scan can be effective method to confirm of the stability of components and to make a plan of treatment.

**Poster # 7**  
**Title:** The outcome of total ankle arthroplasty in patients with rheumatoid arthritis  
**Author(s):**  
Elizabeth Pedersen, MD, FRCS(C)  
Ellie Pinsker, BA&Sc, Phd cand  
Mark Glazebrook, MSc, PhD, MD, FRCS(C)  
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Murray Penner, MD, FRCS(C)  
Peter Dryden, MD, FRCS(C)  
Timothy Daniels, MD, FRCSC

**Abstract:**  
**Introduction:** The failure rate of total ankle arthroplasty in rheumatoid patients may be higher than in osteoarthritis patients due to the medications and comorbidities in this population. The purpose of this study was to prospectively look at the intermediate-term outcomes of total ankle arthroplasty in patients with rheumatoid arthritis and to compare the results to a matched cohort of patients with osteoarthritis of the ankle receiving total ankle arthroplasty.

**Methods:** This study is a prospective, multicentre comparison study of patients two to eight years post total ankle arthroplasty. A cohort of 50 patients with rheumatoid arthritis was identified from the prospective national database of total ankle arthroplasties (RA group). Matched controls were identified in the database using age, type of prosthesis, and follow-up time as matching criteria (OA group). The following data was collected: demographic information, previous and additional surgeries at the time of ankle arthroplasty and major and minor complications including revisions. Generic and disease specific, validated outcome scores collected include the ankle osteoarthritis index (AOS) as well as the short-form 36 (SF-36). Radiographs were reviewed for preoperative deformity, cyst formation and angular changes.

**Results:** The two groups were similar with regards to demographics (table 1). Preoperative outcome scores were worse in the RA group than the OA group and there was significant improvement in outcome scores in both groups (table 2). There was a higher rate of additional surgeries, predominantly hindfoot fusions, in the RA group than the OA group (31 vs 25). There were four revisions of tibial and/or talar components and one major wound complication requiring skin graft in the RA group. There were three revisions of components and no major wound healing problems in the OA group. Radiographic analysis revealed a higher rate of preoperative deformity defined as varus or valgus malalignment of greater than 10 degrees in the OA group than the RA group (13 vs 5). Post-operatively, there were more cysts visible on radiographs in the OA group than the RA group (17 vs 12).

**Conclusion:** Total ankle arthroplasty is a good option for patients with rheumatoid arthritis. This group of patients shows similar improvement in generic and disease specific quality of life outcome measures as a matched group of osteoarthritis patients. Revision rates were similar between the groups; however, the patients with RA had a higher rate of wound complications.
Poster # 8
Title: Capturing Patient Perceived Benefit After Ankle Arthroplasty or Fusion
Author(s):
Kelly Warmington, BScH, BEd, OCT
Timothy Daniels, MD, FRCSC
Taucha Inrig, BScN, RN, MDiv
Ellie Pinsker, BA&Sc, PhD cand
Dorcas Beaton, BScOT, MSc, PhD

Abstract:
Introduction: The objective of this study was to describe recovery of function and quality of life in patients who have undergone ankle reconstruction. Surgery aims to provide an adequate amount of relief from pain and instability to allow persons to function in their daily activities. However, some of our outcome measures are better at capturing the resolution of all symptoms and limitations, rather than whether or not the results of surgery are “good enough”.

Methods: A cross-sectional survey was completed by 100 patients (arthrodesis n=18, arthroplasty n=82), at least 6 months post-operative, recruited from an orthopaedic practice in an urban teaching hospital. Outcome measures included the Short Musculoskeletal Functional Assessment (SMFA), the Foot Function Index (FFI), the SF-12v2 and the EQ-5D. Patients also completed measures of pain, coping, ability to complete daily activities (ADL) and measures of satisfaction regarding the results of their surgery. Descriptive statistics were calculated. Patient satisfaction and self-reported resolution of ankle problem were compared to pain levels, coping ability, ability to complete ADLs and standardized outcome scores.

Results: Percent and number satisfied with the results of surgery in terms of: ability to do self-care activities (98%, 97); pain relief (78%, 76); ability to do home/yard work (73%, 70); ability to do recreational activities (63%, 60); overall (87%, 83). 30% of patients experienced mild pain (1-3) [0-10, 0=no pain], 54% experienced moderate-severe pain (4-10). 85% (77) said they cannot do all of the activities they would like to do and forget about their ankle problem. However, 86% (83) reported that their ankle problem was at a level where they could ignore it and do what they needed to do. Only 15% reported having no residual symptoms or limitation. Most had compensated to work around residual difficulties (15%) or redefined the scope of meaningful activities and learned to live with residual problems (51%). Only 13% felt that they were not better. Self-reported measures were able to differentiate between those with few residual problems and those with some residual difficulties, but were not always sensitive to how people with expected residual difficulties were able to describe an overall satisfaction or well-being (feeling “better”). All scales were sensitive to differences between patients who were “better” or “not better” and between patients who were satisfied or dissatisfied with the results of their surgery.

Conclusion: The majority of patients are satisfied with the results of their ankle surgery, even though it did not achieve perfect resolution of all symptoms and restrictions. Patients reported that surgery provided enough relief for them to cope through adaptation or redefining meaningful activities in their daily lives. Additional measures are needed for this and other reconstructive procedures that allow patients to describe the benefit of their surgery and capture this satisfactory level of functioning that allows them to cope.
Basic Science:

Poster # 9
Title: The contact area of the INBONE™ saddle and sulcus total ankle replacement designs
Author(s): Gregory C. Berlet, MD - ofacresearch@orthofootankle.com
James R. Brownhill, PhD - James.Brownhill@wmt.com

Abstract:
Introduction: Measurement of contact area for total joint replacements is done to ensure that adequate area is provided for load transfer throughout the entire range of motion. In the post-operative Total Ankle Replacement (TAR), inadequate contact area results in elevated stresses in the materials and can be thought of as a precursor to polyethylene wear and, potentially, implant failure due to fracture or loosening [Vaupel et al. FAI 2009 Sep;30(9):815-23]. The INBONE™ TAR system offers two articulation options: a Saddle and a Sulcus design. The purpose of this study was to determine the contact area of the smallest available size of the INBONE™ Saddle and Sulcus designs, and to compare these results with published data.

Methods: Contact area was measured for 6 of the smallest size INBONE™ Saddle and Sulcus bearing couples for flexion angles between 20° dorsiflexion and 20° plantarflexion using a stain transfer method. Axial compressive forces were selected for ankle flexion angles based on published data, assuming patient body weight of 250lbs (1112N) [Stauffer et al. CORR 1977 Sep(127):189-96; Nicholson et al. CORR 2004 Jul(424):125-9]. Contact area was also measured for 3 Sulcus implants using a digital sensor film and was compared with published data for the AGILITY™ TAR [Nicholson].

Results: The INBONE™ Saddle articulation had higher contact area than the Sulcus at 10° and 20° of dorsiflexion (p<0.05). The smallest INBONE™ Sulcus (Size 2) had equivalent or higher contact area than the largest AGILITY™ (Size 6) at all compressive loads.

Conclusion: The data presented in Table 1 shows that the INBONE™ Sulcus would experience 2.9 times less stress than a similarly sized AGILITY™ under a 1200N load. Nicholson reported that the Size 1 AGILITY™ components have contact stresses of 16MPa under 1200N (270lb) of compressive force, which suggests that they routinely exceed the recommended 10MPa fatigue limit of polyethylene during normal daily activities. The high incidence of lysis, migration and lucency at early to intermediate follow-up [Kopp et al. FAI 2006 Feb;27(2):97-103] may be due, in part, to excessive polyethylene stresses and resultant wear debris. The data presented in Table 1 shows that the INBONE™ Sulcus would experience 2.9 times less stress than a similarly sized AGILITY™ under a 1200N load. The increased contact area of the INBONE™ designs should reduce polyethylene stresses, potentially leading to lower wear and better load transfer to the underlying bone, which in turn should reduce the likelihood of osteolysis and component

Poster # 10
Title: A Phase 3 Trial of DepoFoam® Bupivacaine, an Extended Release Bupivacaine Local Analgesic, in Bunionectomy
Author(s): Stephen Daniels, DO
Michael Golf, MD

Abstract:
Introduction: This phase 3 clinical trial compared DepoBupivacaine, an investigational extended release liposomal bupivacaine-based analgesic, to placebo for post-surgical pain relief after bunionectomy procedures.

Methods: After obtaining IRB approval, 193 consenting patients undergoing bunionectomy were randomly assigned to receive either a single injection of placebo (n=96) or 120mg DepoBupivacaine (n=97) administered via wound infiltration at the conclusion of the surgical procedure. The severity of pain was assessed after surgery at specified predetermined time points using a numeric rating scale (NRS) at rest for pain with 0 = no pain and 10 = worst possible pain. The NRS scores were used to calculate the area under
the curve (AUC) from immediately post op (time 0) through multiple postoperative time points. Other endpoints included number of patients requiring no parenteral opioid analgesic (rescue) medications, number of patients who were pain free (NRS=<1) postoperatively, and median time to first opioid use (rescue).

**Results:** The AUC for the NRS pain scores from the start of study drug injection demonstrated a statistically significant advantage to DepoBupivacaine over placebo at 24 hours (p=0.0005) and 36 hours (p<0.03). A larger percentage of DepoBupivacaine-treated patients avoided opioid rescue medication during the first 24 hours after surgery (7% vs 1%; p<0.05). Statistically significantly more DepoBupivacaine-treated patients were pain free at 2, 4, 8, and 48 hours. The median time to first opioid use was also significantly delayed in favor of DepoBupivacaine (4 hours vs 7 hours; p<0.0001). Treatment emergent adverse events (TEAEs) were reported by 60% of DepoBupivacaine-treated patients compared to 68% in the placebo group; there were no deaths in either group, although there was one discontinuation due to a TEAE in the placebo group.

**Conclusion:** DepoBupivacaine, an investigational long-acting local analgesic, provided extended pain relief and decreased opioid use after bunionectomy compared to placebo, and therefore may offer clinically meaningful advantages in providing post-surgical pain relief.

**Poster # 11**  
**Title:** Effect of Articulating Surface Design to Reduce Contact Pressure in Total Ankle Replacement  
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**Abstract:**  
**Introduction:** Clinical outcomes have indicated that lower conformity (flat) in Total Knee Arthroplasty (TKA) designs can lead to reduction in tibiofemoral contact area and can contribute to increased wear [Sharkey, Clin. Orthop., 2002; Feng, Clin. Orthop., 1994]. Since the knee and ankle share similarities in loading and potential design philosophies it is prudent to learn from history. Therefore, one of the key design goals in Total Ankle Replacement (TAR) is to reduce contact pressure in the bearing surfaces. The objective is to utilize a computational model of normal gait to investigate the effect of articular surface geometry on polyethylene contact pressure in fixed-bearing TAR designs.

**Methods:** Computational models for finite element analysis (FEA) were developed for two fixed bearing TAR designs – a conforming design and a flat design. Both models consisted of a tibia component, polyethylene articular surface, and talus component. Models were generated with similar talus anterior/posterior (A/P) lengths (small ~ 28mm; medium ~36mm), in order to minimize the impact of component size on results. The hypothesis is that by incorporating load and motion profiles derived from normal gait into a detailed computational model of TAR, the impact of design philosophies within fixed-bearing ankle prostheses on contact patterns during gait can be quantified.

The components were virtually implanted in neutral position. The loads and motion curves for the simulation use a physiological force profile taken from the literature [Bell et al, J Biomat Res, 2007]. This represents the most comprehensive set of kinematic and kinetic data available on the ankle during the normal gait cycle. Flexion/extension (F/E) ranged from 16° plantarflexion to 15.2° dorsiflexion. Internal/external (I/E) tibia rotation ranged from -2° IR to +8° ER. A/P translation ranged from +1.5mm anterior to -1.5mm posterior. The peak axial force of 3188 N (4.4x700N Body Weight) was applied at the heel off position (41% gait position). Medial/lateral (M/L) motion was unconstrained and was a resultant of the axial load, A/P, I/E and F/E displacements. Dynamic loading and boundary conditions throughout the gait cycle were applied through tibia and talus - I/E rotations and axial loads were applied through tibial component; F/E flexion and A/P translation were applied through talus. Contact area and pressure throughout the gait cycle were recorded.

**Results:** Peak contact area was predicted at 41% gait position, matching the position of peak load. At 41% gait, the small size conforming design predicted 2x greater contact area and 4x lower peak contact pressure than the small size flat design. At 41% gait, the medium size conforming design predicted 2x greater contact area and 2.25x lower peak contact pressure than the medium size flat design.
**Conclusion**: The articulating surface geometry in the conforming TAR design results in reduced polyethylene contact pressure as compared to the flat TAR design.

**Poster # 12**
**Title**: Histological Analysis of the Bone-Implant Interface of a Three-Component Total Ankle  
**Author(s)**:  
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Alexej Barg, MD  
Markus Knupp, MD

**Abstract**:  
**Introduction**: Most current TAR use a porous coat with or without hydroxyapatite (HA) cover for cementless fixation. This 3-component ankle prosthesis used HA single coat for the 1st-generation, porous CoCr (200μm) with HA double coat for the 2nd-generation, and a Titanium (200μm) with HA double coat for the 3rd-generation. This is a report of histological analysis of retrieved implants of different generations.

**Methods**: Three patients were included: 1) female, 52years, 8.6years after TAR (1st-generation), chronic pain; 2) male, 71years, 6.8years after TAR (2nd-generation), peroneus nerve palsy; and 3) female, 6.2years after TAR (3rd-generation), painful arthrofibrosis. Tibial and talar implants were removed with bone-bloc (6mm) and prepared for histological analysis.

**Results**: While regular bony ingrowth to HA layer was found in all 3 cases, the HA layer was not stable in the 1st-generation which resulted in partial loosening. For the 2nd and 3rd generation implants, trabecular stress concentration was found around the 6mm peaks and at posterior and anterior aspect of tibial and talar implants.

**Conclusion**: Our findings are in accordance with clinical studies of different implants showing that single HA coating results in an inferior osteointegration when compared to double coated implants. The histological distribution of trabecular bone at the interface supports earlier observations that load transfer occurs mainly through the cortical rim. We conclude that tibial component should cover the entire cortical rim and that a stem or a fin is not necessary for fixation, and that precise bone cut on talar side is important for proper bony support.

**Poster # 13**
**Title**: The Influence of Bisphosphonates on the Maintenance of Proteoglycan Content and Chondrocyte Viability in Fresh Osteochondral Allografts in Cold Storage  
**Author(s)**:  
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Kevin Baker, MS  
Carly Gratopp, BS  
Paul Fortin, MD

**Abstract**:  
**Introduction**: The use of fresh osteochondral allografts is an increasingly popular option for the treatment of large, full-thickness chondral defects of the talus. Chondrocyte viability is critical to the incorporation of fresh osteochondral allografts and thus their clinical success. Viability and extracellular matrix production of chondrocytes within osteochondral tissue is known to decrease with increasing storage times. The goal of this in vitro study is to examine the effect of tissue storage media supplemented with nitrogenated (risedronate) or non-nitrogenated (etidronate) bisphosphonates on chondrocyte viability and maintenance of proteoglycan content within human fresh osteochondral tissue. Improved maintenance of chondrocyte viability and proteoglycan content may lead to enhanced outcomes associated with osteochondral allografting.

**Methods**: Fifty cylindrical osteochondral cores were taken from five hemi-condyles from two donors (49/m and 19/m). Following the harvest and subsequent rinse with normal saline, the osteochondral cores were
either immersed in tissue storage media (control), or media containing low (0.01 M) or high (0.1 M) dose risedronate or etidronate bisphosphonates. Cores were stored in their respective media for up to 38 days following their post-mortem harvest. At various timepoints, the osteochondral cores were removed from the storage media sectioned for histology and stained with Safranin-O + Fast-Green to assess proteoglycan content; an indirect measure of chondrocyte viability. Terminal deoxynucleotidyl transferase (TUNEL) staining of the osteochondral cores was employed to assess active apoptosis of chondrocytes within the osteochondral tissue. Histologic slides were imaged by phase contrast microscopy equipped with digital image acquisition.

**Results:** Risedronate and etidronate additions to storage media were not found to have any deleterious effect on the cellularity or cellular organization of the osteochondral tissues at any timepoint. Osteochondral cores from all treatment and control groups exhibited a time-dependent loss of Safranin-O staining intensity, consistent with a reduction in proteoglycan content as a function of storage duration. High dose (0.1M) etidronate (non-nitrogenated) resulted in the weakest Safranin-O staining, when compared to control tissue at each timepoint, as shown in Figure 1. Low dose (0.01M) risedronate (nitrogenated) yielded the most intense staining for proteoglycans when compared to control tissue at all time points. The trend for Safranin-O staining intensity, and thus proteoglycan content within the osteochondral tissue was as follows: 0.01M risedronate > Control > 0.1M risedronate > 0.01M etidronate > 0.1M etidronate. TUNEL staining of the osteochondral cores showed a storage-duration dependent increase in chondrocyte apoptosis (decrease in viability). Positive TUNEL staining (higher incidence of apoptosis) was greatest for etidronate at high and low doses. Low dose risedronate showed less chondrocyte apoptosis compared to Control tissue and tissue treated with high dose risedronate.

**Conclusion:** Maintaining chondrocyte viability in fresh osteochondral tissues during storage remains a significant challenge. The addition of low dose nitrogenated bisphosphonates, such as risedronate, to tissue storage media during cold storage appears to help reduce in situ chondrocyte apoptosis and maintain proteoglycan content in fresh osteochondral tissues during storage. Improvements in the maintenance of chondrocyte viability and proteoglycan content may translate to enhanced outcomes associated with osteochondral allografting of full-thickness chondral defects of the talus.

**Poster # 14**
**Title:** The Incidence of DVT After Hindfoot Arthrodesis- Is Prophylactic Anticoagulation Justified?
**Author(s):**
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**Abstract:**
**Introduction:** Due to the low incidence of lower extremity DVT, prophylactic anticoagulation for patients undergoing lower extremity surgery has been a debated topic of conversation. Recent surveys among foot and ankle surgeons have demonstrated a low rate of use of anticoagulation (19%) for elective and traumatic foot and ankle surgeries. Specifically the issue of anticoagulation for patients undergoing hindfoot arthrodesis has recently emerged as a controversial topic and as of yet is unresolved. Early studies have indicated that anticoagulation is not necessary but recent criticism of these earlier studies has led to mixed opinions on the standard for orthopaedic surgeons performing hindfoot fusions. The purpose of this study is to determine the incidence of DVT and the efficacy of postoperative prophylaxis against thromboembolism with use of low--molecular weight heparin (LMWH) or Warfarin in patients undergoing hindfoot fusion.

**Methods:** A retrospective review of all patients undergoing hindfoot fusions (tibio-talar, ankle, and triple) by the four senior authors from 2001-2010 was performed. During this period a total of 315 hindfoot fusions were performed in 300 patients. Of those we were able to determine the postoperative anticoagulation status after 256 hindfoot fusions. Ages ranged from 15-95 with a mean of 58.3 at the time of surgery. All patients
with clinical symptoms of DVT underwent bilateral compression ultrasonography during the post-operative period.

**Results:** After 92 of 256 procedures performed the patients received anticoagulation. In this anticoagulation group 3 (3.3%) patients were found to have evidence of acute DVT via ultrasound. Of the remaining 193 patients who did not receive any anticoagulation only 3 (1.6%) were found to have an acute DVT.

**Conclusion:** The incidence of DVT in patients undergoing hindfoot arthrodesis is low. In patients undergoing hindfoot fusion, postoperative prophylaxis with low--molecular weight heparin (LMWH) or Warfarin does not significantly reduce the incidence of clinically symptomatic DVT.

