PAPERS

PAPER NO. 46
Role of Collateral Ligaments in Metatarsophalangeal Stability: A Cadaver Study
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INTRODUCTION: Lesser metatarsophalangeal joint (MTPJ) instability is a common complaint. A primary role of the accessory collateral ligament in maintaining metatarsophalangeal stability was identified in this biomechanical cadaver study. METHODS: We used 26 fresh-frozen cadaver lesser MTPJs to test the instability with the amount of force necessary to translate the joint 3 mm dorsally. Specimens were tested for 1) intact collateral ligaments, 2) transected accessory collateral or proper collateral ligaments (ACL or PCL), 3) repaired ACL or PCL, 4) transected ACL and PCL, 5) repaired ACL and PCL, and 6) transferred interosseous (IO) tendon. RESULTS: The mean force required for 3 mm of dorsal displacement was 25.2 +/- 13.1 N (range, 11.3 to 51.7 N) in the 26 specimens. Transecting either the ACL alone or the ACL and PCL led to the most instability vs. transecting the PCL alone (p < 0.001). Repairing both ligaments improved stability (p = 0.001). The IO tendon transfer was comparable to the direct repair of the PCL (p = 0.287) but was inferior to the direct repair of the ACL (p = 0.038). DISCUSSION AND CONCLUSION: Both ACL and PCL have stabilizing effect on the MTPJ. However, the ACL was more important since primary transection of the ACL led to more instability and additional transection of the PCL in an ACL deficient model did not lead to significantly more instability.

PAPER NO. 47
Biomechanics of the Distal Fibula During Simulated Ankle Loading Tests for High Ankle Sprains
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INTRODUCTION: Syndesmosis (high ankle) sprains of the ankle produce disruption of the distal tibiofibular ligaments. Forces acting on the distal fibula from ankle loadings thought to produce these injuries have not been measured in cadaveric specimens. METHODS: A custom designed load cell, rigidly attached to the fibula, recorded forces acting on the distal fibula from forced ankle dorsiflexion and applied external foot torque. Medial-lateral and anterior-posterior displacements of the distal fibula were recorded during these tests. Distal fibular forces and axial displacements of the fibula were also recorded as axial weight-bearing force was applied to the foot. RESULTS: During the forced ankle dorsiflexion and external foot torque tests, the distal fibula always displaced posteriorly with respect to the tibia with no measurable medial-lateral displacement. At 10 N-m of applied ankle dorsiflexion moment, cutting the tibiofibular ligaments approximately doubled mean fibular force and posterior fibular displacement values. Cutting the tibiofibular ligaments significantly increased mean posterior fibular displacements at applied external foot torque levels greater than 1 N-m. Distal fibular forces and axial displacements from applied axial weight-bearing force were highest with the foot in a maximally dorsiflexed position. The highest fibular force in the study (mean 271.9 N) was recorded when a 10 N-m external foot torque was applied to a dorsiflexed foot loaded with 1000 N axial weight-bearing force. DISCUSSION AND CONCLUSION: Three important modes of loading that could produce high ankle sprains were identified: 1) forced dorsiflexion of the ankle, 2) axial weight-bearing force applied to a dorsiflexed ankle, and 3) external torque applied to a dorsiflexed ankle loaded with axial weight-bearing force. The distal tibiofibular ligaments restrained posterior fibular displacements produced by forced ankle dorsiflexion and applied external foot torque, indicating that the ligaments were loaded during these testing modes. It is commonly believed that forced ankle dorsiflexion and applied external foot torque widen the ankle mortise by producing lateral displacement of the distal fibula. We found that the distal fibula displaced posteriorly during these loading modes. Any residual mortise widening observed at surgery may actually be the result of tibiofibular ligament injuries caused by posterior displacement of the distal fibula. Therefore a syndesmosis screw used to fix the fibula would be subjected to posterior bending forces from these loading modes, and not tensile forces acting to pull the screw out of bone. Ankle bracing to prevent extreme ankle dorsiflexion during rehabilitation may be advisable to prevent excessive fibular motions that could affect syndesmosis healing.

The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
Biomechanical Cadaveric Analysis of Biotenodesis Screw versus Bone Tunnel Fixation Methods in FHL Transfers

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INTRODUCTION: Chronic Achilles tendon ruptures can be a debilitating injury. Surgical intervention is often required to restore function. This is commonly achieved by transferring the flexor hallucis longus (FHL) tendon into the calcaneus. The FHL may be harvested in two locations: 1) proximal to the master knot of Henry requiring a second incision, 2) at the os trigonal process requiring one incision. The longer tendon harvest is fixed into the calcaneus via bone tunnel while the shorter harvest requires tenodesis with an interference screw. The biomechanical properties of the biotenodesis screw technique are not known. The purpose of this study was to determine if the biotenodesis screws would provide equal or stronger mechanical properties as compared to bone tunneling method.