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**Poster # 15**

**Title:** Characterization of patient specific contact pressures within talar footprint of retrieved Agility total ankle arthroplasty tibial components

**Author(s):**
Sean Matuszak, MD
Zac Vaupel
Erin Baker, MS
Tristan Maerz, BS
Kevin Baker, MS
Michael Kurdziel
Meagan Richardson-Frazzitta
Paul Fortin, MD

**Abstract:**

**Introduction:** In preliminary clinical investigations, the Depuy Agility total ankle arthroplasty implant was shown to result in favorable patient outcomes. Intermediate term follow-up studies have described incidence of osteolysis and prosthetic loosening. A previous study at our institution analyzed retrieved Agility prostheses and damage modes, showing talar components formed a ‘footprint’, typically on the medial aspect of the polyethylene (PE) liner, which was identified as the preferential articulation site of the talar component on the PE liner. Our study analyzes forces across explanted components at the talar footprint, correlating results to clinical and damage mode analysis findings. We hypothesize the forces at the tibiotalar interface are altered as articulation becomes increasingly constrained, resulting in forces that affect the magnitude and location of peak stress on the PE liner thereby contributing to PE wear, osteolysis and implant failure.

**Methods:** Six retrieved Agility total ankle arthroplasties (two of each design; first, second, third generation) exhibiting a talar footprint were tested in the servo-hydraulic materials testing machine (MTS; Eden Prairie, MN). Measurements were obtained with a thin-film pressure sensor (K-scan 5033; Tekscan; South Boston, MA) placed in the tibiotalar articulation. Loads were applied uniaxially from one to six times patient body weight, which was retrieved from patient records. Mean peak pressures were calculated from peak force and area data, and pressure images were obtained. Damage mode analysis and medical record review were conducted.

**Results:** Measured peak forces in the talar footprint increased with increasing applied body weight. Average peak pressures for all designs ranged from 2.02 to 10.70 MPa, dependent on applied load. First generation implant designs exhibited the highest average peak pressures (7.57+/-2.04 MPa), followed by second generation (5.39+/-2.10 MPa) and third generation implants (5.3+/-1.55 MPa). Measured contact area increased with increasing applied body weight. Little variation existed in measured contact area between the three repeated tests at the same body weight, suggesting static mechanical testing of the explants was capable of inducing plastic deformation of the PE tibial component. Damage, including burnishing, scratching, pitting and dishing, was evident on the PE liner. Operative notes, at revision, described loose tibial and/or talar components for each case and radiographic analysis determined osteolysis was highest in zones 1 & 6, which indicates effects of PE wear debris in proximity to sites of PE liner wear.

**Conclusion:** Measured peak forces illustrate the quantitative effects of the constrained articulation of the talar component in the ‘footprint’ of the PE liner, while damage mode analysis and clinical data confirm the
effects of PE wear on the performance of the Agility TAA. This is the first study to quantify differences in
peak pressure location and magnitude on retrieved PE TAA components, and a first step to understanding
the contribution of implant design features in wear and damage of PE tibial components. Future work will
focus on providing a method for comparing TAA designs, through continued measurement of peak pressures
on each design at consistently applied forces and additional anatomically-relevant angles.

Poster # 16
Title: Are patient information handouts useful following operative treatment of ankle fracture? The results of
a prospective randomized trial.
Author(s):
D Joshua Mayich, MD
David W. Sanders, MD, FRCSC
Christina Tieszer, CCRP
Abdel R. Lawendy, MD, FRCSC
Will McCormick, MD

Abstract:
Introduction: It has been shown in the literature that physiotherapy (PT) following ankle fractures, as an
adjunct to surgical management, is an essential part of the rehabilitation process. It helps recover range of
motion, reduce activity limitation and pain. The value of educational handouts, in the form of an instructional
brochure, as an adjunct to post-operative PT has not been assessed.

Methods: Between 2005-2007 51 patients who suffered an operative ankle fracture were randomized to
receive either standard post-operative care (SG) for an ankle fracture, or received a copy of the AAOS
handout on "ankle fractures" and a panel-approved handout on post-operative ankle fracture PT (or HOG).
Each patient was followed for 3 months clinically and radiographically. At the 6 week and 3 month mark each
patient was asked to complete the Olerud-Molander Questionnaire (or OMQ), and two questions regarding
their level of satisfaction.

Results: Pre-operative characteristics compared favorably. Three patients were lost to follow-up (all three
occurred in the SG). The HOG was significantly more satisfied with the staff at 3 months (9.2 vs 6.3; p <
0.01). There were significant improvements in the Work/Activity ability at 6 weeks. (p=0.01) This advantage
disappeared at 3 months. (p =0.24) These were the only differences detected. Although the HOG trended
towards significance at 6 weeks in the Stiffness (p = 0.1), Squatting ability (p=0.08), total OMQ score
(p=0.07) any differences were lost by 3 months.(p = 0.94, 0.53, 0.82, respectively) No differences in post-
operative complication rates were noted.

Conclusion: Although handouts can be helpful in providing patients with accessible information in the post-
operative period, they do not seem to have any significant impact on their post-operative outcomes. They do;
however, seem to enhance the interaction between staff and patient at post-operative visits. This may
contribute to an overall increase in satisfaction regarding their care post-ankle fracture surgery.

Poster # 17
Title: Thromboprophylaxis after Elective Foot and Ankle Surgery: What is the State of Practice
Author(s):
Kalpesh Shah, MS Ortho, FRCS Tr Orth - bonecutter@doctors.net.uk
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Abstract:
Introduction: The risks of complications secondary to Venous Thromboembolism (VTE) has to be balanced
against the cost, risk and effectiveness of prophylactic treatment. The risk of fatal pulmonary embolism after
foot and ankle surgery is much lower than after hip or knee surgery. A thoughtful proactive approach to this
potential complication is required. There is limited research on thromboprophylaxis after elective foot and
ankle surgery. This purpose of this study was to assess the current trends in practice with regards to VTE thromboprophylaxis amongst expert orthopaedic foot & ankle surgeons.

**Methods:** An email-based survey of active American Orthopaedic Foot and Ankle Society (AOFAS) committee members was conducted (n=100). Surgeons were questioned as to their use, type and duration of thromboprophylaxis following elective ankle fusion surgery. Scenarios included: 1) a 50 year old female with no risk factors; 2) a 50 year old female with a previous history of pulmonary embolism; and 3) active use of birth control pill (35 years old). The response rate was 80% (80/100)

**Results:** Almost all surgeons (97.5% (78/80)) recommended thromboprophylaxis after a previous pulmonary embolus. 77% (60/80) recommended Low Molecular Weight Heparin (LMWH), 18% (14/80) recommend warfarin, and 6% (4/80) recommended other prophylaxis (Aspirin, IVC filters, etc.) The majority of respondents (45/80) did not recommend prophylaxing a 50 year old patient with NO risk factors. For those recommending prophylaxis the primary method was aspirin (23/35). Prophylaxis was recommended by 61% (49/80) for a 35 year old on the birth control pill. Aspirin (24/49) and LMWH (23/49) were the most commonly recommended methods of prophylaxis. The length of time that prophylaxis was recommended varied widely (Range: 1 day - 6+ weeks).

**Conclusion:** There was wide agreement that patients who had previously had a documented pulmonary embolism should receive thromboprophylaxis prior to undergoing elective ankle fusion surgery. Most surgeons used either LMWH or warfarin as the primary means of prophylaxis although the duration of prophylaxis was variable. The majority of surgeons surveyed did not recommend using DVT prophylaxis in patients with NO risk factors although the responses were quite variable. In patients undergoing elective foot and ankle surgery the potential catastrophic risk associated with VTE as well as the potential for serious complications related to providing DVT thromboprophylaxis demands that orthopaedic foot and ankle surgeons have a well formulated evidence-based approach to deciding whether DVT prophylaxis is indicated. One aspect of this approach should be specifically asking patients whether they have had a previous history of pulmonary embolism.

**Poster # 18**

**Title:** Quality of Internet Information for Common Foot and Ankle Diagnoses

**Author(s):**
Jeremy Smith, MD - jsmith42@partners.org
Olivia Pate, MD
Daniel Guss, MD
Jared Lee, MD
Chris Chiodo, MD
Eric Bluman, MD, PhD

**Abstract:**

**Introduction:** Patients' use of the Internet for health-related information has increased dramatically. The goal of this study was to assess the quality and content of Internet-based information for common foot and ankle diagnoses.

**Methods:** The ten most common foot and ankle diagnoses at our academic medical center from September 2009 to August 2010 were identified, based upon ICD-9 codes. Two large Internet search engines were used to identify the top ten websites for each of these diagnoses. A custom grading form was created for each diagnosis including classification of the website type, website author(s), integrity based upon the Health on the Net (HON) Foundation principles, presence of HONcode seal, and quality of information content of five sections: disease summary, pathogenesis, diagnostic tests, treatment options/complications, and prognosis/outcomes. Four independent reviewers graded each website according to these criteria.

**Results:** One hundred thirty-six unique websites were reviewed. The average HON score was 62.4 (range, 52.3 to 68.8) and information content score was 49.7 (range, 33.8 to 62.1) out of a maximum of 100. Commercial websites made up 53% of websites. Websites having the best scores were administered by academic institutions and nonprofit organizations. Average content scores ranged from 32.2 for prognosis/outcomes to 53.9 for treatment/complications. Interobserver variability for scoring was low.
Websites displaying the HONcode seal had better overall scores, as did those authored by primary care physicians.

**Conclusion:** The quality of Internet information for common foot and ankle diagnoses is variable and in general not very good. These findings raise concerns about the quality of Internet-based foot and ankle information currently available to patients.

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**Poster # 19**

**Title:** Risk Factors for Nonunion in Arthrodesis Surgery: A Survey of International Orthopaedic Foot and Ankle Surgeons

**Author(s):**
- Gowreeson Thevendran, FRCS (Tr&Ortho)
- Kalpesh Shah, MS Ortho, FRCS Tr Orth
- Alastair Younger, MD, FRCSC
- Stephen Pinney, MD, FRCSC

**Abstract:**

**Introduction:** Nonunion following foot and ankle arthrodesis surgery may result in dissatisfied patients and increased health care costs. Based on a surgeon survey, this study aimed to assess how established foot and ankle surgeons perceived an individual patient's nonunion risk profile.

**Methods:** A survey of the editorial board of Foot and Ankle International, the current executive committee members of the British Orthopaedic Foot and Ankle Society (BOFAS), the International Federation of Foot and Ankle Surgeons (IFFAS), the Canadian Orthopaedic Foot and Ankle Society (COFAS) and the Australian Orthopaedic Foot and Ankle Society (AOFAS) was performed. The survey was conducted online and respondents were asked to rate, on a scale of 0 to 10, their perception of the relative risk of nonunion for a variety of potential nonunion risk factors. As a benchmark for comparison, a smoker of 1 pack/day was considered to demonstrate a nonunion risk of 5/10.

**Results:** The response rate was 72% (100/139). Eighty percent (80/100) of the respondents had foot and ankle surgery encompass more than 90% of their current practice. The highest perceived risk factors (based on the highest mean scores that was statistically different in comparison to smoking 1 pack/day, ie: 5/10) were: smoking 2 pack/day (mean score 8.69, p < 0.001), lack of fusion site stability (mean score 8.66, p < 0.001) and poor local vascularity (mean score 7.66, p < 0.001). The least significant risk factors were: age > 60 (mean score 2.54, p < 0.001), rheumatoid arthritis (mean score 3.05, p < 0.001) and osteoporosis (mean score 3.56, p < 0.001). The response to absolute contraindications to arthrodesis surgery was equally distributed between smoking, local active infection and poor vascularity. There was no significant difference between the North American and global standard of practice with respect to nonunion risk factor stratification.

**Conclusion:** A positive smoking history, lack of fusion site stability and poor vascularity were perceived to be the biggest risk factors for nonunion. Focused improvements in pre-operative patient education and risk modification, better surgeon training of fixation techniques and improved post operative care may help reduce the risk of nonunion following arthrodesis surgery.
Abstract:

Introduction: Metatarsalgia is a common finding in patients with and without hallux valgus. In the last few years different osteotomies have been studied for the treatment of metatarsalgia, with varied success rates. The Wolf osteotomy is simple, requires no fixation, and can be loaded without restriction. No study has reported the amount of elevation or shortening obtained with this osteotomy. The objective of this study was to perform a geometrical analysis of how the Wolf osteotomy could elevate and shorten the metatarsal head.

Methods: A geometrical model of the second metatarsal bone was designed, with a head diameter of 16 mm and a total length of 75 mm. A transverse osteotomy was simulated, starting on the distal dorsal aspect on the neck of the model. A plantar angulation of 15 degrees was assigned to the model. The amount of shortening and elevation of the metatarsal head was calculated, removing either a 2 or 3 mm dorsally based wedge.

Results: With a 2 mm wedge resection, the Wolf osteotomy elevates the head in 1.3 mm, and shortens the metatarsal bone in 1 mm. If the wedge is increased to 3 mm, the elevation increases to 2.1 mm, and the shortening increases to 1.5 mm.

Conclusion: When dealing with 2nd rocker metatarsalgia, without lesser toe deformities, and we want to avoid extensive soft tissue dissection, the Wolf osteotomy can be considered as an option as it will elevate safely 2 mm the metatarsal head without needing internal fixation and it may be enough to alleviate symptoms.
Posters:

**Poster # 21**

**Title:** Double Proximal Phalanx Osteotomy in Percutaneous Surgery of Severe Hallux Valgus

**Author(s):** Sergey Berezhnoy, MD - berezhnoy61@mail.ru

**Abstract:**

**Introduction:** Proximal phalanx osteotomy without bone fragment internal fixation is a permanent stage in the hallux valgus percutaneous surgery. Stability of the phalangeal fragments is an important condition for obtaining positive result. Preserving the outer cortical layer of the phalanx at the time of osteotomy is essential to achieve maximum stability of the bone fragments. In severe hallux valgus surgery preservation of the proximal phalanx lateral cortex is often impossible, that can lead to delayed union and loss of correction.

**Methods:** The results of percutaneous proximal phalanx osteotomies of 72 feet (1 surgeon, 2 hospitals) at various degrees of hallux valgus were reviewed. Using pre- and postoperative X-rays, the angle between distal and proximal basal phalanx joint surfaces lines was measured to estimate distal phalangeal fragment deviation after osteotomy. It was indicated, that lateral deviation for more, than 20° in most cases (70%) leads to lateral cortex rupture with subsequent loss of correction in 8% of cases. To avoid lateral cortex rupture and loss of correction, double percutaneous proximal phalanx osteotomy is introduced in most severe hallux valgus cases as an alternative to standard percutaneous Akin procedure.

**Results:** 11 patients (17 feet) underwent double percutaneous proximal phalanx osteotomy with the mean follow-up of 6 months (range 3 to 15). Two dorsomedial approaches were used to make osteotomies. No internal fixation was used. Postoperative rehabilitation protocol after double osteotomy and standard Akin procedure did not differ. Immediate full weight bearing was authorized. In all cases the desired phalangeal fragments deviation were achieved and delayed unions or losses of correction were avoided.

**Conclusion:** Double proximal phalanx osteotomy is safe, effective and predictable procedure and should be reserved for the treatment of most severe hallux valgus deformities. The surgeon needs an experience in percutaneous forefoot surgery. The effectiveness of the procedure is maximal in cases, when for some reasons 1 metatarsal osteotomies do not performed.

**Poster # 22**

**Title:** Radiologic Analysis of Second Metatarsal Height in Hallux Valgus.

**Author(s):** Hyun-wook Chung, MD - peter622@naver.com

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Sung Jong Woo, MD - sjs0506@paik.ac.kr

**Abstract:**

**Introduction:** The purpose of the present study is to analysis for radiologic changes after operations of hallux valgus deformity with use of three different techniques.

**Methods:** Between August 2005 and May 2009, 54 patients (62 feet) underwent proximal chevron metatarsal osteotomy, scarf metatarsal osteotomy, and distal chevron osteotomy. Standardised weight bearing anterior-posterior and axial radiographs were taken preoperatively and postoperatively. These were compared to determine changes in hallux valgus angle, intermetatarsal angle, length of first metatarsal, and second metatarsal height. The second metatarsal height was defined as the height from floor to base of second metatarsal head on axial radiograph.

**Results:** The results of proximal chevron osteotomy showed greatest changes in hallux valgus angle, intermetatarsal angle and second metatarsal height. Significant changes in intermetatarsal angle (p=0.023) and second metatarsal height (p=0.008) were identified in proximal chevron metatarsal osteotomy.
Conclusion: In proximal chevron osteotomy, significant elevation of second metatarsal head results in relative decompression of second metatarsal head on weight bearing and reduction of necessity of additional second metatarsal osteotomy.

Poster # 23
Title: Mid- to long-term Survivorship of HINTEGRA Total Ankle
Author(s):
Beat Hintermann, MD - beat.hintermann@ksli.ch
Lukas Zwicky, MSc
Alexej Barg, MD

Abstract:
Introduction: While the early HINTEGRA ankle prosthesis design has evidenced some problems of mid- to long-term stabilities of components, improvements were achieved by adding pegs to talar component and Titanium fluid on porous coat. The aim of this study was to determine the survivorship of TAA with the use of this 3rd generation HINTEGRA ankle in a consecutive series of 429 primary total ankle arthroplasties (TAA).

Methods: Between 05/2003 and 12/2008, 429 primary TAA were performed in 409 patients (females, 194 (202 ankles); males, 215 (227 ankles), age 61.1 ± 13.0 years). Underlying diagnosis was posttraumatic osteoarthritis in 354 ankles, primary osteoarthritis in 25 ankles and inflammatory arthritis in 50 ankles. All patients were clinically and radiologically assessed after 4.5 (2.0 – 7.7) years, and survivorship analysis was calculated. Revision of a metallic implant or conversion into ankle arthrodesis was taken as the endpoint.

Results: Overall incidence of component loosening was 1.63%. 10 ankles were revised to TAA (component loosening, 5; misalignment, 3; scratches, 1; cysts, 1), and 5 ankles (recurrent misalignment, 2; component loosening, 2; pain, 1) were revised to ankle arthrodesis. Estimated survivorship at 6 years was 93.4%, being 95.5% for the talar component and 93.6% for the tibial component.

Conclusion: Obviously, TAA using the 3rd generation HINTEGRA ankle design have evolved to a safe procedure with reliable results at mid- to long-term, and particularly with a high primary stability of components. These encouraging results support our belief that TAA has become a viable alternative to ankle arthrodesis even for younger patients and more difficult conditions, as often the case in posttraumatic osteoarthritis.

Poster # 24
Title: Treatment of Moderate to Severe Hallux Valgus Using Proximal Reverse Chevron Metatarsal Osteotomy and Akin Osteotomy Through One Medial incision
Author(s):
Hong-geun Jung, MD PhD
Tae-hoon Kim, MD
Jae-yong Park, MD

Abstract:
Introduction: Cosmesis is a key factor for success in hallux valgus (HV) surgery, and dorsal 1st web space operation scar is a profound obstacle in improving the cosmesis. This is to verify that excellent functional and cosmetic improvement can be achieved for moderate to severe HV by performing distal soft tissue procedure (DSTP), proximal reverse chevron metatarsal osteotomy (PCMO) and Akin osteotomy through one medial incision.

Methods: The study is based on 51 feet (41 patients) of moderate to severe hallux valgus treated with DSTP, PCMO and Akin from February 2008 to October 2009 with at least 12 months followup. Clinically, VAS pain score, AOFAS Hallux functional score and patient satisfaction were analyzed. Radiographically, hallux valgus angle (HVA), intermetatarsal angle (IMA), medial sesamoid position (MSP) and 1-5th metatarsal width were analyzed.
Results: AOFAS score improved from 56.3 to 89.6 and VAS pain score decreased from 6.4 to postoperatively 1.3 (p<0.001). Radiographically HVA decreased from 34.9° to 6.4° postoperatively and IMA decreased from 17.0° to 4.7° postoperatively (p<0.001). MSP improved from grade 2.6 to grade 0.5 postoperatively while 1-5th metatarsal width reflecting broadness of foot decreased from 95.3mm to 83.9mm postoperatively (p<0.001). Normal MTP range of motion was maintained. Eighty-four percent of the patients were satisfied with the results. No major wound problem or skin necrosis occurred.

Conclusion: We have achieved very favorable clinical and radiographic outcome with minimal complication & high patient satisfaction for moderate to severe HV treated with DSTP, PCMO and Akin osteotomy through one medial incision. Also additional Akin osteotomy was necessary to complete the HV correction while maintaining 1st MTP joint congruency

Poster # 25
Title: Role of Intraoperative Varus Stress Test for Lateral Soft Tissue Release during Distal Chevron Bunion Procedure
Author(s): Hyong-nyun Kim, MD - hyongnyun@naver.com
Yong-wook Park, MD
Ki -hoon Park, MD
Hee-joon Lim, MD
Pil-sung Whang, MD

Abstract:
Introduction: The purpose of this study is to evaluate the clinical results of distal chevron osteotomy performed in conjunction with selective lateral soft tissue release. The criterion for doing a lateral soft tissue release was determined by determining the ease and completeness of passive hallux valgus correction at the time of surgery.

Methods: Between August 2005 and November 2007, 48 feet in 43 patients classified mild to moderate hallux valgus were retrospectively studied. Distal chevron osteotomy without lateral soft tissue release was performed in 26 cases (Group 1) when passive correction of the hallux valgus deformity was possible. Distal chevron osteotomy with lateral soft tissue release was performed in 22 cases (Group 2) when passive correction was not possible. Average follow-up was 23 months (range, 12 to 28 months). Clinical results were assessed using radiographic parameters [(HVA), (1,2 IMA)], AOFAS scale and patient’s subjective satisfaction.

Results: For Group 1: the average correction of HVA was 12.8 degrees, the average correction of IMA was 4.7 degrees, and the AOFAS score improved an average of 29.2 points at the last followup. Thirteen patients were very satisfied and ten patients were satisfied with the results. No patient was dissatisfied. For Group 2: the average correction of HVA was 19.1 degrees, the average correction of IMA was 7 degrees, and the AOFAS score improved an average of 31.8 points at the last followup. Twelve patients were very satisfied and seven patients were satisfied and one patient, who had stiffness of the first metatarsophalangeal joint, was dissatisfied with the result. Both group showed no case of hallux varus or osteonecrosis of the metatarsal head and none of the cases recurred at the last follow-up.

Conclusion: Distal chevron osteotomy with selective lateral soft tissue release based on the ability to passively correct the hallux valgus deformity leads to safe and stable correction.
Poster # 26
Title: Stress Fractures in patients with Metatarsus Adductus
Author(s):
David Lemos, MD, FRCSC - david.lemos@mainegeneral.org
Arthur Manoli, II, MD

Abstract:
Introduction: Metatarsus adductus in adults has been treated as a cosmetic deformity, and is not generally considered to be a risk factor for future problems. While other foot deformities such as cavus have been associated with an increase in stress fractures the same association has not been considered to be true for metatarsus adductus. Studies have also shown that foot posture can affect foot stresses. The purpose of this study is to document a pattern of stress fractures seen in patients with metatarsus adductus foot deformities.

Methods: A retrospective review of available medical records and conventional radiographs was performed on 19 patients (12 men and 7 women; ages 24-57 years old) with stress fractures and metatarsus adductus. Factors evaluated were location, type of fracture, and metatarsus adductus angle. Predisposing conditions including trauma, osteoporosis and neuropathic osteopathy were assessed for. AP radiographs were evaluated and Metatarsus Adductus Angle (MAA) was measured for using Kilmartin’s Method.

Results: A total of 38 stress fractures in 19 patients and 25 feet (16 left and 9 right) were demonstrated. Of these, 0 were in the 1st Metatarsal, 1 was in the 2nd Metatarsal, 3 were 3rd Metatarsals, 15 were in the 4th Metatarsals, and 19 were seen in the 5th metatarsals. The fracture level in the metatarsal was proximal in 34 metatarsal fractures, middle in 3 metatarsal shaft fractures, and distal in 1 metatarsal shaft fracture. All fractures were considered to be stress fractures, with no history of trauma noted in any of the cases. The average Metatarsus Adductus Angle of the involved feet was 35.8 degrees (range from 24 to 48 degrees).

Conclusion: Patients with metatarsus adductus may be at increased risk of stress fractures specifically in the lateral metatarsals as compared to patients with normal foot posture. This may likely be due to higher biomechanical stresses on the lateral metatarsals. These cases illustrate that lateral stresses placed on a foot with metatarsus adductus may lead to problems during adulthood, which may have previously been under appreciated. Non-operative treatment has been utilized in most cases; however, occasionally operative repair may be necessary.

Poster # 27
Title: Relative and Absolute Bone Density at the TMT Joint In Bunions
Author(s):
Richard Owens, MD
Darin Nye, MD
Mark Carl Miller, PhD
Stephen Conti, MD
Colin Galvin
Deborah Corson, MD
Carmen Latona, MD

Abstract:
Introduction: The progression of hallux valgus deformity is thought to be a mechanically mediated phenomenon caused by lateral angulation of the great toe at the metatarsophalangeal joint. This angulation may cause the metatarsal shaft into a medially angulated position, thereby increasing the 1,2 intermetatarsal angle and causing changes at the TMT joint. Our hypothesis was that there is osseous remodeling at the TMT joint that occurs during this process. The long-range goal of the current research was 1) to determine whether the TMT joint in bunions undergoes osseous remodeling due to the changes in angular orientation; and 2) to determine the absolute density of the TMT joint of cadaveric bunion specimens. The short-range goal was to establish a method for the analysis of bone remodeling in hallux valgus.

Methods: Two stainless steel pins were placed across the first and second metatarsals parallel to the TMT joint space while a weight-bearing load was applied to five bunion feet (2 male), each with a minimum of 25 degrees hallux valgus angle (HVA). A CT scan of each foot was taken, with a 0.6mm slice thickness. The 1st
and 2nd TMT joint were harvested from the foot, taking care to keep the proper orientation of the joint. The joint was extracted using the proximal cuneiform joint space and the mid-shaft of the metatarsals as boundaries while the pins held the bones together. Excess tissue was removed using an elevator and the joint was fixed in a polymer resin. After the resin had cured, the K-wires were removed and longitudinal slices were cut with a fiber reinforced cut off wheel. The sections were cut from dorsal to plantar orientation with a slice thickness of 1.8 mm. Plain film images, which included an aluminum penetrometer for reference density, were taken of the slices. The CT images were used directly for a relative density of the TMT joint.

Results: The plain film images of the TMT joint were analyzed using Hounsfield numbers for the cancellous bone near joint surfaces and the aluminum reference wedge. Four areas were analyzed on each joint; distal lateral (DL), distal medial (DM), proximal lateral (PL), and proximal medial (PM). We observed that all five cadaveric feet showed bone density decreasing from dorsal to plantar region (Figure 1), regardless of gender with significant changes medial to lateral.

Conclusion: Both the radiographic data and the CT data showed a decrease in bone density from dorsal to plantar with significant changes on the medial portion of the TMT joint compared to the lateral portion. This suggests that remodelling of the joint is a viable explanation for the evolution of bunions. Rather than the metatarsal angulating medially with resultant incongruency/instability of TMT joint, the first metatarsal may move medially with remodelling of the medial cuneiform with resultant congruency/stability of the TMT joint. This is a previously undescribed explanation for how acquired bunions progress.

Poster # 28
Title: Radiographic Outcomes of Hammer Toe Treatments: A Retrospective Case-Control Study
Author(s):
Wenjay Sung, DPM - wenjay.sung@gmail.com
Lowell Weil, Jr., DPM, MBA
Lowell S. Weil, Sr., DPM, FACFAS

Abstract:
Introduction: While a number of studies have reported the outcomes after PIP joint arthroplasty and arthrodesis, there are few reports of the outcome of interpositional arthroplasty of the PIP joint with silicone implant for the correction of second hammertoes. The purpose of this study was to compare the long-term outcomes of second hammertoe deformities that underwent proximal interphalangeal (PIP) joint correction using arthroplasty, arthrodesis or interpositional implant arthroplasty.

Methods: Medical records from patients who underwent 2nd PIP joint correction between January 1998 to December 2008 were retrospectively reviewed. A total of 114 patients (136 cases) were included in the study that had anterior-posterior (AP) and lateral (LAT) radiographic views pre-operatively and post-operatively. We separated patients into three groups: Arthroplasty, Arthrodesis, and Implant. The pre-operative and post-operative 2nd PIP joint angle was measured on AP and LAT views. A visual analog pain scale was recorded prior to surgery and at last follow-up. The number of revision surgeries was recorded. Statistical analyses were performed with SPSS version 14.0 for a personal computer (SPSS Science Inc, Chicago, Ill). We used a two-way repeated measures analysis of variance (ANOVA). Inferential statistics included paired two-tailed t tests for continuous variables. The a priori α level was .05 for all statistical tests.

Results: In the Arthroplasty Group (39 patients/ 45 cases), the average age of patients was 62.7 years with an average follow-up of 45.3 months. Pre-operative VAS scores averaged 7.1 versus 1.0 post-operatively (P<0.01). The average AP preoperatively was 8.20 versus 11.40 post-operatively (P < 0.05). The average LAT pre-operatively was 46.90 versus 31.50 post-operatively (P<0.01). There was a 37.8% revision surgery rate. In the Arthrodesis group (34 patients/ 43 cases), the average age of patients was 55.5 years with an average follow-up of 47.8 months. Pre-operative VAS scores averaged 8.0 versus 1.9 post-operatively (P<0.01). The average AP preoperatively was 7.20 versus 5.40 post-operatively (P = 0.59). The average LAT pre-operatively was 46.40 versus 24.70 post-operatively (P<0.01). There was a 14.6% revision surgery rate. In the Implant Group (41 patients/ 48 cases), the average age of patients was 59.0 years with an average follow-up of 47.8 months. Pre-operative VAS scores averaged 8.2 versus 1.3 post-operatively (P<0.01). The average AP preoperatively was 7.80 versus 2.90 post-operatively (P<0.01). The average LAT pre-
operatively was 49.10 versus 24.20 post-operatively (P<0.01). There was a 10.4% revision surgery rate.

Testing for variance we found the only significance between AP radiographs among the groups.

**Conclusion:** Our series demonstrated that there are significant positive outcomes with long-term results with different treatments for second hammer toes. Although all treatment groups demonstrated significant positive changes post-operatively, the implant group was found to correct in the AP radiographic plain more significantly than the other groups with less chance of revision surgery.
Forefoot:

Poster # 29
Title: Short term outcomes of first metatarsophalangeal fusion with a novel intramedullary screw technique
Author(s):
Stephen Arndt, MD
Mark Berkowitz, MD

Abstract:
Introduction: First metatarsophalangeal arthrodesis has long been considered an excellent treatment option for hallux rigidus, severe hallux valgus, failed hallux valgus surgery, failed implant arthroplasty, and previous failed arthrodesis of the first metatarsophalangeal joint. It has a long history of excellent results, and many techniques have been described to accomplish this procedure. An ideal arthrodesis technique would be easily reproducible, achieve a high union rate, and have a low rate of complications. Concerns about hardware irritation and dorsal plate prominence as well as plate size and the number of screws in each bone have sparked interest in a new intramedullary technique to achieve first metatarsophalangeal arthrodesis. This technique should theoretically reduce hardware complications and skin irritation as well as provide stable fixation and compression through the central axis of the joint.

Methods: Twenty four consecutive cases of first metatarsophalangeal arthrodesis using the Hallu.x (Extremity Medical inc, Parsipanny, NJ) system for first metatarsophalangeal fusion over a three year period, 2007-2009, were reviewed retrospectively. We analyzed outcomes based on rate of radiographic union, patient’s preoperative and postoperative pain scores, and rate of complications, specifically looking for superficial and/or deep wound infections and hardware irritation, as well as hardware failure and non-union. The average follow-up was 16 months (range 5-39 months). The most common indication was hallux rigidus. All patients had a trial of non-operative management prior to intervention. Post-operatively patients were kept in a cast non-weightbearing for 3 weeks. After the initial three weeks, progression to full weightbearing in a walking boot or post-operative shoe was achieved over the next four weeks.

Results: Of the 24 feet reviewed, union was achieved in 23 of the 24 cases (95.8%). The average time to fusion was 3 months. The average pre-operative pain score (VAS analog method, 1-10) was 5.92 and the average post-operative pain score was 1.72. The average reduction in pre and post-operative pain scores was 4.2. Fourteen patients reported their score as 0 or 1 and six reported their pain as a 2. One patient had a non-union with hardware breakage. No other complications were noted including no hardware irritation, no hardware removal, and no superficial wound infections.

Conclusion: These results show that first metatarsophalangeal arthrodesis with use of a novel intramedullary screw technique produces excellent fusion results as well as very good patient reported pain outcomes. This technique was also effective at reducing skin and hardware related complaints/complication and no hardware was removed. This technique may be particularly useful in patients with concerns about skin and plate prominence and irritation as well as patients with concerns of small bones and the number of screws/purchase in each bone.

Poster # 30
Title: Third Metatarsal shortening for Morton’s neuroma
Author(s):
In-tak Chu, MD

Abstract:
Introduction: We have experienced good clinical results in Morton’s neuroma by third metatarsal shortening and suggest this operative treatment as new surgical modality for Morton’s neuroma.

Methods: Nineteen patients (21 feet) with Morton’s neuroma who had not been responsive to conventional treatment were treated with third metatarsal shortening. Third metatarsal shortening were obtained by third metatarsal sliding osteotomy at the proximal third level. The operation did not include neurectomy or neurolysis for the involved interdigital nerve. Postoperatively we recommended the patients full-weight-
bearing before stable healing of osteotomy site. The clinical results were analyzed with comparing preoperative and postoperative validated scoring system.

**Results**: Clinical subjective symptoms were improved in 19 cases (90.4%). Postoperatively, the mean VAS score was changed from 6.8 preoperatively to 2.1 and the mean AOFAS score improved from 59.3 preoperatively to 80.8 at final followup. The mean degree of third metatarsal shortening was checked 2.1 mm but did not show correlation with the validated scoring systems. Postoperative complications contained mild tenderness at osteotomy site in 3 cases and newly developed plantar corn at second metatarsophalangeal joint in 2 cases. Two patients with unsatisfactory result were recurrent case after previous neurectomy and case with newly developed painful plantar corn.

**Conclusion**: The third metatarsal shortening with sliding osteotomy is relatively simple and has little neural complication compared to neurectomy and neurolysis for Morton’s neuroma. For treating Morton’s neuroma surgically, we suggest third metatarsal shortening as safe and excellent method.

**Poster # 31**
**Title**: Revision of Failed 1st MTP Arthroplasty with Allograft Interposition Arthrodesis
**Author(s)**: Bryan Ding, MD - bcding@gmail.com
John Early, MD - jearly@txorthopaedic.com

**Abstract**:
**Introduction**: Successful revision treatment of first metatarsophalangeal joint pathology can be challenging due to issues related to bone loss and prior bone resection.

**Methods**: We report a case of bilateral 1st MTP hemiarthroplasty with over 1cm of metatarsal shortening treated with staged unilateral 1st MTP arthrodesis using an interposition allograft bone dowel and dorsal plating. The purpose of this paper is to describe a technique to create a biomechanically stable construct which is technically easier to perform than similar operations previously described, while most importantly addressing a problem of a shortened first ray due to failed prior hallux MTP joint surgery.

**Results**: The use of a commercially available allograft bone dowel eliminates the need for autograft bone harvest, requires minimal surgical fashioning, results in a stable implant construct, and most importantly is able to restore length to a deficient first ray.

**Conclusion**: Within six months after revision surgery of each side, the patient reported resolution of her hallux MTP pain, transfer metatarsalgia, and was able to return to wearing what she deemed were fashionable shoes.

**Poster # 32**
**Title**: Modified Butler’s procedure for the treatment of the adducted fifth toe
**Author(s)**: Luis Donzis, MD
Pablo Maggi, MD
Diego Yearson, MD
Nicolas Monsalve, MD
German Joannas, MD

**Abstract**:
**Introduction**: Adducted fifth toe is a congenital deformity, often bilateral, in which the fifth toe is medially directed, rotated and hyperextended. Generally, symptomatic patients are teenage and young adults with uncomfortable callosities located in the dorsum of the fifth toe. It is likely that this deformity does not correct itself. Surgical treatment is indicated when pain and tenderness are unbearable.

**Methods**: 39 patients who underwent surgical treatment (modified Butler’s procedure) were retrospectively evaluated.
Results: Average follow-up was seven years and a half. Results were evaluated according the Black Score in which cosmetics, comfort and pain were included. Thirty-seven results were considered excellent, regarding the complete deformity’s correction and the daily use of shoes with no pain. No cases of reoperation due to the lost of correction nor pain incapable of treatment were reported. All patients were satisfied with the result and would advise other patients to undergo the same operation.

Conclusion: Although it is a simple procedure, we should pay attention to some important steps during the operation.

Poster #33
Title: Double Bone Block Medial Column Arthrodesis for Correction of a Dorsal Bunion Deformity
Author(s):
Jeffrey Johnson, MD - johnsonje@wustl.edu

Abstract:
Introduction: The purpose of this study was to describe a new surgical technique for the correction of a dorsal bunion and present radiographic results.

Methods: A chart review and analysis of pre and post operative weight bearing radiographs was performed to identify all patients that underwent a double allograft bone block arthrodesis of the naviculocuneiform 1-2 joints and 1,2 intercuneiform joints for correction of a dorsal bunion deformity.

Results: Seven (7) patients (9 feet) were identified for review that underwent an allograft bone block fusion medial column midfoot fusion for correction of a dorsal bunion. The dorsal bunion resulted from prior clubfoot deformity correction in 6 feet and as a congenital deformity in 3 feet. There were 2 females and 7 males in the study group. Numerous other adjunctive procedures were performed in addition to the dorsal bunion for correction of associated deformities including tendon transfers, MTP-1 joint release, calcaneal osteotomies and hindfoot arthrodeses. The average age at time of surgery was 19 (9-49). The average followup was 12 months (3-31). The average correction in the first metatarsal head height measured from floor was 16 mm. The average preoperative lateral first metatarsal axis angle was 7 degrees (-8 – 15). The average postoperative lateral first metatarsal axis angle was 21 degrees (17-21). The average improvement in the lateral first metatarsal axis angle was 14 degrees. There were no nonunions but there were two reoperations for hardware removal.

Conclusion: Discussion: Observation of the radiographs of patients with a dorsal bunion deformity indicates that the first metatarsal dorsal angulation noted clinically is actually secondary to a dorsal angulation of the entire medial column originating at the first naviculocuneiform joint. This new operative procedure for dorsal bunion correction has advantages over prior described procedures in that it makes the correction of the foot at the location where the deformity exists, which is in the medial column of the midfoot (as opposed to the forefoot). The reoperations for prominent hardware removal were due to a prominent extraosseous soft tissue anchor for anterior tibial tendon transfer and this has been switched to an intraosseous anchor. Conclusion: A new procedure for correction of a dorsal bunion deformity has been developed to address the deformity where it exists in the medial column of the midfoot and will reliably correct the deformity with a low complication rate.
Abstract:

**Introduction:** Hallux sesamoidectomy is indicated for the treatment of chronic fracture and painful non-union. The literature is conflicted regarding the origin of sesamoid fractures, with some references suggesting that fractures are secondary to spontaneous avascular necrosis of the sesamoid. Reported complications of sesamoidectomy include iatrogenic hallux varus or valgus, painful scarring, and nerve injury.