METHODS: Calcaneii from 16 cadaver limbs were harvested along the FHL and Achilles tendons. The FHL was transferred using the biotenodesis screw or the bone tunnel techniques. The biomechanical properties of the transferred tendon (ultimate strength, Young's modulus, failure strain and strain energy) were determined under displacement control using a custom-designed fixator and a testing machine. Paired and unpaired Student's t-tests were performed (Excel or SYSTAT) to determine the differences between groups (alpha = 0.05).

RESULTS: Eighty-eight percent of samples from the bone tunnel group failed at the suture site due to the tearing of FHL tendon. Among all samples age-dependent decrease in ultimate strength and Young's modulus were found (Fig. 1). Using paired comparison to compensate the age-dependent variation, we found a decrease of Young's modulus (19±7%, p=0.01) and an increase of strain energy (37±22%, p=0.01) in the biotenodesis screw group as compared to the bone tunnel group (Fig. 2). No differences in ultimate strength and failure strain were seen between groups.

DISCUSSION AND CONCLUSION: Biotenodesis screws provide similar spontaneous mechanical properties to that of bone tunnel fixation of the FHL tendon. The biotenodesis screw technique offers fixation of the FHL tendon through a single incision while decreasing morbidity of a second incision site and possible disruption of the normal interconnections between the FHL and flexor digitorum longus tendons.

Weight Bearing in the Non Operative Treatment of Acute Achilles Tendon Ruptures: A Randomized Controlled Trial

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INTRODUCTION: Acute achilles tendon ruptures are increasing in incidence, however there remains a lack of consensus on the optimum treatment for acute ruptures. Randomized studies comparing operative versus non-operative treatment show operative treatment to have a significantly lower re-rupture rate, but these studies have generally used non-weight bearing casts in the non-operative group. Recent series utilizing more aggressive non-operative protocols with early weight-bearing have noted a far lower incidence of re-rupture, with rates approaching those of operative management. The purpose of this study was to compare outcomes of traditional casts versus Bohler-iron equipped weightbearing casts in the treatment of acute Achilles tendon ruptures.

METHODS: Eighty-three patients with acute Achilles tendon ruptures were recruited from three centers over a two-year period. Patients were randomized within one week of injury to receive either a weight-bearing cast with a Bohler iron or a traditional non weight-bearing cast. A set treatment protocol was used, with a total cast time of eight weeks. Patients underwent detailed muscle dynamometry testing at six months, with further follow-up.

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up at one and two years. Primary outcomes assessed were patient satisfaction, time to return to work, and overall re-rupture rates. Secondary outcomes included return to sports, ankle pain and stiffness, footwear restrictions, and patient satisfaction. RESULTS: There were no significant differences in patient demographics or activity levels prior to treatment. At follow up, one patient (2%) in the Bohler iron group and two patients (5%) in the non weight bearing group sustained re-ruptures (p=0.62). There was a trend toward an earlier return to work in the weight bearing group, with 58% versus 43% returning to work within four weeks, but the difference was not significant. A total of 63% of patients in the weight bearing group reported freedom from pain at 12 months compared to 51% in the non weight bearing group. There were no statistically significant differences in Leppilahti scores, patient satisfaction, or return to sports between groups. DISCUSSION AND CONCLUSION: Weight-bearing casts in the non-operative treatment of Achilles tendon ruptures appear to offer outcomes that are at least equivalent to outcomes of non-weight bearing casts. The overall re-rupture rate in this study is low, supporting the continued use of initial non-operative management in the treatment of acute ruptures.

PAPER NO. 50
Functional Treatment after Surgical Repair for Acute Lateral Ligaments Disruption of the Ankle in Athletes
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INTRODUCTION: Functional treatment (FT) has been developed for acute lateral ligaments disruption of the ankle as the most effective treatment. However, there have been several reports which showed 20 to 40% failure after FT. We supposed that one of the reasons for the failure cases is due to an uncontrolled excessive tensile load to the ruptured ligament which widens the space between the stumps and obstructs the healing process. We hypothesized that FT after primary surgical repair of the ruptured ligament has an advantage of decreasing the failure rate by resisting overload during FT. The purpose of this study was to investigate and compare the clinical results between the functional treatment group and the functional treatment after surgical repair group, and to clarify the efficacy of the functional treatment after surgical repair for acute lateral ligaments rupture of the ankle. METHODS: A total of 132 feet of 132 patients were included in this study. Seventy-eight cases were treated with functional treatment (group F), and remaining 54 cases were treated with functional treatment after primary surgical repair (group RF). Clinical results with AOFAS score, talar tilt angle and anterior displacement of the talus in stress radiography, and the duration between the injury and returning to full athletic activity with no external supports were evaluated. RESULTS: The mean AOFAS score at two years after injury was 95.4±5.2 points in group F and 97.4±2.7 points in group RF (p=0.065). The differences of talar tilt angles compared with the contralateral side and displacement of the talus in stress radiography at two years after injury was 1.1±1.5 degrees and 3.6±1.6 mm in group F, and 0.8±0.9 degrees and 3.2±0.8 mm in group RF respectively. Eight cases which showed fair to poor results with less than 80 points in the AOFAS score and showed instability at two years after injury were indicated only in group F. The duration between the injury and returning to full athletic activity without any external supports was 16.0±5.6 weeks in group F and 10.1±1.8 weeks in group RF (p<0.0001). Although seven cases in group RF showed complications after surgery, they disappeared within three months after surgery. DISCUSSION AND CONCLUSION: Although the undoubted efficacy of early active mobilization for healing the ruptured ligament, the current study showed 10.3% of failure cases in the functional treatment group (group F). Primary surgical repair of the ruptured ligament has an advantage of lower risk to widen the distance between the remnants if the patient gets overload out of the assumption. In the current study, there were few cases recurrent of instability or with unsatisfied clinical results against the early accelerated mobilization after surgery. Accordingly, although a FT should be performed as a primary choice for treating the acute lateral ligaments rupture of the ankle, we recommend a FT after surgical repair in cases which hope to return to the initial athletic activities within a definite period of time.