**Methods:** Records and radiographs were reviewed for 46 patients who underwent hallux sesamoidectomy and flexor hallucis brevis reconstruction between 1986 and 2009. First, chart review was performed. Any history of trauma or repetitive impact injury was noted, as was the duration of symptoms prior to surgery. Complications were documented, specifically nerve injury symptoms, wound complications, and clinical hallux alignment. Pain relief, return to activity, and orthotic wear were reported. Secondly, pre-operative and post-operative radiographs were measured for changes in hallux valgus angle (HVA), 1-2 intermetatarsal angle (IMA), and sesamoid position. Lastly, pathology reports of the resected sesamoid histology were reviewed.

**Results:** Records and radiographs were reviewed for 46 patients (20 males and 26 females) who underwent hallux sesamoidectomy (23 medial and 23 lateral) and flexor hallucis brevis reconstruction, between 1986 and 2009. Eight patients denied any history of trauma, while 39 reported either a specific traumatic event or recurring impact activity. Running was the most commonly reported sporting activity. Symptoms were present for an average of 25 months (range 1-120 months) prior to surgery. Average age at surgery was 35.4 years (range 16-70 years). Average follow-up was 47.6 months (range 1-178 months). Forty-three of 46 patients stated they would have the procedure again. Complications included sesamoiditis in the residual sesamoid in 3 patients. Numbness and tingling about the hallux occurred in 4 patients, two of whom had resolution of symptoms. Two patients had a superficial wound infection that resolved with oral antibiotics. Orthotics were required by 6 patients. All but two patients reported return to pre-operative sporting activities. HVA change averaged 0.28 degrees (range -8 to 6) and IMA change averaged -0.13 degrees (range -9 to 4). Post-operative position of the residual sesamoids was maintained compared to pre-operative radiographs. Histologic examination reports were available for 39 of the 46 patients, demonstrating histologic evidence that fracture was the primary pathologic process in 32 of the 39. Localized areas of osteonecrosis were present in 16 of the 32, but these were histologically secondary to the fracture.

**Conclusion:** Sesamoidectomy can produce satisfactory clinical results with a high level of return to sporting activities and low risk of late hallux deformity, with appropriate surgical reconstruction of the flexor hallucis brevis tendon and sesamoid sling. Histologic evidence shows no basis for primary avascular necrosis, rather that sesamoid fractures are the result of repetitive trauma, especially in impact athletic activities.
Abstract:

Introduction: The natural history of rheumatoid arthritis (RA) varies greatly from mild to a destructive disease, which is progressing rapidly over a few years. Not a few patients require joint surgeries because of severe destruction of synovial joints despite intensive treatment for RA. Orthopedic procedures may provide improved function in the affected joints and the better quality of life for the patients. Though the forefoot joint is extremely important for mobility, balance and weight-transfer in normal gait, most RA patients damaged the forefoot joint from the early stage of the disease. The aim of the present study was to identify risk factors of having forefoot surgery in a cohort of RA patients followed prospectively for 9 years. To identify the risk factors provides important insights into the course of the disease, as well as the potential consequences for health care resource utilization planning.

Methods: Possible risk factors related to forefoot surgery were assessed over a 9-year period as part of a large cohort study. In 2000, a large observational cohort of RA patients was established at the Institute of Rheumatology, Tokyo Women’s Medical University (IORRA). This clinical database of the cohort is a powerful resource to evaluate therapeutic strategies including orthopedic surgeries under real-life conditions. Clinical information of the patients is collected biannually to construct a database that consists of three domains: evaluation data generated by trained physicians, information offered by patients, and results of laboratory investigations. The datasets from the IORRA cohort that we used in this study were gender, age, disease duration, body mass index (BMI), a visual analog scale (VAS) generated by physicians, a patient-reported VAS for pain, disease activity score 28 (DAS28), disability level using the Japanese version of the Health Assessment Questionnaire (jHAQ), rheumatoid factor (RF) positivity, C-relative protein (CRP) level and past history of surgery. Many cases had operations by resection arthroplasty, osteotomy and/or arthrodesis. These patients were followed until the forefoot surgery occurred, for up to 9 years, ending October 2009. Risk factors were determined by analysis of the data using the Cox proportional hazards model.

Results: Of the 9,150 patients registered at baseline, 187 (2.04%) had surgery on one or both forefoot joints. Table 1 shows the results of the multivariate Cox regression. The variables with positive coefficients were gender, long RA duration, jHAQ, RF positive and past history of surgery; higher BMI was associated with a reduced risk of forefoot surgery. The hazard ratios were: 4.73 for gender, 1.03 for RA duration, 0.94 for BMI, 1.75 for jHAQ, 1.65 for RF, and 3.69 for past history of surgery.

Conclusion: In summary, we found that 187 (2.04%) of the 9150 patients registered in October 2000 forefoot surgery within 9 years. The factors that were consistent predictors for forefoot surgery were gender, long RA duration, jHAQ, RF positive, lower BMI and past history of surgery. Further work is required to determine the clinical utility of these prognostic markers.
**Poster # 36**

**Title:** Autogenous and Allogenic Stem Cell Usage in Foot and Ankle Fusions  
**Author(s):**  
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Christopher F. Hyer, DPM, FACFAS - ofacresearch@orthofootankle.com  

**Abstract:**  
The use of orthobiologics is on the rise as surgeons deal with more complex procedures and more patients with multiple co-morbidities and risk factors for nonunion. No longer are surgeons limited to harvesting iliac crest to obtain osteoconductive, osteoinductive, and osteogenic materials for grafting purposes. Synthetic players have evolved that have unlimited volume, no associated harvest site morbidity, and may even eclipse the healing capabilities of autogenous grafts. Mesenchymal stem cells (MSC), available both via bone marrow aspirate (BMA) harvest and via commercially available allografts, provide the current state-of-the-art stem cell usage in foot and ankle surgery.

A brief description of augment options including autogenous and allogenic mesenchymal stem cells is provided along with the surgeon's protocol for use.

There are published clinical studies regarding BMA and bone healing, but no level 1 studies of BMA and/or MSC products to augment bone fusion currently exist. The benefits are based on educated theory combined with limited clinical usage and lower levels of evidence studies. The utilization of these products does not guarantee fusion. MSC’s do not replace proper surgical technique but offer potential enhancement of the technique success.

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**Poster # 37**

**Title:** Rationale and Use of the "Medial Double Fusion:“ A Surgical Technique Description and Case Series  
**Author(s):**  
Bradly W. Bussewitz, DPM, AACFAS - ofacresearch@orthofootankle.com  
Christopher F. Hyer, DPM, FACFAS - ofacresearch@orthofootankle.com  

**Abstract:**  
The triple arthrodesis has been the workhorse for many years in treating hindfoot deformities and arthrosis since its original description in 1923. The severe hindfoot valgus collapse, typically secondary to posterior tibial tendon dysfunction, requires a powerful correction to realign the foot and withstand the tendency to recur over time. The triple has been traditionally performed through an extensile lateral approach in combination with a medial incision. Postoperative lateral wound issues have been reported, particularly in cases with comorbid conditions and long standing deformity. Correction of a hindfoot valgus deformity to neutral position places the lateral incision under tension making closure difficult. Another concern with the triple arthrodesis focuses at the calcaneal cuboid (CC) joint, which is rarely involved in symptomatic arthrosis. There is inevitable shortening that occurs at the CC joint during fusion. Joint preparation and subsequent compression with fixation causes shortening of the lateral column. This counters the correction needed. We present our technique and case series of early results utilizing the medial double arthrodesis correction for severe or rigid PTTD. The medial double arthrodesis consists of a Subtalar (STJ) joint and Talonavicular (TN) joint fusion via a single medial approach.

A detailed surgical description is provided along with surgical pearls and recommendations. Additionally, a case series of eight patients is presented to demonstrate the utility and success of this technique.

Wounds under tension are vulnerable to dehiscence and infection. The classic lateral extensile incision of the triple arthrodesis in the severe valgus malalignment correction, has shown wound complications in 33% of cases. The medial approach seems to alleviate this concern. The medial double allows one less joint preparation saving both time and the possibility of further complications such as CC nonunion and postoperative sural neuritis, in addition to lateral wound complications.
**Poster # 38**

**Title:** Retrograde Intramedullary Nail with Femoral Head Allograft for Large Deficit Tibiotalocalcaneal Arthrodesis- RAIN Database

**Author(s):**
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**Abstract:**

**Introduction:** The use of femoral head allograft in tibiotalocalcaneal (TTC) arthrodesis allows for surgical correction of large bony deficits while reducing donor site morbidity of bulk autograft. The purpose of this study was to use the Retrograde Arthrodesis Intramedullary Nail (RAIN) Database to retrospectively review patients with TTC arthrodesis utilizing femoral head allograft as a treatment for the morbidity of the pathologic hindfoot associated with substantial loss of bone.

**Methods:** All patients with femoral head allograft utilization were reviewed from the RAIN Database, which is a comprehensive chart and radiographic review constructed of all patients who have undergone extended hindfoot and ankle arthrodesis with the use of a retrograde arthrodesis nail at a single institution.

**Results:** Eleven patients met inclusion criteria and were evaluated. Demographic, surgical, outcome, and radiographic data was examined. Three patients went on to solid radiographic union of the ankle, and six radiographic unions of the STJ. Eight limbs were clinically stable. Based on our criteria for success or failure, eight patients were successful, while the three transtibial amputations were considered failures.

**Conclusion:** The treatment of combined hindfoot and ankle pathology is difficult to treat. Large bony deficits dramatically increase the complexity. The authors have reported on the results of intramedullary nail arthrodesis of the hindfoot and ankle with the use of femoral head allograft. The authors feel this is a useful technique as the success rate was reasonable for this difficult population, and the results can be useful to any foot and ankle surgeon faced with this difficult clinical presentation.

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**Poster # 39**

**Title:** The Evans Osteotomy and Risk to Subtalar Joint Articular Facets and Sustentaculum Tali: A Cadaver Study

**Author(s):**
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**Abstract:**

**Introduction:** The Evans lateral column lengthening procedure allows correction of abduction, improved talar head coverage, decreased forefoot and rearfoot valgus, and improvement of medial column arch height. Identifying structures at risk when performing this osteotomy proves difficult in vivo. Utilizing ten cadaveric lower limbs, our goal was to determine the violation of the talocalcaneal facets and ST via the Evans osteotomy.

**Methods:** Ten fresh frozen cadaver limbs were utilized. A standard longitudinal incision was made along the floor of the sinus tarsi. The extensor digitorum muscle belly was reflected from its origin on the calcaneus and the peroneal tendons were mobilized plantarly. A self retaining retractor was placed. The CC joint was identified at its dorsal to plantar midpoint. The osteotomy was planned 1.3 cm proximal from the CC joint and a line perpendicular with the ground was drawn with a marker. A sagittal saw was then used to perform the osteotomy from lateral to medial as a through and through cut. The calcaneus was then disarticulated from the talus and the majority of its dorsal soft tissue was freed, allowing visualization of the superior calcaneus. The number of calcanei with separate facets versus those with conjoined or contiguous facets was recorded. The number of calcanei with at least a portion of the sustentaculum violated was recorded. Any anterior, middle, or posterior facet violation was recorded.
Results: Four of 10 calcanei displayed no facet or ST violations after the osteotomy. Two specimens showed a conjoined anterior and middle facet. In these two, the mid-section of the continuous joint was violated by the osteotomy. Four specimens had at least a portion of the sustentaculum violated with the osteotomy. Two of these four cuts traversed posterior to the middle facet and exited on the arm of the ST, and two violated the middle facet in addition to the ST.

Conclusion: The Evans procedure is useful and effective in correcting pes plano valgus. Avoiding the anterior and middle facets is possible approximately 44% of the time. Intraop identification of the facets utilizing a freer elevator is recommended. We also recommend performing the osteotomy at an angle from posterior lateral to anterior medial to avoid penetrating the ST, even if no distinction of the anterior and middle facets is found. Further long term clinical studies would be useful to assess whether inadvertent violation of subtalar joint facets or the ST with the Evans osteotomy holds any clinical significance.

Poster # 40
Title: Anatomical Aspects of Tibiotalocalcaneal Nail Arthrodesis
Author(s):
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Abstract:
Introduction: Over the last fifteen years, tibiotalocalcaneal (TTC) nail arthrodesis has become an established procedure for the treatment of specific disorders of the hindfoot and ankle. One of the challenges with this procedure is aligning the tibial canal with the central talus and calcaneus for placement of the intramedullary nail. We performed a cadaver study in order to evaluate the radiographic and anatomic position of the tibial canal and the central talus as it relates to placement of a retrograde TTC nail.

Methods: Ten fresh frozen cadaver specimens that had been amputated below the knee were used. A guide wire from a TTC nail was inserted in an antegrade fashion from the center of the tibial canal through the talus and plantar foot with the ankle and hindfoot held in neutral. Standardized anteroposterior and lateral ankle radiographs and axial Harris heel views were obtained for comparison and measurement after wire insertion. Following the wire insertion and radiographs, the ankle joint was dissected to review the position of the wire in the tibiotalar joint and make appropriate measurements.

Results: The anteroposterior and mediolateral diameters of both the talar dome (average of 36.87 mm and 33 mm respectively) and tibial plafond (average of 32.42 mm and 29.62 mm respectively) were measured on each dissected specimen for reference. When the guide wire was examined in relation to the midline of the talus, there were three wires medial to the midline and seven wires lateral to the midline. The medial wires demonstrated a mean of 2.04 mm (range 1.95-2.21 mm and SD 0.15) medial to the midline while the lateral wires were an average of 6.15 mm (range 0.99-10.51 mm and SD 3.58) lateral to the midline. When the Harris heel radiographs were reviewed, they revealed that the guidewire was medial an average of 10 mm to the calcaneal tuberosity (range 0-23 mm and SD 8.73).

Conclusion: A previous study performed a medial malleolar osteotomy with medial talar shift to improve overall alignment and bone purchase when performing a TTC fusion with a nail placed in retrograde fashion. They felt that this improved the overall alignment, bone purchase and protected important neurovascular structures. We sought to examine whether this was necessary. Our results demonstrate that when inserting a TTC guidewire in an antegrade fashion starting in the center of the tibial canal seven of our wires were in the lateral aspect of the talar dome. With medialization of the talus the guidewire could in theory miss the talus laterally in some individuals. However, medialization of the calcaneus would be necessary to insure wire placement within the bone. When a guidewire is placed in the center of the tibial canal and driven in antegrade fashion into the talus, the center of the tibial canal is typically found slightly lateral to the center of the talus. Care must be taken to medialize the talo-calcaneal complex to allow bisection of the calcaneus without passing too far lateral in the talar body.
Poster # 41
Title: Tibiototalocalcaneal Arthrodesis via an Intramedullary Nail Inserted Posteriorly with Fibular Preservation
Author(s):
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James K. DeOrio, MD

Abstract:
Introduction: Tibiototalocalcaneal arthrodesis is a procedure intended for use when both the ankle and the subtalar joint are damaged or previously fused. Thus, it is used for severe arthritis, talar avascular necrosis, post-traumatic deformity, and failed total ankle replacement. Prior studies have reported on the results of tibiotalocalcaneal arthrodeses using a variety of methods including external fixation, plates and intramedullary nails. Many of these approaches require removal of the fibula. The purpose of this study was to describe one surgeon's results via a posterior approach for intramedullary nail placement insertion with fibular preservation.

Methods: Between June 2007 and July 2010, 17 patients underwent a tibiotalocalcaneal arthrodesis using an intramedullary nail via the posterior approach by a single surgeon. The surgical approach included splitting the Achilles tendon and subsequent retraction of the FHL to provide access to the tibiotalar and subtalar joints simultaneously. In five of the patients, a femoral head allograft was used to fill in the defect which remained after removal of an avacular talus or ankle replacement. All patients were assessed clinically and radiographically with a minimum of 3.5 months follow-up.

Results: The mean age was 50 years with 9 male patients and 8 female patients. The most common etiologies were post-traumatic arthritis (5), avascular necrosis (4) and failed total ankle replacement (5). There were 10 co-morbidities in 9 patients including five with diabetes, three with inflammatory arthritis and two who were smokers. Eight patients had no significant co-morbidities. Of the seventeen patients, twelve went on to complete union and five went on to non-union or partial union. Six patients had no complications. There were 16 complications in 11 patients. Non-union was the most common complication. There were 2 delayed unions, 3 hardware removals, 1 deep infection, 2 superficial wound infections and 1 with shin discomfort, and one patient who ended up with a below knee amputation.

Conclusion: Tibiototalocalcaneal arthrodeses are challenging procedures demonstrated by the numerous techniques that have been described. This paper describes a novel approach to tibiotalocalcaneal arthrodeses that has not previously been described. In this study there was a relatively high complication rate. However, the patients included in this study often had significant co-morbidities that may have influenced the results including diabetes and femoral head insertion to maintain leg length. This posterior approach is advantageous in that it provides simultaneous access to both the tibiotalar as well as subtalar joints. Second, this approach allows dissection between angiosomes in order to maintain blood supply to the skin. Furthermore, it spares the fibula allowing increased stability as well as the option of converting the tibiotalar fusion to an ankle replacement in the future. Initial results suggest that this is a viable alternative in difficult cases.

Poster # 42
Title: Retrograde TTC Fusion Nail: Utility review and case examples of deformity correction
Author(s):
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Abstract:
Tibio-talo-calcaneal (TTC) arthrodesis is a useful procedure in complex hindfoot and ankle reconstructions. It is often needed to correct angular deformities of the ankle and hindfoot complex, for fusion of painful, arthritic ankle and subtalar (ST) joints, salvage of avascular necrosis (AVN) of the talus and is increasingly used in Charcot limb salvage situations and revision of failed Total Ankle Replacement (TAR). TTC fusion can be accomplished through different internal fixation constructs including large diameter screws, plating options (locking, non-locking, blade) and retrograde TTC nailing.
Retrograde nailing for TTC fusions has been performed for the past 20 years, but recent technologic and design improvements have broadened its use. Advantages of retrograde nailing over other techniques include ability for multiple plane fixation points, less tissue dissection and exposure and beaming of deformity into a stable tibial segment. Disadvantages can include increased surgeon learning curve if inexperienced with the technique and potential peri-prosthetic fracture, usually related to technique flaws.

The current review discusses technical pearls to assist the surgeon with the retrograde nailing technique, reviews specific nail design recommendations the surgeon should be thoughtful of depending on reconstructive needs and patient factors, and highlights the utility of this procedure for various ankle and hindfoot maladies.

Retrograde TTC nailing is a useful surgical technique in various complex ankle and hindfoot deformities. Several key design features are considered optimal for maximum technique reproducibility, provide stability of the construct and reduce complications.

**Poster # 43**
**Title:** Dubious Uses of the Arthroereisis Screw  
**Author(s):**  
Arthur Manoli, II, MD  
Gregory Pomeroy, MD

**Abstract:**  
**Introduction:** The arthroereisis screw is gaining popularity because it is thought to be a quick and easy way to treat pes planus due to heredity and posterior tibial tendon insufficiency. Some have called it “the internal orthotic.” It has been suggested that it can be used in patients from age 3 years to 100 years.

**Methods:** We reviewed the records of five patients that had been previously treated where an arthroereisis screw had been used improperly.

**Results:** In one case the screw was placed in a teenager with a missed middle facet subtalar tarsal coaliton, resulting in severe talonavicular and subtalar arthritis, necessitating a triple arthrodesis. In two patients it was used in preexisting cavus deformites, making them worse. One patient had the screw placed too deeply, destroying the subtalar joint. One patient had the screw placed in too extreme of a flatfoot deformity, necessitating its removal and a standard foot reconstruction.

**Conclusion:** We have identified a series of patients where the foot type was identified incorrectly for its proper use. Also, technical errors can lead to progressive adjacent joint arthritis. The use of the device in very young children is especially troublesome.

**Poster # 44**
**Title:** Arthrorhisis with Calcaneostop Screw in Children Corrects Talo-1st Metatarsal-Index (TMT-Index)  
**Author(s):**  
Martinus Richter, MD, PhD  
Stefan Zech, MD  
Jens Stueber, MD  
Abdelrahman Qazzaz, MD

**Abstract:**  
**Introduction:** Arthrorhisis with calcaneostop screw is one option for the treatment of flatfoot (Pes abductoplanovalgus) in children. The aim of the study was to analyze the amount of correction (for example talo-1st metatarsal-index (TMT-Index)) and clinical outcome including pedographic assessment.

**Methods:** In a prospective consecutive non-controlled clinical follow-up study, all patients that were treated with arthrorhisis with calcaneostop screw from September 1st 2006 to August 31st, 2009 were included. All
feet sustained an arthrorhisis with calcaneostop screw. If the ankle motion was less than 20 degree dorsiflexion after implantation of the screw, a gastrocnemius slide or Achilles tendon lengthening was performed during the same procedure. One foot was operated at a time, and the contralateral foot was operated 3 months later. Postoperatively, 15kg partial weight-bearing was performed in a standard shoe for 6 weeks. After 6 weeks, full weight-bearing without restrictions was achieved. The screws were planned for removal at 2 years after implantation. Assessment was performed before surgery, after each surgery when full weight-bearing was achieved, and at one year follow-up. The assessment included clinical assessment (including staging of posterior tibialis insufficiency) radiographs with full weight bearing (TMT dorsoplantar/lateral views, TMT Index), pedography (midfoot contact area and course of gravity center in relation to available physiological pedographic data), and scoring (Visual-Analogue-Scale Foot and Ankle (VAS FA)).

Results: 18 patients / 31 feet were included in the study (age, 11.1 (10-14), 45% male). Gastrocnemius slide was performed in 25 (81%) cases and Achilles tendon lengthening in one foot (3%). No complications were observed and all feet achieved full weight bearing during the 7th postoperative week Table 1 shows the relevant parameters. In comparison with the preoperative parameters, the parameters posterior tibialis insufficiency stage, midfoot contact area and percentage of lateralized course of center of gravity were decreased at assessment at early full weight-bearing and at one year follow-up, and TMT dorsoplantar/lateral/Index and VAS FA scores were increased (each p<.05)

Conclusion: All relevant parameters (stage of posterior tibialis insufficiency, TMT Index, pedographic midfoot contact area and course of gravity center, VAS FA) improved after arthrorhisis with calcaneostop screw in Pes abductoplanovalgus in children. Since the complication rate is very low, this method allows safe and predictable correction.

Poster # 45
Title: Talar neck osteotomy to lengthen the medial column after malunited talar neck fractures
Author(s):
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Markus Knupp, MD
Beat Hintermann, MD

Abstract:
Introduction: Malunited talar neck fractures can result in shortening of medial column, which, in turn, causes an adduction and supination position of forefoot. The patients complain typically painful overload of lateral foot and are significantly disabled in daily activities. Little is known about the feasibility and efficiency of talar neck osteotomy to address this deformity. The purpose was to establish whether correcting osteotomy of talar neck is efficient in correct the forefoot supination and adduction deformity and to normalize the foot posture.

Methods: Between 2002 and 2009, we treated seven patients (females, 2; males, 5; age 41.6 [17-60] years) by correcting osteotomy of talar neck for a malunited talar fracture. All but two patients had prior surgical treatment of talar neck fracture. A dorsomedial approach was used to expose and to do the osteotomy of the talar neck. The osteotomy was opened with the use of a distractor mounted over two K-wires until the forefoot got a normal position. An allograft (five patients) or autograft from iliac crest (two patients) was used for interposition. One or two fully threaded screws or a small plate was used for fixation. Patients were seen on a regular basis, with a mean follow-up of 2.7 (1-8) years.

Results: There were no perioperative complications. All but one talus healed within 2 to 3 months. The patient with non-union was successfully revised with a subtalar and talonavicular fusion. Radiographically, there was no evidence of avascular necrosis of talar head in no one case. All patients were satisfied with the result. The mean AOFAS Ankle Hindfoot Score was 80.7 (56-100) and for the subscale pain 31.4 (20-40). All patients were able to wear commercial shoes. Good or excellent results were obtained in all 7 patients indicating that reconstructive osteotomy of talar neck was effective in all, and there was no evidence that beneficial effects reduced over time.
**Conclusion:** We found that correcting osteotomies to lengthen the malunited talar neck fractures are effective in correcting the disabling and painful adduction and supination deformity of the forefoot. We did not encounter any complication, in particular not an avascular necrosis of talar head. We thus continue to use this approach to lengthen the medial column in the case of malunited talar neck fractures.
Imaging:

Poster # 46
Title: Clinical versus MRI Diagnosis for Acute Achilles Tendon Rupture: Stochastic Simulation of Economic Implications
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Abstract:
Introduction: Acute rupture of the Achilles tendon is a relatively common traumatic condition with an increasing incidence. Diagnosis of acute Achilles tendon rupture may be effectively accomplished clinically or with magnetic resonance imaging (MRI) – each of these diagnostic modalities is associated with differing costs, however controversy remains as to which approach is most efficient. This study characterizes the economic implications of clinical and MRI diagnosis of Achilles tendon rupture at the population level.

Methods: After IRB approval, consecutive cases of Achilles tendon repair at a single institution between August 2000 and March 2010 were identified. Only patients with acute rupture who had both clinical and MRI evaluation were included. Patient records were retrospectively reviewed for intra-operative confirmation of rupture, clinical exam findings at initial evaluation (abnormal Thompson test, decreased/absent resting tension compared to uninjured side, and palpable defect), and demographic data. A unique stochastic decision tree model was developed based on testing parameters derived from our data, and age and sex specific incidence estimates from the literature. MRI reimbursement rates for ankle MRIs were obtained from the CMS Physician Fee Schedule, and estimates for private insurance reimbursements were back projected from these values. A modified Monte Carlo simulation was conducted with each diagnostic approach using identical theoretical populations of 100,000 patients over the age of 5 modeled from the 2008 US Census Estimates. The simulation was iterated 10 times to achieve stable estimates, and the results analyzed.

Results: 66 patients were identified as having complete Achilles rupture intra-operatively – each of these patients demonstrated an abnormal Thompson test, decreased or absent comparative resting tension on the injured side, and a palpable defect. Using intra-operative confirmation of Achilles rupture as the gold standard, clinical diagnosis demonstrated 100% sensitivity for rupture; MRI diagnosis rates were assumed to be similarly accurate in this study. Our simulation model demonstrated 31,628 (95%CI 26,909 to 36,346) Achilles ruptures in the US annually, or an aggregate incidence of 10.4/100,000. MRI diagnosis of these cases was associated with excess costs of $10,678.80 (95%CI $9,207.24 to $12,150.36) per 100,000, which represents an annual incremental cost excess in the US of $32,475,603.35 (95%CI $28,000,397.35 to $36,950,809.34) relative to clinical diagnosis.

Conclusion: In the context of clinical diagnosis as an effective and efficient means of identifying Achilles tendon rupture, use of MRI for diagnosis is redundant and accrues a significant unnecessary cost. Use of clinical indicators without MRI for diagnosis of Achilles tendon rupture would result in over $32 million of economic savings annually in the US.
**Poster # 47**  
**Title:** Ganglion-like Lesions of the Foot on the Ultrasonography  
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**Abstract:**  
**Introduction:** The authors have experienced various lesions that simulate ganglion of the foot on the ultrasonography. The purpose of this study is to evaluate ultrasonographic findings of soft tissue lesions, which were interpreted as ganglion but confirmed as different lesions in the foot.

**Methods:** We reviewed a database of patients with ganglion on the ultrasonography from two different institutions. There were 109 patients who underwent both ultrasonography and surgical confirmation. Twenty one lesions were identified, of which initial interpretation on the ultrasonography included ganglion which pathology revealed to be different lesions. All images were evaluated by one musculoskeletal radiologist, regarding size, margins, internal echogenicity of lesions, and presence of posterior enhancement.

**Results:** Of 21 lesions, there were 6 fibrous tumors including fibroma, giant cell tumor of tendon sheath, and fibromatosis, 3 hemangiomas, 2 epidermal inclusion cysts, 2 chondromas, 2 angioleiomyomas, 1 trichilemal cyst, 1 neurofibroma, 1 granular cell tumor, 1 neurilemmoma, 1 neuromyxoma, and 1 nodular hidradenoma. Mean size of the lesion was 1.1 cm. Margins were smooth in 10, mild lobulation in 8 and marked lobulation in 3 lesions. Lesions were hypoechoic in 16, anechoic in 4 and isoechoic in 1 case. Posterior acoustic enhancement was definitely present in 5 lesions.

**Conclusion:** On the ultrasonography, various soft tissue lesions of the foot may be confused with ganglion. During surgical resection care should be given even to a simple ganglion as it might turn up to be a solid lesions such as fibrous tumors.

**Poster # 48**  
**Title:** Normalization of MRI signal from plantar fasciitis after gastrocnemius recession  
**Author(s):**  
David Kim, MD - mbz81@yahoo.com  
Edward Pino, MD  
Mark Berkowitz, MD

**Abstract:**  
**Introduction:** In the subset of patients who have gastrocnemius contracture and plantar fasciitis, gastrocnemius lengthening has been recently advocated if prolonged non-operative measures fail. This is the first report which demonstrates normalization of the abnormal MRI signal after the procedure.

**Case Report:** Our patient is a 56 year old female who has had heel pain for over 3 years. She had tenderness at the origin of plantar fascia, and tight gastrocnemius as demonstrated on Silfverskiold test. She had exhausted all non-operative treatments over three years. She had pain even at rest. MRI (ordered to rule out stress fracture) demonstrated pathologic changes at the origin of the plantar fascia. Her immediate post operative course was unremarkable after Vulpius type Gastrocnemius lengthening procedure. She reported almost immediate relief of pain, and at 6 months follow up, she reported no limitations. Approximately 1 year after the surgical procedure, she returned complaining of pain along the dorsolateral aspect of the same foot. The physical exam was equivocal for a mass near the lateral talo-navicular joint. She had no pain along the heel and had maintained the dorsiflexion of the ankle. Mild calf asymmetry was noted which the patient was unaware of. MRI demonstrated a small cyst arising from the talonavicular joint. This imaging study also showed her plantar fascia well, and it demonstrated resolution of all abnormal signal of the plantar fascia previously noted before the surgical procedure.
Conclusion: This is the first clinical case in which abnormal plantar fasciitis MRI signal resolved after gastrocnemius recession procedure to normal MRI appearance. This objective data is in line with the conclusions of Patel and Di Giovanni who have reported on its association, and supports those authors who have advocated application of this procedure to patients with gastrocnemius equinus and chronic plantar fasciitis.

References:
2. Maskill JD; Bohay DR; Anderson JG; Gastrocnemius Recession to treat isolated foot pain. Foot Ankle Int.31:19-23,2010
3. Patel A; DiGiovanni B; Association between plantar fasciitis and isolated contracture of the gastrocnemius. Foot Ankle Int 32:5-8,2011

Poster # 49
Title: Reliability and validity of radiographic measurements in hindfoot varus and valgus
Author(s):
Daegyu Kwon, MD
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Abstract:
Introduction: Even though radiographic evaluation is frequently utilized in measuring hindfoot deformities, there are no gold standard methods. This study was performed to determine the validity and reliability of the radiographic measurements evaluating hindfoot valgus and varus deformities.

Methods: Seventy two patients with hindfoot deformity (36 hindfoot valgus, mean age 15.5 years; 36 hindfoot varus, mean age 30.2 years) were evaluated. Nine representative indices in weight bearing radiographs were used in this study. Three examiners measured radiographic indices at two sessions, and intra- and interobserver reliability was assessed. Discriminant validity of the radiographic measurements between hindfoot valgus and varus were evaluated by Cohen’s d and effect-size r. The correlation with the pedobarographic findings in evaluating the distribution of foot pressure during gait were assessed for convergent validity.

Results: Naviculocuboid overlap, anteroposterior talonavicular coverage angle, anteroposterior talo-first metatarsal angle, calcaneal pitch angle, and lateral talo-first metatarsal angle showed excellent reliability over the ICC values of 0.8. Naviculocuboid overlap, anteroposterior talonavicular coverage angle, and anteroposterior talo-first metatarsal angle showed excellent discriminant validity and convergent validity in terms of effect-size r and correlation coefficients with pedobarographs respectively (Table I).

Conclusion: Naviculocuboid overlap, anteroposterior talonavicular coverage angle, and anteroposterior talo-first metatarsal angle were found to be the reliable and valid measures in evaluating hindfoot valgus and varus deformities in terms of reliability, discriminant validity, and convergent validity.
Poster # 50
Title: Non-invasive quantification of posterior tibial tendon elasticity using ultrasound elastography
Author(s):
L. Daniel Latt, MD, PhD
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Gregory Heden, BS
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John Szivek, PhD
Matthew Houdek, BS
Russell Witte, PhD

Abstract:
Introduction: Posterior tibial tendon (PTT) dysfunction is characterized by a progression from tendonitis to an irreversible change in the mechanical properties of the tendon. Treatment decision-making depends on determining the state of the tendon. This assessment is usually made clinically using the single leg heel rise test. There are many factors (pain, weakness, motivation) that potentially confound a patient’s performance of a single leg heel rise test and thus may lead to inaccurate results. Ultrasound elastography (UE) has been used to measure the mechanical properties of many soft tissues. It is an optimal tool for non-invasively quantifying the mechanical properties of the PTT. UE could be used clinically to objectify the treatment decision-making process. The goal of this project was to develop the technique of UE for the PTT and compare the measurements of tendon stiffness obtained from UE to those obtained directly through mechanical measurement.

Methods: The proximal portion of the PTT was dissected free of the muscle and whipstitched with high strength suture in four healthy cadaveric feet. Each foot was mounted in a materials testing machine and the PTT was attached via the suture to the actuator. The tendon was loaded isometrically to 60kg while inversion force measurements were obtained from a load cell that abutted the medial aspect of the first metatarsal head. Ultrasound images of the tendon were collected from behind the medial malleolus using a clinical ultrasound sensor. The displacement within the tendon at a number of locations was obtained by analyzing the ultrasound images with a custom-designed 2D phase-sensitive cross-correlation speckle-tracking algorithm. Load-displacement and stress-strain plots were made for each trial and modulus of elasticity as a function of applied load was calculated from both the ultrasound and the mechanical measurements.

Results: Load displacement curves showed greater displacement for a given load with the mechanical measurements than the ultrasound measurements. The modulus of elasticity was found to be relatively constant across specimens and over the range of loads tested. The average modulus of elasticity was found to be 0.2391 +/- 0.0464 GPa for the mechanical measurements and 0.6200 +/- 0.1470 GPa for the ultrasound measurements. This difference was not unexpected as the mechanical measurements involve the transmission of force through a number of structures other than the posterior tibial tendon.

Conclusion: Ultrasound elastography can be used to determine the modulus of elasticity of the PTT. The values obtained from UE in the current study are similar to what has been found in other studies for the human tibialis anterior tendon. Further study is needed to determine how the elasticity of the diseased PTT compares to that of healthy tendon. The clinical measurement of PTT elasticity can then be used in patients suffering with posterior tibial tendon dysfunction to aid in the treatment decision –making process.
Poster # 51
Title: The radiological morphology of peritalar instability
Author(s): Tomasz Nosewicz, MD - t.nosewicz@gmail.com
Markus Knupp, MD
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Beat Hintermann, MD

Abstract:
Introduction: Given the considerable contact area to the surrounding bones, talar position may be highly confined by the talocrural, subtalar and talonavicular (peritalar) joints. In vitro, the highly congruent talocrural joint has been found to provide as much as 100% talar frontal plane stability while the foot is loaded, implying that incompetence of one or more ankle ligaments will not affect talar position within the ankle. In daily practice, however, we often see patients with a misaligned (varus or valgus) weightbearing ankle joint. Obviously, other factors must contribute to talar stability. One hypothesis may be that loss of peritalar stability allows the talus to shift on the peritalar calcaneal and navicular bone surfaces, thus undergoing a 3-dimensional positional change. This peritalar destabilization process is not fully understood yet. To gain insight into the subsequent talar dislocation pattern, we assessed standard weightbearing X-rays of a consecutive, varus or valgus ankle osteoarthritis patient cohort. The purpose was to determine talar malpositioning with regard to the surrounding bony and articular structures, and to describe talar malposition patterns in all three planes.

Methods: After exclusion of all patients who previously underwent an arthrodesis, ligament reconstruction or tendon transfer on the affected hindfoot, 193 consecutive patients (127 male, 66 female, age 64±11 years) with 207 varus or valgus osteoarthritic ankles were included. Three standard weightbearing X-rays (frontal, sagittal and horizontal) were performed. The frontal tibiotalar surface (TTS) angle was used to measure frontal misalignment. The sagittal talocalcaneal inclination (TCI) angle and horizontal talometatarsal I (TMT I) angle were used to determine talar sagittal and horizontal position. These latter measurements were compared to neutral ranges obtained in controls (mean±2SD). These neutral ranges were: TCI 22˚-39˚, TMT I -12˚-19˚. Talar malpositioning in addition to frontal varus/valgus (i.e. sagittal plantarflexion/dorsalflexion, horizontal exorotation/endorotation) was defined when outside any neutral range.

Results: While the talus was found to be malpositioned solely in the frontal plane in 85/207 (41%) ankles (varus, 41/126 [33%], TTS 75±8˚; valgus, 44/81 [54%], TTS 101±7˚), it was malpositioned in two planes in 80/207 ankles (39%) and in three planes in 42/207 ankles (20%). Out of possible 18 positions, 11 different malposition patterns were found. The six predominant talar malposition configurations included 80% (166/207) of all cases. The talus only exorotated when dorsalflexed and in varus, or when in valgus and neutral or dorsaflexed in sagittal plane. The talus did not endorotate when in valgus and dorsaflexed or neutral in sagittal plane.

Conclusion: Although, in peritalar instability, the talus obviously was found to move and rotate into various positions, there are 6 predominant dislocation and malorientation positions. This may explain failures in obtaining correct talar position within the mortise after surgical interventions such as ligament reconstruction, re-aligning osteotomies and total ankle replacements as long as peritalar stability has not been addressed. Further studies are, however, necessary to clarify the underlying causes and to get more insight into the ongoing pathologic process.
Poster # 52
Title: The reliability and validity of talar radiographic position measurements in varus and valgus osteoarthritic ankles

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Beat Hintermann, MD

Abstract:
Introduction: Treatment of complex deformities remains a challenging issue in foot and ankle surgery, particularly in ankle osteoarthritis, where talar frontal plane misalignment is common. The significant amount of additional procedures performed during corrective surgery furthermore suggests that deformity in the varus and valgus ankle in many cases is not confined to the frontal plane. Understanding of the deformity in all three dimensions, therefore, remains one of the main problems in corrective surgery. Despite newer imaging techniques, weightbearing radiography still remains the standard for assessment of foot and ankle abnormalities. Compared to the forefoot, the role of radiography to determine talar three dimensional position in the varus or valgus osteoarthritic ankle is less well elucidated. The goal of this study, therefore, was to evaluate the most reliable and valid radiographic measurement method to determine talar three dimensional position in the varus and valgus osteoarthritic ankle.

Methods: Nine radiographic measurements were blindly performed by three investigators on anteroposterior, sagittal and horizontal weightbearing radiography of 33 varus and 33 valgus feet (63 patients; 36 male, 27 female, age 68±8 years). Intra- and interobserver reliability was determined with the intraclass correlation coefficient (ICC). Discriminant validity of measurements between varus and valgus was assessed by calculating effect size (ES). Convergent validity (Pearson’s r) was evaluated by correlating measurements to the dichotomized varus and valgus group. Obtained measurements in both groups were finally compared to eachother and to a control group (19 male, 11 female, age 44±12 years, range 17 – 67) by performing ANOVA three group testing and Bonferroni Stepdown post-hoc analysis.

Results: Reliability was excellent (ICC > 0.80) in all but two measurements (Table 1). Whereas frontal plane validity was excellent (ES and r > 0.80), horizontal and sagittal measurements showed low to moderate validity (ES and r between 0.20 and 0.60). Five measurements were significantly different between groups (p < 0.05). Whereas the varus group showed talar positional tendency towards endorotation/dorsiflexion; in the valgus group, this was towards exorotation/plantarflexion. The frontal tibiotalar surface angle, sagittal talocalcaneal inclination angle and horizontal talometatarsal I angle showed the best combination of reliability, validity and difference between groups.

Conclusion: Our results suggest that talar radiographic position in varus or valgus osteoarthritic ankles should be determined by the frontal tibiotalar surface angle, sagittal talocalcaneal inclination angle and horizontal talometatarsal I angle. These measurements may be used in quantitative evaluation of hindfoot deformities or aid in preoperative planning and postoperative evaluation. Furthermore, the considerable overlap and moderate effect size in sagittal and horizontal measurements supports previous observations that varus and valgus deformities are complex 3-dimensional deformities, occurring neither isolated in the frontal plane nor uniformly in the sagittal and horizontal plane. Careful three dimensional radiographic analysis is therefore important prior to initiating treatment.
Poster # 53
Title: Inter-rater Reliability of Radiographic Grades Used to Assess 1st Metatarsophalangeal Joint Osteoarthritis

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Abstract:
Introduction: Osteoarthritis (OA) of the 1st Metatarsophalangeal (MTP) joint is a significant clinical problem due to its high prevalence and attendant disability.(1) Severity of 1st MTP joint OA changes are frequently assessed using radiographic scales. While two foot-specific scales are available to evaluate 1st MTP joint OA, (2, 3) no objective data are available assessing inter-rater reliability, or evaluating associations between the two scales. The purpose of this study is to assess inter-rater reliability of two radiographic scales to grade 1st MTP OA, and to evaluate whether the two scales are related.

Methods: Following IRB approval, radiographs from 30 feet with 1st MTP joint OA (26 patients, 56% female) were obtained from the orthopaedic foot and ankle service at NYU Hospital for Joint Diseases. Antero-posterior and lateral views were available on all feet; oblique views were available on 78% feet. Radiographs were de-identified, and graded by five raters, including three fellowship-trained orthopaedic surgeons, one fellowship-trained radiologist, and one orthopaedic resident. Each rater was provided with standard grading criteria for both scales. (2, 3) The Coughlin scale refers to radiographic criteria developed by Coughlin and Shurnas (2003). The Menz scale assesses the presence of osteophytes and joint space narrowing on two separate subscales that are subsequently averaged to obtain a mean score. Inter-rater reliability was assessed using quadratically weighed kappa for ordinal data, and intraclass correlation coefficient (Model (2,1)) for continuous data. Relationships between scales were assessed using Spearman’s rho.

Results: Quadratically weighted kappa for the Coughlin scale ranged from 0.43-0.67 (Table 1). ICC(2,1) for the Menz scale ranged from 0.63-0.85 (Table 1). Radiographic grades expressed using the Coughlin scale were strongly related to those obtained using the Menz Scale (Table 1).

Conclusion: The key findings of this study indicate that radiographic scales used to evaluate 1st MTP joint OA have moderate reliability, consistent with previous studies assessing the Menz scale,(3) and Kellegren Lawrence grades.(1) More detailed analysis revealed good agreement (ICC(2,1)>0.80) between the three orthopedic surgeons and resident. Between 65-80% of the variance in the Menz scale could be explained by the Coughlin scale, suggesting substantial overlap in aspects of the disease process captured by the two scales. Future studies are indicated to evaluate disease progression and response to intervention using these scales. 1. Trivedi B, et al.. Osteoarthritis Cartilage. Aug 2010;18(8):1027-1035. 2. Coughlin MJ, Shurnas PS. JBJS Am. Nov 2003;85-A(11):2072-2088. 3. Menz HB, et al. Osteoarthritis Cartilage. Nov
Abstract:
Introduction: Increased availability of MRI has led to widespread use in the evaluation of foot and ankle pathology. However, MRI overutilization has contributed to the rising costs of health care, secondary to increases in operational costs and unnecessary scans. We hypothesized that the pre-scan diagnostic accuracy of primary care physicians (PCPs), prompting the supposed need for MRI, is significantly less than that of orthopaedic foot and ankle specialists and that MRI scans are overutilized by PCPs in the evaluation of foot and ankle pathology.

Methods: A retrospective chart review was performed under IRB approval for 5093 consecutive new patients who presented to one of three orthopaedic fellowship-trained foot and ankle specialists between 2006 and 2008. Only those patients who presented with or subsequently underwent MRI scans of the foot and/or ankle were included in the study; patients lost to follow-up after MRI or with incomplete records were excluded. 251 patients referred from their PCP following MRI and 199 patients referred for MRI after initial orthopaedic evaluation met inclusion criteria. Each pre-scan diagnosis, radiographic interpretation, and post-scan orthopaedist diagnosis were recorded. The rate of overutilization was calculated as described by Bradley et al.

Results: The pre-scan diagnosis provided by the PCP agreed with the orthopaedic post-scan diagnosis in 42% of patients, whereas the orthopaedist pre-scan diagnosis was accurate in 78% (p<0.0001). The odds of the specialist’s post-scan diagnosis agreeing with their pre-scan diagnosis were 396% higher, with an odds ratio (OR) of 4.96 (95% CI: 3.26-7.56). The PCP pre-scan diagnosis agreed with the MRI interpretation in 49% of patients, while the orthopaedist’s pre-scan diagnosis correlated with the MRI findings in 63% (p=0.0036). The odds of an MRI interpretation agreeing with the pre-MRI diagnosis were 76% higher when ordered by an orthopaedist (OR 1.76, 95% CI: 1.20-2.57). Lastly, the post-MRI orthopaedist diagnosis agreed with the MRI findings in 73% of cases when ordered by the specialist as opposed to 68% of the time when ordered by the PCP (p=0.24). PCPs demonstrated an overutilization rate of 48%, in contrast to a 12% overutilization rate by orthopaedic foot and ankle specialists.

Conclusion: In conclusion, we demonstrated a significant difference in the pre-scan diagnostic accuracy of PCPs, relative to both MRI findings and the post-scan diagnosis, compared to the foot and ankle orthopaedist’s diagnostic accuracy. In addition, the high rate of overutilization of MRI scans by PCPs is of great concern. Over 25% of patients received final diagnoses different than their MRI findings, demonstrating that correlation of imaging is critical to avoid inappropriate treatment of irrelevant findings. The cost of an orthopaedic referral is less than an MRI scan and will yield superior diagnostic information to an MRI ordered by a PCP. To help limit the rising costs of health care, we recommend limited use of MRI by PCPs in assessing foot and ankle pathology and encourage careful history and physical examination, cost efficient imaging techniques, and orthopaedist referral for complex or unclear diagnoses.
Title: Prediction of Plantar Plate Injury by Magnetic Resonance Imaging with Correlation to Intra-Operative Findings

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Richard Rolfes, MD

Abstract:
Introduction: To our knowledge, there are no data from the literature regarding magnetic resonance imaging (MRI) correlation of intra-operative findings for plantar plate injury. This preliminary study examines the predictive indicator of MRI results versus intra-operative findings in patients with plantar plate injury.

Methods: We prospectively examined MRI findings for all consecutive adult patients that were suspected of plantar plate pathology at the second metatarsophalangeal joint (MTP). After clinical findings that were suggestive of plantar plate injury with equivocal findings on plain radiographs, patients underwent MRI of the foot. One fellowship-trained musculoskeletal radiologist, blinded to the clinical data, evaluated the magnetic resonance images with regard to the integrity of the plantar plate ligament. Power analysis determined the need for 45 subjects (alpha level = 0.05, Observed R2 = 0.15, Observed Power = 0.80) to reject the null hypothesis. If the patient elected to have surgery, one foot and ankle fellow examined all intra-operative findings. The predictor that was included in the model was the integrity of the plantar plate. Sensitivity, specificity, positive predictive, and negative predictive values were calculated using this model.

Results: From September 2010 until May 2011, forty-five patients (45 feet) underwent MRI scan for suspected plantar plate pathology. All patients then elected to have surgery to the case foot. There were 39 cases that the MRI was read as plantar plate "ruptured" and all 39 cases correlated positively with intra-operative findings. There were six cases that the MRI was read as plantar plate "not-ruptured". Two of those cases negatively correlated with intra-operative findings with visual ruptures. Four cases was positively confirmed intact with visual inspection. Sensitivity was calculated as 95.1% and specificity was 100%. Positive predictive value of MRI was 100%, but negative predictive value was 66.7%.

Conclusion: What is demonstrated is that the predictive quality of MRI may be highly sensitive and specific for detection of tears to the plantar plate. MRI appears to be a good predictive "ruling-in" test for a tear; however, MRI may not be as predictive for "ruling-out" a tear.
**Midfoot:**

**Poster # 56**  
**Title:** Anatomic Predisposition to Primarily Ligamentous Lisfranc Injuries  
**Author(s):**  
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**Abstract:**  
**Introduction:** Subtle Lisfranc fractures (purely ligamentous or with an avulsed bony component) occur following low-energy trauma to the midfoot. These injuries can be debilitating. Being ligamentous they may not heal requiring arthrodesis in some. Classically, when loaded in a plantar flexed position, an axial load is applied leading to subluxation of the Lisfranc joint complex. Mortise anatomical characteristics on radiographs have been previously shown to predispose to the ligamentous subtype. It is not known if there are other morphometric characteristics such as arch height or relative length of second metatarsal that can similarly influence these injuries.  

**Methods:** A retrospective case control study was done in 27 consecutive subtle Lisfranc-injured patients at two institutions treated from 2006 to 2010 following IRB approval. Clinical and radiographic data were examined regarding foot anatomy, specifically second metatarsal length relative to the foot length, first intermetatarsal angle, navicular-cuboid overlap to cuboid vertical height, first metatarsal-talus angle, and calcaneal pitch to determine if significant differences were present between control subjects (n=26) and those with subtle Lisfranc injuries (n=27). A logistic regression analysis was then performed to evaluate potential risk for fracture based on the above anatomical variables.  

**Results:** Subtle Lisfranc injury patients were found to have a significant difference in second metatarsal to foot length ratio (p<0.001) (shorter) compared with control patients on anteroposterior weight-bearing radiographs. Additionally, two radiographic morphometric parameters for the foot shapes ‘cavus’ versus ‘flat foot’ (calcaneal pitch and cuboid-navicular overlap to cuboid vertical height) showed significance (p=0.02 and p=0.002 respectively) as a risk factor for low energy Lisfranc injuries. No significance was found with 1st intermetatarsal angle between control subjects and the Lisfranc group.  

**Conclusion:** A correlation was noted between patients with lower calcaneal pitch, decreased navicular-cuboid overlap ratio, a shorter second metatarsal and with subtle Lisfranc injuries. Better understanding of the pathomechanics of Lisfranc injuries is important to help explore and develop strategies to prevent these injuries that can be debilitating and have potential to end an athletic career.  

Level of Evidence. Level III. This is a case-controlled study  

**Poster # 57**  
**Title:** The Slot Graft Technique for Foot and Ankle Arthrodesis in a High Risk Patient Group  
**Author(s):**  
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**Abstract:**  
**Introduction:** High rates of arthrodesis nonunion have been described in the ankle, hindfoot and midfoot in patients with significant risk factors. The purpose of this study was to evaluate fusion rates, risk of reoperation, post operative pain scores and patient satisfaction for a slot graft inlay arthrodesis technique used in a high risk group of foot and ankle patients.
Methods: We retrospectively reviewed all ankle, hindfoot and midfoot arthrodeses by two foot and ankle surgeons in our institution between January 2000 and January 2009. Seventeen arthrodesis procedures in 16 patients using the slot graft technique were identified. Patient charts were reviewed for medical history, risk factors, previous surgery and postoperative complications. Time to union was evaluated on radiographs. Patients provided final follow up by phone with an assessment of pain, overall satisfaction and use of orthotic or assist devices.

Results: Union occurred in 13 arthrodesis procedures (77%) with an average time to union of five months. Postoperative infection occurred in one patient. Additional surgery was performed in nine patients. At final follow up patients reported low pain scores (3/10) and high satisfaction (8/10). Fourteen of fifteen patients contacted indicated that they would choose to undergo the procedure again.

Conclusion: The slot graft arthrodesis technique provided satisfactory results in this small group of patients with a low complication rate. Patient satisfaction rates were high with low pain scores at an average of 62 months postoperatively.

Poster # 58
Title: Diagnosis of Lisfranc Fracture-Dislocations: How Are We Doing?
Author(s):
D Joshua Mayich, MD
Mark Harrison, MD, FRCSC
Ron Holden, PhD
Heather Grant, MSc

Abstract:
Introduction: Lisfranc fracture dislocations (LFDs) are relatively rare but devastating injuries. Although there has been very good study around the effectiveness of imaging modalities for diagnosing LFDs little is currently known of the reliability, accuracy and reproducibility associated with diagnosis of this relatively common injury amongst primary care physicians, and orthopaedic surgery staff alike. The purpose of this pilot study was to validate a survey that could assess the diagnostic accuracy of physicians assessing clinical history and plain film case presentations containing LFDs.

Methods: An electronic-based case-based qualitative survey was developed and then validated for use in assessing the management of case presentations with LFI. PCPs working in South Eastern Ontario were contacted by mail and email and asked to complete the survey. Demographic data on PCPs currently actively practicing in Ontario was obtained. Reliability analysis, as well as test, re-tests analyses were performed.

Results: 130 of the 855 (15%) contacted PCPs replied. Based on the obtained demographic data, a representative sample was obtained. 66% of PCPs noted the presence of fractures in the radiographs of clearly fractured LFDs provided. A miss-diagnosis of “soft tissue sprain” was made 34% of the time. 56% of PCPs were able to appreciate the unstable nature of the LFDs presented.

Conclusion: A directed educational intervention aimed at teaching PCPs principles for diagnosis and management of LFDs is indicated. This may help in lowering the missed-diagnoses rate for LFDs in Canadian primary care settings.
Poster # 59
Title: The Characteristics of Metatarsal-tarsal Bone Fractures Associated with Lisfranc Joint Injuries
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Abstract:
Introduction: Lisfranc joint injuries are often misdiagnosed, leading to significant morbidity. Recently it was often reported treatments and surgical techniques of Lisfranc joint injuries were investigated, but it has been seldom reported about a procedure for a diagnosis of Lisfranc joint injury without MRI. In some cases, a diagnosis of Lisfranc joint injuries can be difficult without MRI, and the problem of difficult diagnosis must be solved for family practice. We investigate the association between a grade of Lisfranc joint injuries and fracture of metatarsal and midtarsal bones.

Methods: It is investigated that a severity classification is evaluated with a diagnosis of metatarsal and midtarsal bone fracture. Characteristics of metatarsal-tarsal bone fractures are examined for the association with Lisfranc joint injuries.

Results: A retrospective review of the roentgenograms of 78 patients treated in our institution for metatarsal-tarsal bone fractures with/without Lisfranc joint injuries over a 10-year-period was performed. In order to diagnose a Lisfranc joint injury, the alignment of Lisfranc joint was evaluated with Stein method, and all injuries were classified according to a system described by Myerson. The type of Lisfranc joint injury with Myerson’s classification was compared with the distribution pattern of metatarsal-tarsal bone fractures, which were induced by this indirect-closed injury.

Conclusion: In 39 feet with indirect-closed injury, there was clearly correlation between the Myerson’s classification and the distribution pattern of metatarsal-tarsal bone fractures. Therefore, the fracture patterns of the metatarsal and tarsal bones may be one of the clues to the extent Lisfranc joint injury. Whenever fractured metatarsal and tarsal bones were observed, increasing the appreciation of the risk of Lisfranc joint injury may improve the diagnosis and treatment of these potentially disabling injuries.

Poster # 60
Title: Comparison of Joint Compression and Contact Area using Locking Compression Plate Versus Lag Screw Fixation in Single Joint Midfoot Fusion Model
Author(s):
Richard Owens, MD
Mark Carl Miller, PhD
Stephen Conti, MD

Abstract:
Introduction: Fusion of multiple joints in the midfoot is technically challenging. Traditionally lag screw fixation has yielded acceptable results. Newer locking compression plates have been developed which are easier to insert and provide surgeon controlled compression of the arthrodesis surfaces. A biomechanical study was performed using a sawbones model to compare joint compression and joint coaptation surface area using the two techniques.

Methods: A sawbones model of a second metatarsocuneiform (MTC) joint was used to compare 3.5 millimeter (mm) lag screw fixation with a Uni-clip CP™ locking compression plate. A pressure sensitive film was interposed into the arthrodesis site to measure compression force and contact surface area.

Results: The locking compression plate produced more significantly more total compression force (p=0.036) and a higher surface area of joint contact (p < 0.005) than lag screw fixation. The plates produced a tendency to create a gap at the opposite side of the joint which was corrected by pre-bending the plate to a slightly over-bent configuration.
Conclusion: Locking compression plate fixation produces better joint compression and coaptation than lag screw fixation. Care must be taken not to over-compress the plates and they should be pre-bent in order to obtain optimal performance. Use of the plates should achieve at least equivalent clinical fusion results based on their superior biomechanical performance.

Poster # 61
Title: Infection rates following midfoot arthrodesis procedures in an ambulatory surgery center
Author(s):
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Abstract:
Introduction: Current protocols advocate midfoot arthrodesis procedures to be performed as an inpatient surgery. Performing these procedures at an outpatient facility would reduce healthcare costs and may even be beneficial to patients. The aim of the present study was to determine infection and complication rates following midfoot arthrodesis when performed as an outpatient procedure.

Methods: Between 2007 and 2009, midfoot arthrodesis was performed in 190 patients as a daycare procedure. The etiology included 133 patients with degenerative arthritis, 52 with posttraumatic arthritis, three with Charcot feet and one with rheumatoid arthritis. Mean age at surgery was 52 years and mean body mass index was 30. Patients were divided into three groups according to the time of day of the procedure: before noon (69), 12 to 4pm (65) and after 4pm (56).

Results: None of the patients had an intraoperative complication nor did any patient require a transfer to an inpatient facility. Only five (2.6%) patients required a readmission for a secondary procedure. Overall, 13 patients (6.8%) developed an infection during the postoperative period. All infections were restricted to wound complications without osteomyelitis. Of these, seven patients had superficial wound infections that required local wound care and antibiotics. Six patients had deep wound infections requiring an intervention procedure. Eleven of the 13 patients were obese (BMI more than 30) while only two were not (p = 0.007). Smoking, primary or secondary procedure, or time/duration of the procedure did not affect the incidence of infection.

Conclusion: The overall infection and complication rates following midfoot arthrodesis performed as an outpatient procedure are low and comparable to those performed at an inpatient facility. Obesity may increase the risk of wound complications. In summary, performing midfoot arthrodesis as a daycare procedure is a reliable and safe alternative to an inpatient procedure. Further investigation regarding the relationship between postoperative infection rates and BMI is warranted.
Posters:

**Poster # 62**

**Title:** Does Utilizing the Achillon Device in Rotation for Achilles Tendon Repair Avoid Injury to the Sural Nerve: A Cadaveric Study

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**Abstract:**

**Introduction:** The Achillon device is commonly used as a percutaneous technique for Achilles Tendon Repair (ATR). A previous study conducted by the current authors found a 28% risk of sural nerve injury per specimen and a 14.8% risk of nerve injury from each needle pass of the device. This study aimed to establish methods of reducing sural nerve injury when using the Achillon device. Specifically, this study aimed to quantify (1) sural nerve violation with internal and external rotation of the device (2) tibial nerve violation with internal and external rotation of the device.

**Methods:** Thirteen paired, intact cadaveric lower limbs were available. A 2cm longitudinal incision was made over the midline of the Achilles tendon; 4cm proximal to the most palpable aspect of the calcaneus. The Achilles tendon was then dissected out and pulled through the incision. After incision of the paratenon, the Achilles tendon was cut transversely. The Achillon device was then utilized as per protocol. Group 1: Achillon was rotated 30° internally from neutral position; Group 2: Achillon was rotated 30° externally from neutral position. For both groups, three needle passers were inserted in a medial to lateral direction, starting from the most proximal hole of the device (outlets 1 to 3). With the device in place, dissections were made to locate the sural and tibial nerves. The number of suture passes that hit either the sural or tibial nerve was documented per specimen.

**Results:** During internal rotation of the device, 8 of the 13 specimens tested had at least one suture passing through the sural nerve, demonstrating a 61.5% violation rate. During external rotation of the device, this violation rate was significantly reduced to 0% (p<.001). A total of 78 needle passes were completed in thirteen specimens (39 internal rotation; 39 external rotation). With internal rotation of the device, 10 of the 39 needle passes completed (25.6%) were found to directly hit the sural nerve. 6 of these violations (60%) occurred in the most proximal hole (outlet 1); 3 (30%) in the second outlet; and 1 (10%) in the most distal hole (outlet 3). Sural nerve violation was significantly increased in Outlet 1 than in Outlet 3 (p=.03). With external rotation of the device, 0 of the 39 needle passes completed directly hit the sural nerve. There was one violation (7.7%) to the tibial nerve during internal rotation and one violation (7.7%) during external rotation (p=1.0).

**Conclusion:** A previous study demonstrated a 28% risk to sural nerve injury per specimen and 14.8% risk to nerve injury per needle pass when utilizing the Achillon in a neutral position during ATR. This current study revealed an increased risk to sural nerve injury when the device was internally rotated, with a 61.5% violation rate per specimen and 25.6% violation rate per needle pass. However, external rotation of the device significantly reduced the sural nerve injury rate. These findings support use of the Achillon device with external rotation for a percutaneous approach to ATR.
**Poster # 63**

**Title:** The Risk of Sural Nerve Injury during Achilles Tendon Repair Using the Achillon Device: A Cadaveric Study

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**Abstract:**

**Introduction:** The conventional open approach to Achilles Tendon Repair (ATR) is associated with wound complications. Percutaneous methods for ATR may reduce surgical wound complications. However, the risk of sural nerve injury from blind repair remains of concern. The Achillon device is frequently used as a percutaneous method for ATR. The objective of this investigation was to measure the incidence of direct sural nerve injury during ATR in a cadaveric model.

**Methods:** Intact cadaveric left lower extremities (n=18) were used for this study. A 2cm longitudinal incision was made over the midline of the Achilles tendon; 4cm proximal to the calcaneus. The paratenon and Achilles tendon were located and cut transversely. The Achillon device was inserted proximally within the paratenon, and three percutaneous needle passers, each with no. 2 fiber wire sutures, were inserted from a medial to lateral direction. With the Achillon instrument still in place, formal dissection to localize the needle/suture course, and specifically its relation to the sural nerve, was completed.

**Results:** Of the 18 cadaveric specimens, five had at least one suture passing through the sural nerve (28%). A total of 54 needle passes were completed in 18 cadaveric specimens. Eight needle passes (14.8%) were found to directly pierce the substance of the sural nerve. Four sural nerve violations (50%) occurred during needle passage through the most proximal needle passer (Outlet #1), three violations (38%) occurred through the middle needle passer (Outlet #2) while one violation (12%) occurred through the distal needle passer (Outlet #3). There were no cases of complete transection of the sural nerve.

**Conclusion:** There is an inherent risk to the sural nerve using percutaneous methods of ATR. In this study, there was a 28% risk of sural nerve injury per specimen and a 14.8% risk of nerve injury from each needle pass. Nerve injury occurred more frequently through the proximal outlets. Sutures were found to pull out through the sural nerve during withdrawal of the Achillon device without complete transection. This may explain post-operative paresthesias/numbness in the sural nerve distribution after percutaneous ATR. Methods for reducing sural nerve violation using the Achillon device should be further investigated.

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**Poster # 64**

**Title:** Biomechanical comparison of the Achillon vs. a minimally invasive locking suture device for Achilles tendon repair (PARS).

**Author(s):**
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**Abstract:**

**Introduction:** Percutaneous and limited open repair techniques for the treatment of acute Achilles tendon rupture have demonstrated lower complication rates when compared to open repairs. Controversy persists regarding the strength of repair of limited open techniques. The PARS device (Arthrex,Naples,FL) is a novel instrument that allows for percutaneous placement of locking sutures in the Achilles tendon. The goal of this study was to determine the resistance to gap formation under cyclic load, and maximum load to failure for the Achillon device (Integra,Lyon,France), the PARS device using one locking and one simple suture (PARS 1), and the PARS device using two locking sutures (PARS 2).
Methods: Twenty-one fresh-frozen human cadaver lower limbs were obtained and randomized to either the Achillon group, the PARS 1 locking group, or the PARS 2 locking group. Each repair was performed using #2 polyblend sutures (FiberWire, Arthrex, Naples, FL). Specimens were subject to a two stage cyclic loading protocol consisting of 1,000 cycles from 20N to 100N, and 1,000 cycles from 20N to 190N at 1Hz. A differential variable reluctance transducer (DVRT, Microstrain, Burlington, VT) was used to measure displacement during each cycle. Specimens were then loaded to failure at a rate of 0.025 m/s. The number of cycles to initial gapping (2mm), gapping at 5mm, and gapping at 9.5mm was recorded for each specimen. Maximum load to failure and mode of failure was recorded for each repair. The Kruskal-Wallis test was used to assess differences among repair techniques on the number of cycles to gap formation, and maximum load to failure. If an effect was noted, Mann-Whitney U tests were performed to compare the three groups. An alpha level of 0.05 was deemed statistically significant.

Results: There was a difference in strength of repair noted across the groups for 2mm gap formation at the repair site while under cyclical load (p=0.03), and maximum load to failure (p=0.004), (Table 1). No differences were found between groups for gapping of 5mm and 9.5mm. Post-hoc analysis demonstrated a significant difference in the number of cycles to 2mm gapping between the Achillon and PARS 1 groups (p=0.048), and between the Achillon and PARS 2 groups (p=0.015), with the PARS groups being superior. Two specimens from the PARS 1 group and two specimens from the PARS 2 group completed the loading protocol without reaching a 9.5mm gap. The PARS 2 group was superior in maximum load to failure when compared to the Achillon group (p=0.001). The mode of failure for all specimens in the Achillon group was suture pullout from the tendon, whereas 6 of the 8 specimens in the PARS 2 group failed by suture breakage.

Conclusion: In this study, we compared the strength of repair of the Achillon with the PARS device, a novel system that allows for placement of locking sutures in the Achilles tendon using a limited open technique. The PARS device was superior to the Achillon in resisting initial gap formation under cyclical load, and when maximally loaded to failure.
**Results:** The creation of a medial defect significantly decreased mean force, mean pressure and peak pressure compared to the intact condition on the medial third of the talus. Graft implantation significantly increased mean force, mean pressure and peak pressure compared to the defect condition. There were no statistical differences in mean force, mean pressure and peak pressure between the intact and graft conditions (Figure 1A-C). The mean graft height of the overall population was $-0.15 \pm 0.31$ mm (range $-1.00$ mm to $0.40$ mm). There was no statistical difference in mean force ($p=0.083$), mean pressure ($p=0.061$) and peak pressure ($p=0.054$) measurements when the graft is sunken, flush, or proud. The posterior region of interest on the graft sustained a significant increase in force, mean and peak pressure relative to the intact condition. In contrast, the anterior, medial and lateral regions of interest on the graft sustained a significant decrease in force, mean and peak pressure relative to the intact condition. The forces on the peripheral rim of the defect were not significantly changed from intact to graft.

**Conclusion:** The current study has shown that autologous osteochondral plug transplantation restores the mean force and pressure to intact levels after the creation of an OCD. However, when the graft and peripheral rim of the defect are analyzed specifically, these data suggest that certain regions of the graft could potentially be subjected to significant changes in force compared to the intact model. This may have clinical implications and further study is warranted to refine this technique such that the native surface anatomy is recreated as closely as possible.

**Poster # 66**

**Title:** Clinical and MRI Outcomes Following Platelet Rich Plasma Injection for Chronic Mid-substance Achilles Tendinopathy

**Author(s):**
Richard Owens, MD
John Ginnetti, MD
Stephen Conti, MD

**Abstract:**

**Introduction:** Within the Orthopaedic community, successful treatment of chronic mid-substance Achilles tendinopathy remains elusive. Approximately 25-50% of patients fail conservative treatment modalities. Scientific evidence has implicated Platelet Rich Plasma (PRP) in the tendon healing process, however despite initial promise there is a paucity of clinical data to validate a role for PRP in the treatment of tendon disorders including chronic mid-substance Achilles tendinopathy.

**Methods:** As an alternative to operative treatment our practice offers patients with chronic mid-substance Achilles tendinopathy intratendinous injection of PRP. We retrospectively reviewed all patients treated for Achilles tendinopathy with PRP injection over a two year period. Baseline and post injection functional scores including the Foot and Ankle Ability Measure (FAAM), Foot and Ankle Ability Measure – Sports (FAAMS), and the Short Form health survey (SF-8) were examined. Patients also underwent post-injection magnetic resonance imaging (MRI), which were compared to available pre- injection MRI data.

**Results:** Thirteen patients were identified for this study. Pre- and post-injection functional outcomes scores were available for eleven of thirteen patients. The average SF-8 score improved from 26.1 to 30.4, the average FAAM score improved from 58.5 to 68.7, and the average FAAMS score improved from 15.1 to 19.5. Complete MRI data was available for eight patients. Only one in eight Achilles tendons demonstrated qualitative MRI improvement post-injection.

**Conclusion:** Patients who received PRP injection demonstrated modest improvement in functional outcome measures, however MRI appearance of diseased Achilles tendons remained largely unchanged following PRP injection.
**Poster # 67**
**Title:** A technique for percutaneous tendon graft augmentation of lateral ankle reconstruction procedures  
**Author(s):**  
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**Abstract:**  
The usual curved antero-lateral incision for a Brostrom reconstruction provides limited access to the talar and calcaneal origins of the anterior talo-fibular (ATFL) and calcaneo-fibular (CFL) ligaments. If augmentation of the lateral ankle ligaments with a tendon graft which reproduces the anatomy and orientation of the normal ligaments is planned then access to these talar and calcaneal sites is needed.

A technique was developed for creating tendon graft anchor sites which facilitate the placement, tensioning, and anchoring of a tendon graft utilizing the standard antero-lateral curved Brostrom incision. This technique permits anatomic positioning and orientation of both the ATFL and CFL grafts.

Using the Brostrom incision transosseous drillholes are made in the talus and calcaneus-both exiting the medial side of the foot. The talus drill hole is placed transversely at the proximal junction of the body and neck so that the graft will subsequently “rest” along the normal attachment of the ATFL on the anterior-lateral aspect of the talar body. The calcaneus drill hole is made by lifting up & protecting the peroneal tendons and identifying the anatomic origin of the CFL. This drill hole then passes obliquely exiting the medial calcaneus below the FHL.

A "L" shaped tunnel is created in the distal fibula. The size of the graft is limited by the size of the distal fibula. The diameter of the talar and calcaneal drill holes are matched to the diameter of the proposed graft.

A pull suture is placed in each end of a single strand graft or in the tail ends of a folded double strand graft. The tendon graft is passed through a medial percutaneous incision, through the transosseous drill hole in the talus from medial to lateral; through the fibular tunnel; and then through the calcaneal drill hole from lateral to medial and out the medial heel. A graft of 12-14 cm is of adequate length to completely fill all of the drill holes in most patients. A bioabsorbable anchor of appropriate size is placed from lateral to medial in the talar drill hole. The graft is then tensioned through the fibula and out the calcaneal drill hole and a second anchor placed in the calcaneus. Alternatively the graft can be tensioned in the opposite direction with anchoring in the calcaneus first and then the talus. No anchor is placed in the fibula to avoid breading out the fibular tunnel.

**Conclusion:** Augmentation of an ankle ligament reconstruction with a tendon graft can be achieved with minimal additional exposure of the talus and calcaneus using a percutaneous technique of passing and then anchoring either a single or double stranded tendon graft to restore both the ATFL and CFL.

**Poster # 68**
**Title:** Computertomographic Evaluation of Talar Edge Configuration for Osteochondral Plug Transplantation  
**Author(s):**  
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**Abstract:**
**Introduction:** One of the current research topics is the aim to produce tissue engineered osteochondral grafts for future treatment of osteochondral lesions (OCL) of the talus. For the exact anatomic reconstruction, the dimensions of the medial and lateral talar dome must be considered. Sparse data is available regarding the normal anatomic talar dimensions on standard radiographs of ankle joints [1, 2]. The purpose of this study was to describe normal anatomy of different sections of the talar dome on 3D reconstructions of computertomographic (CT) images.

**Methods:** CT data sets (Somatom 10, Siemens Erlangen, Germany) of 82 patients (86 ankles) (28 female, 54 male; average age 41.9y (range 15-76y)) without talar pathologies were included. Measurements were performed with a geometry analysis software (VGStudio MAX 2.0, Volume Graphics, Heidelberg, Germany).
To assure measurement reproducibility, the reference planes were defined in a first step. To measure the frontal talar edge radius, circles were fitted into the medial and lateral talar edge on frontal planes. To allow measurement of different segments of the talus, the frontal plane was tilted through the center of the talus (defined as a circle fitted to the talus on sagittal view) at 15° and 30° anteriorly and posteriorly. To measure the sagittal radius of the medial and talar edge, circles were fitted into the medial and lateral talar edge on sagittal planes.

Results: The talar edge radius in the frontal plane at 0° was 4.9 mm medially (3.0 mm laterally), at 15° ante. 4.2 mm (3.1 mm), at 30° ante. 4.6 mm (3.1 mm), at 15° post. 4.5 mm (3.9 mm), and at 30° post 4.1 mm (6 mm). There was a significant difference (p<0.01) between the mean medial and lateral talar edge radius at all angles. The talar edge radius in the sagittal plane was 20.4 mm medially and 20.3 laterally. There was no significant difference between the mean medial and lateral sagittal talar edge radius.


Poster # 69
Title: Application of Allogenic Dermis As A Supplement to Achilles Repair
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Abstract:
Introduction: Tendon augmentation grafts have been shown to be successful in achieving enhanced stability in the repair of Achilles ruptures. Biomechanical testing has shown allogenic and porcine dermis to be the strongest soft tissue repair matrices, providing as much as a two-fold increase in load to failure compared to suture alone. Variations of suture repair techniques in applying the augmentation graft may add additional stability during the repair. The purpose of this trial is to compare load to failure of a standard Krakow repair of the Achilles, versus a repair supplemented with allogenic dermis applied circumferentially and attached to the Achilles with a running locking suture technique.

Methods: Seven matched pairs of human cadaver legs were utilized. The Achilles tendons were isolated from cadaver legs at the musculotendinous proximally, and distally with its native insertion attached to a portion of the calcaneus. Specimens were placed on an Instron 8511 (Instron, Norwood, MA) and pre-loaded to 5N. Constructs were cyclically loaded for 10 cycles from 5N to 30N at 12.5N/sec. Achilles tendon ruptures were created 6cm proximal to the calcaneal insertion. Tendons were repaired with a modified Krackow stitch. One of each matched pair was augmented with a 4x7cm allogenic dermis repair patch (DermaSpan ACD, Biomet, Warsaw, IN manufactured by Tissue Banks International, San Rafael,CA). The repair patch was placed circumferentially around the tendon and sutured with a lateral trap running locking suture technique. Each construct was subsequently cyclically loaded for 10 cycles from 5N to 30N at a rate of 12.5N/sec. This was followed by tensile testing to failure at a displacement rate of 2.54mm/sec. The repair load to failure was determined by the location at which the tendon repair failed as noted as the point the load-displacement curve deviated from the linear progression. Repair stiffness was calculated from the linear region of the load-displacement curves. Paired t-tests were performed to compare the repair load to failure and stiffness with and without augmentation. Statistical significance was set at p<0.05.

Results: The repair load to failure in the control group was 120.43N±45.80 compared to 355.87N±70.29 in the group augmented with the allogenic dermis (p<0.00001). The repair stiffness in the control group was...
4.92±2.11N/mm which was statistically significantly less than the 18.56±5.29N/mm in the group augmented with allogenic dermis (p<0.0001).

Conclusion: Addition of an allogenic repair patch with a running locking suture technique shows a statistically significant biomechanical advantage over a Krakow repair, providing a load to failure nearly 3 times that of the suture repair alone. The increase in repair strength provided by the DermaSpan ACD suggests the possibility for earlier and more aggressive rehabilitation when utilized clinically to augment Achilles tendon ruptures.
Trauma:

Poster # 70
Title: Comprehensive Classification of periprosthetic fractures in TAA
Author(s): Dan Boack, MD

Abstract:
Introduction: There is extensive literature available about periprosthetic fractures in TKA and THA. Periprosthetic fractures in TAA have been reported only as an intra-operative complication while TAA-Implantation-Procedure. But a classification of periprosthetic fractures has not been reported before. That’s why a subtle analysis in a clinical prospective investigation was done.

Methods: prospective Study: 2002-2010 Subjects: 530 TAA Complete radiological analysis (x-rays, ct-scans)

Results: A-Pre-existing fractures (before TAA) A1: Stress-Fracture due to deformity 5/530 (0,9%) A1.1: medial malleolus (varus arthritis) (3) A1.2: lateral malleolus (hindfoot valgus) (2) A2: non-union after fracture 13/530 (2,5%) A2.1: lateral malleolus (varus arthritis) (3) A2.2: medial malleolus (hindfoot valgus) (3) A2.3: central [Pilon] (4) A2.4: Talus (3) B-Intra-operative Lesion (9/530 / 1,7%) B1: medial malleolus B2: lateral malleolus B3: tibial plafond B4: Talus Fracture can be complete or incomplete Fractures were be caused by oscillating saws or impingement associated or could be happened by an atypical osteotomy line. Stable Lesions were called B1.1s and fixed percutaneously but unstable lesion B1.2u. (corresponding (B2-4) were treated by ORIF. C- Periprosthetic Early-Fracture Periprosthetic Early-Fracture could occur within 6 month after TAA. Two different types have been found. C1 Periprosthetic Insufficiency fracture (low input fx / weak bone) Frequency: 3/530 (0,6%) C1.1: extra-articular tibial fracture C1.2: intra-articular tibial fracture C1.3: intra-articular fibula fracture C1.4: medial malleolar fracture C1.1- / C1.2-Fractures were caused by multiple positioning of the tibial aiming device with consecutive tibial diaphyseal bicortical Pin-Fixation. Typically a spiral fracture was found. C1.3- / C1.4-Fractures were caused by a combination of vertical and horizontal Undercutting. The intra-articular fracture types (C1.2-C1.4) have the potential risk of TAA-involvement. The treatment was performed by ORIF. C2 Periprosthetic stress fracture (permanent overloading / normal bone structure) Frequency: 6/530 (1,1%) C2.1: tibial metaphyseal Fx C2.2: medial Malleolar-Fx C2.3: lateral Malleolar-Fx C2.1-Fractures runs medial from the edge of the tibial component through tibial Metaphysis in the sagittal plan and are associated with (Varus-) deformity. The treatment of choice is the corrective osteotomy of deformity. C2.2-Lesions are short oblique fractures of the medial malleolus caused by increased medial translation forces after dTFJ-Fusion. (additional enhanced by varus tibial component-positioning, reduced inlay height and lateral talomalleolar impingement) Treatment option is a medial displacement OT (malleolar positioning corresponding to MDO as a Translations-Osteotomy and ORIF). D-Periprosthetic Every time-Fracture (high input fx / normal bone structure) Types and Description corresponding to C as a D1- to D4-Fracture type Frequency: 1/530 (0,2%) E- Periprosthetic Late-Fracture (low input fracture / changed bone structure) In our 8-years-study we did not find any of this. But we have analyzed 50 patients with a secondary TAA-Procedure after subsidence and loosening of a primary outside TAA-surgery. E1: insufficiency fracture by cysts but stable TAA E2: insufficiency fracture by cysts and unstable TAA-Components (tibial and/or talar) E3: osteolysis fracture of the prosthetic saddle (tibial and/or talar) E4: osteolysis fracture in „low-grade“-infection situation Subgroups of the E1-Lesions are corresponding to C1-Fx or D-Fx. Treatment of choice is fracture fixation and excochleation of the Cysts, bone grafting und eliminating of the loosener connections. The treatment option for E2-Type could be the as mentioned in E1 but additional a change of the TAA (maybe partial). The E3-Fx should be performed with a fusion procedure and in E4-cases a two step procedure is necessary.

Conclusion: Subtle Analysis and comprehensive classification is necessary to solve periprosthetic fracture in TAA.
**Poster # 71**

**Title:** Screw Placement to the Calcaneal Fracture Constant Fragment: An Anatomic Study  
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**Abstract:**  
**Introduction:** Placement of a screw from the lateral wall of the calcaneus into the constant “sustentaculum tali” fragment can be difficult when surgically repairing a calcaneal fracture. This screw serves to compress fracture fragments and support the posterior facet. This difficulty is born out of the small landing zone of the sustentaculum tali with its nearby vulnerable soft tissue structures. The goal of this study was to describe the sustentaculum tali anatomy and describe anatomical landmarks, which could be used for targeting the screw placement for calcaneal fracture ORIF.

**Methods:** Ten adult cadavers were utilized for this study. These limbs were numbered and denuded of their soft tissue surrounding the calcaneus. The height and width of the ST was measured. All measurements were performed with a digital caliper. Measurements to determine the orientation of the ST in relation to the lateral calcaneal wall was completed using a series of Steinman pins. A Steinman pin (pin 1) was placed from the center of the ST across the calcaneus from medial to lateral. A second pin (pin 2) was placed from lateral to medial, inferior to the center of the posterior facet in the dense subchondral bone in the typical “constant fragment” lag screw placement. This pin exited medially in the ST creating an apex with the start point.

**Results:** The mean height and width of the ST was 12.8 mm. and 20.8, respectively. The average position from pin 1 to the STJ was 6.6 mm. The average position from pin 1 to the CC joint was 22.0 mm. The average position from the front edge of the posterior facet to pin 1 was 5.0 mm. The mean distance from pin 1 to pin 2 measured 16.1 mm. The average angle created from pin 1 to pin 2 was 29.8 degrees.

**Conclusion:** Identifying a starting point and angle of entry of the ST screw utilized in calcaneal fracture repair is beneficial. The starting point is easily reproducible and an angle of 30 degrees from posterior lateral to anterior medial can be estimated to land centrally in the sustentaculum tali. The ST perpendicular reference point is approximately 22 mm proximal from the CC joint. The ST lag screw starting position is approximately 16 mm proximal to the reference point or 38 mm proximal from the CC joint. This information should help the surgeon reliably target this important fixation in the ORIF of calcaneal fractures.

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**Poster # 72**

**Title:** Soft tissue complications after sinus tarsi approach for open reduction and internal fixation of calcaneal fractures  
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**Abstract:**  
**Introduction:** The L-shaped, extensile lateral approach to the calcaneus is the commonly utilized incision for the open reduction and internal fixation of displaced intra-articular fractures of the calcaneus. This approach has the disadvantage of difficult visualization of the subtalar joint surface, and may be complicated by wound infection, dehiscence, and injury to the sural nerve, with reports of up to 20% wound complications in closed fractures.
Methods: We retrospectively reviewed the short-term results of wound complications in 27 unilateral, closed, Sanders Type II and III fractures of the calcaneus treated by open reduction and internal fixation via a horizontal lateral incision at the level of the sinus tarsi and posterior facet of the subtalar joint. Patients were evaluated for wound and flap complications, as well as for adequacy of fracture reduction. The majority of patients had lateral plate and screw fixation. Plates were slid under the inferior flap, and where necessary, screws were placed percutaneously through the plate.

Results: There were no deep infections or sural nerve injuries. One patient had a superficial wound dehiscence which resolved with local wound care and oral antibiotics. Average pre-operative Bohler's angle was 16.3 degrees, and average post-operative was 30.9 degrees. Maintenance of reduction was demonstrated to be within an average of <1 degree (range 0-4) based on the comparison of immediate post-operative and final radiographs. Fracture reduction was satisfactory, and usually deemed better by the authors as compared to experience with the extensile lateral approach because of the enhanced ease of visualization of the subtalar joint. Eight fractures were amenable to fixation with interfragmentary screws alone, and nineteen fractures were fixed with plates and screws.

Conclusion: Successful reduction and internal fixation of displaced intra-articular fractures of the calcaneus can be achieved via a horizontal incision at the level of the sinus tarsi and subtalar joint, with enhanced joint visualization and decreased risk of postoperative complications.

Poster # 73
Title: Modern Lisfranc Classification
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Abstract:
Introduction: Most Lisfranc classifications clearly describe all possible combinations of metatarsal dislocations but failed to determine prognosis and were helpless as a treatment guide.

Methods: This is a prospective, randomized statistic analysis based on 2816 observation instances of 64 cases using a modern classification, on a simple blind mode against control cases. Intraclass correlation coefficient (ICC) was used to determine its reliability.

Results: The highest CI values reached in the inter and intraobserver evaluation were higher than 0.8 for a maximum of 1 obtaining statistic relevance.

Conclusion: The collected data strongly support the hypothesis that the classification has a high degree of reproducibility demonstrated in the CI values obtained in interobserver as well as in intraobserver reliabilities, which makes it highly recommendable for its clinical use.

Poster # 74
Title: Biomechanical study of two fixation techniques used to treat proximal fifth metatarsal fractures: A Cadaveric Study
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Abstract:
Introduction: A transverse fracture at the metaphyseal-diaphyseal junction of the fifth metatarsal, typically 1.5 cm from its base but never extending distal to the intermetatarsal joint, is more commonly known by its
A total of sixteen fresh-frozen cadaveric feet (age range: 46-92 years) were divided into two groups. In each foot, the base of the fifth metatarsal was exposed via a lateral incision and a “fracture” was created with an oscillating saw 2 cm distal to the tuberosity. The fracture was then fixed with one of the following devices: 1) a 4.5 mm, partially threaded, cannulated screw; 2) a contoured distal fibular plate with 2 proximal and 2 distal 2.3 mm cortical screws (Hook plate, TriMed). Each metatarsal was then harvested and the load to failure for each fracture was determined using an electromechanical test device at a rate of 1mm/sec.

Results: Eight fractures were fixed with an intramedullary screw and eight with contoured distal fibular plate. The average load to failure for the intramedullary screw constructs was 176 N. Screw pullout was the cause of failure of the intramedullary screw-bone construct. Contoured distal fibular fixation failed at an average load of 496.50 N and a standard deviation of 367 N. Failure of the plantar plate construct occurred with deformation of the plate and lateral rotation of the proximal fragment.

Conclusion: Our results suggest that intramedullary screw fixation is inferior to plantar plate fixation for Jones fractures in terms of initial and ultimate load to failure. Screw length did not appear to have clinical significance in ultimate load to failure. Limitations of the study include small sample size, cadaver bone, unmatched metatarsals with possible variations in bone quality between samples, and the use of ultimate as opposed to cyclic failure load.

Poster # 75
Title: Percutaneous Reduction and Fixation of Less Severe Intra-articular Calcaneal Fractures (IACF)
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Abstract:
Introduction: Despite the ideal choice of treatment of displaced IACF is still controversial, there is some evidence that anatomic restoration of calcaneal joint congruity and shape is a key factor to predict higher functional results in certain group of patients. Classic open reduction and internal fixation via an extended lateral approach allows excellent visualization of fragments, but wound complications remain a major concern, with reported rates of wound edge necrosis ranging between 2-11% and those of wound infections varying between 1.3-7%. To minimize this soft tissue complications percutaneous reduction and fixation procedures had been proposed, but these techniques carry the risk of inaccurate restoration of the posterior calcaneal facet. The objective of this work is to evaluate (1) rate of soft tissue complications, (2) functional results at short and medium follow up and (3) anatomical restoration of calcaneus with radiographic measurements after percutaneous reduction and fixation of less severe IACF.

Methods: Retrospective evaluation of patients with percutaneous reduction and fixation after displaced less severe IACF (defined as Sanders type II) between January 2009 and November 2010. Exclusion criteria were fractures older than 3 weeks and patients with Sanders type I, III or IV calcaneal fractures. Technique employed involved percutaneous leverage with Schantz screw introduced through calcaneal tuberosity using Westhues / Essex-Lopresti method in Sanders type IIC, performing an additional sinus tarsi approach to
visualize reduction of posterior facet in Sanders type IIA and IIB, and percutaneous screw fixation via stab wounds. Intraoperative confirmation anatomic reduction and screw position was performed with Broden, lateral and axial X-rays and postoperative CT scans. 11 patients (12 feet) were included (6 men), with a mean age of 50 years (range 22-79). All patients were available for follow-up and they were examined according to standardized assessment protocol which included registration of postoperative complications, American Orthopaedic Foot and Ankle Society (AOFAS) ankle-hindfoot score, Kenneth Johnson satisfaction score, return to work and sports activities and preoperative and postoperative Böhler angles.

**Results:** Follow up ranged from 4 to 17 months, with a median of 11 months. Two patients presented postoperative complications; one suffered delayed wound closure and superficial infection, treated effectively with oral antibiotics and ambulatory wound care with complete closure after 2 months, and one with symptomatic fixation material for 6 months. There were no other complications. The median AOFAS ankle-hindfoot score reached 95.5 points (range 78-100 points). 7 patients were completely satisfied, 3 were satisfied with minor reservations and one satisfied with major reservations. All patients returned to their previous work activities in a range of 1 to 5 months. One patient was performing soccer in a regular fashion prior to fracture, and returned to practice 5 months after surgery. Median preoperative Böhler angle was 10° (range 3°-17°). Median postoperative Böhler angle was 20° (range 14°-29°); no significative step-offs of posterior facet joint were detected en CT scans.

**Conclusion:** Percutaneous reduction and fixation is a reliable technique for less severe IACF, presenting excellent short and medium follow up functional results, with a low rate of postoperative wound complications.

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**Poster # 76**

**Title:** Reduction and Fixation of Metatarsal Head and Neck Fractures Using Closed Antegrade Intramedullary Nailing

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**Abstract:**

**Introduction:** The purpose of this study is to present the results of the metatarsal head and neck fractures treated with closed antegrade intramedullary nailing

**Methods:** From August 2005 to September 2009, 20 feet in 18 patients (14 male, four female) with metatarsal head and neck fractures (four head fractures, 28 neck fractures) were enrolled in the study. Inclusion criteria were metatarsal head or neck fractures with displacement more than 3-4 mm or angulation more than 10 degrees in sagittal plane (dorsal to plantar). We excluded the fractures combined with Lisfranc injury or metatarsal shaft or base fractures. Clinical results were assessed from the range of motion at the metatarsophalangeal (MTP) joint and the residual pain at 6 weeks after the operation and at final follow-up. AOFAS lesser metatarsophalangeal-interphalangeal scale was evaluated at final follow-up. The mean time of the final follow-up was 12 months (range, 8 to 16 months).

**Results:** Fracture union was obtained at an average of 7.1 weeks (range, 6 to 10 weeks). The average time of full weight bearing was started at an average of 6.3 weeks (range, 6 to 10 weeks). Two patients had moderate limitation of MTP joint at 6 weeks but recovered to full range at final follow-up. The average AOFAS score at final follow-up was 96.7 points (range, 83 to 100 points). None of the patients showed painful keratosis on the plantar area of the fractured metatarsal head at final follow-up.

**Conclusion:** Closed antegrade intramedullary nailing is a useful method for the treatment of displaced metatarsal head and neck fractures, which allows immediate motion of the MTP joint and partial weight bearing in a stiff soled shoe.
Poster # 77
Title: Comparative Effect of Orthosis Design on Functional Performance
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Abstract:
Introduction: Military conflicts in Iraq and Afghanistan have been characterized by high-energy lower extremity trauma (HELET). Surgical advances allow limb salvage in the face of injuries once considered unsalvageable. Initially orthotic options for limb salvage were limited, and patients expressed frustration with prolonged rehabilitation and limited functional capabilities. A custom carbon fiber energy-storing ankle foot orthosis (AFO), the Intrepid Dynamic Exoskeletal Orthosis (IDEO), was created and used in combination with high intensity rehabilitation to improve physical function. We hypothesized that use of the IDEO would lead to improved performance on tests of agility, power and speed as compared to a commercial non-custom carbon fiber orthosis (BlueRocker™ (BR), Allard International, Helsingborg, Sweden), a hard plastic posterior leaf spring AFO (PLS), and no brace.

Methods: Eighteen patients underwent testing wearing the IDEO, BR, PLS, and no brace. Validated functional measures included the five-time-sit-to-stand(5TSS), four-square-step-test(FSST), self-selected walking velocity over level(SSWV-L) and rocky terrain(SSWV-R), and timed stair ascent(TSA). Brace order was randomized and five trials completed for each functional measure in each brace. Subjects completed a forty yard dash (40D) with two independent timers and a satisfaction questionnaire indicating if they had ever considered and still intended to proceed with amputation. Statistical significance was set at p<0.05.

Results: There was a statistically significant improvement in performance on the FSST, SSWV-L, SSWV-R, TSA and 40D in the IDEO compared to the BR, PLS and no brace (p <0.004). Patients in the IDEO improved their average forty yard dash time by nearly 5 seconds over the PLS and no brace (36% improvement), and by 3.4 seconds over the BR (28% improvement). There was a significant improvement on the 5TSS in the IDEO compared to the BR (p =0.014), but no significant difference compared to the PLS and no brace. The BR demonstrated a significant improvement in the 40D compared to no brace (p =0.033), and in SSWV-L compared to no brace and PLS (p <0.028), but no significant difference was found between the PLS, BR and no brace conditions in any other functional measure. Of the thirteen patients who initially considered amputation, 8 wish to continue limb salvage, 2 are undecided, and 3 wish to proceed with amputation.

Conclusion: Use of the IDEO in combination with high intensity physical rehabilitation leads to significantly improved performance in functional measures designed to test agility, power and speed. Of those Soldiers who initially considered amputation, 62% favor limb salvage after completion of this non-invasive intervention.
Poster # 78
Title: Quantification of Posterior Ankle Exposure Through an Achilles Tendon-Splitting vs. Posterolateral Approach
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Abstract:
Introduction: Optimal surgical exposures to the posterior ankle for trauma and reconstruction are a source of debate. We hypothesized that the Achilles tendon-splitting approach would provide greater exposure of the posterior distal tibia and talus than the posterolateral approach.

Methods: Methods: Forty surgical approaches were performed in twenty fresh-frozen hemicorpectomy cadavers. Achilles tendon-splitting and posterolateral approaches were performed using a crossover randomization design for surgical sequence. Six osseous landmarks (posteromedial medial malleolus, medial gutter, ankle joint, subtalar joint, incisura fibularis, and posterolateral lateral malleolus) were identified by direct visualization or palpation. A calibrated digital photograph was taken and Image J (http://rsb.info.nih.gov/ij/) was used to calculate the surface area of distal tibial and talus exposed in both neutral and maximum dorsiflexion.

Results: Results: Using a posterolateral approach, the average exposed distal tibia was 11.260 cm² in neutral and 10.190 cm² in dorsiflexion. The average talus exposed was 2.032 cm² in neutral and 2.366 cm² in dorsiflexion. Using an Achilles tendon-splitting approach, the average distal tibia exposed was 32.5% more (14.925 cm²) in neutral, and 43.3% more (14.608 cm²) in dorsiflexion. The average talus exposed was 47.4% more (2.996 cm²) in neutral, and 76% more (4.170 cm²) in dorsiflexion. All increases in exposure were statistically significant. The medial malleolus was visualized in 19 tendon-splitting versus 6 posterolateral approaches. The medial gutter was visualized in 20 tendon-splitting versus 13 posterolateral approaches. These differences were statistically significant. All other landmarks could be visualized through both approaches.

Conclusion: Conclusion: The Achilles tendon-splitting approach provides significantly greater exposure of the posterior distal tibia and talus, particularly the far medial sided structures, as compared to the posterolateral approach. The Achilles tendon splitting approach can serve as an alternate approach for any surgical procedures which require maximal visualization of the posterior ankle or subtalar joints.

Poster # 79
Title: Treatment of the posterior malleolus and distal fibula fracture using a single oblique incision
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Abstract:
Introduction: It is widely agreed that indirect reduction of posterior malleolar fragment is possible since the fragment is connected to the fibula by posteroinferior tibiofibular ligament and to the tibia with posterior capsule. So the fixation via anterior to posterior lag srew placement is popularly used. But, sometimes the
posterior fragment is not perfectly reduced even though the lateral malleolar fracture is completely reduced. Therefore we designed and performed single incision dual approach for the distal fibula and posterior malleolus which helps in direct visualization of the fracture and the intermediary fragments.

Methods: Between 2008 and 2010, 24 patients (10 males and 14 females, 13 Rights and 11 Lefts, average age was 47.5 years old) with ankle fracture involving posterior and lateral malleolar fracture were received operation by single oblique posterolateral incision. These patients were followed up at least more than 12 months and their radiologic and clinical results were analyzed using AOFAS score.

Results: Average radiologic union time was 13.3 weeks, we could confirm the reduction is satisfied and the displacement is less than 1mm in all the cases. Average AOFAS score was 93.75 at the final result. There occurred one complication of op site marginal solughing which resolved without additional operation.

Conclusion: In the case of communition or large impacted posterior fragment, we could obtain favorable clinical result by single oblique incision dual approach for the posterior and lateral malleolus. We believe it has advantage of better visualization and avoiding sural nerve injury.