PAPER NO. 51
Platelet-Rich Rich Plasma is More Effective than Cortisone for Chronic Severe Plantar Fasciitis
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INTRODUCTION: Chronic plantar fasciitis is a common but sometimes difficult condition to successfully treat. Platelet rich plasma (PRP), a concentrated bioactive component of autologous blood that is rich in cytokines and other growth factors, was compared with cortisone injection in the treatment of severe cases of plantar fasciitis resistant to traditional non-operative paradigms. METHODS: Thirty-six patients (16 males, 20 females) with severe chronic plantar fasciitis who had failed traditional non-operative treatment (rest, heel lifts, PT, NSAIDS, cam walker immobilization, night splinting, local modalities) were randomized into two study groups and evaluated prospectively. All patients had pre-treatment MRI and ultrasound studies consistent with plantar fasciitis. Group 1 was treated with a single ultrasound-guided injection of 40 mg methylprednisolone at the injury site and Group 2 was treated with a single ultrasound-guided injection of un-buffered autologous PRP at the injury site. All patients were then immobilized fully weight bearing in a cam walker for two weeks, started on eccentric home exercises and then allowed to return to normal activities as tolerated and without support. RESULTS: Group 1 had an average age of 59 (24-74) and had failed 5.4 months (4-24) of standard non-operative management and had pre-treatment AOFAS scores of 52 (24-60). The PRP group had an average age of 51 (21-67) and had failed 5.7 months (4-26) of standard non-operative management and had pre-treatment AOFAS scores of 37 (30-56). Post-treatment AOFAS scores in Group 1 initially improved to 81 (60-90) at three months but decreased to 74 (56-85) at six months and dropped further to 58 (45-77) at 12 months follow up. Post-treatment AOFAS scores in Group 2 improved to 95 (84-90) at three months and reMed excellent at 94 (87-100) at six months and stayed at 94 (86-100) at 12 months follow up (CI 95% P=0.001). No patients were lost to follow up. DISCUSSION AND CONCLUSION: This study suggests that platelet rich plasma injection is significantly more effective and durable than cortisone injection for the treatment of severe chronic plantar fasciitis refractory to traditional non-operative management.
Arthroscopic Lateral Ankle Ligament Reconstruction

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INTRODUCTION: The modified Brostrom is the treatment of choice for ankle instability. This study retrospectively evaluates outcomes of arthroscopic lateral ligament reconstruction for chronic ankle instability.

METHODS: From November 2007 to December 2010, we evaluated the results of 22 patients (22 ankles) who underwent arthroscopic lateral ligament repair using either one or two bioabsorbable suture anchors placed on the distal fibula. All patients had positive ankle instability with manual stress testing and failed non-operative management. Patients were evaluated with subjective and functional improvement scores as well as manual stress tests.

RESULTS: After an average follow up of 12 months (range 12 to 46), all patients reported significant improvement compared to their preoperative symptoms. There were 20 patients with good/excellent scores, two fair, and zero poor. Four patients were noted to have mildly positive (trace to 1+) residual stress tests despite no functional limitations. There were two complications including one case of deep vein thrombosis (DVT) and one sural neuritis. One patient developed an unrelated neurologic process.

DISCUSSION AND CONCLUSION: Arthroscopic ligament reconstruction for chronic lateral ankle instability potentially reduces operative time and produces good clinical results with minimal complications. The early results with this minimally invasive procedure suggests it is a good alternative to open techniques.

Symdesmosis and Lateral Ankle Sprains in the National Football League

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INTRODUCTION: Syndesmosis compared to lateral ankle sprains in the National Football League (NFL) can present a significant source of disability with non-standardized treatment methods and an ill-defined algorithm for return to play. This study evaluated diagnostic, treatment, and outcome measures of syndesmosis and lateral ankle sprains in NFL football players to better enable orthopaedic surgeons to identify and manage these complex injuries.

METHODS: All syndesmosis and lateral ankle sprains from a single NFL team database were reviewed over a 15-year period, including diagnosis, treatment methods, and time loss from participation. Descriptive and/or statistical analysis was then performed including diagnosis, treatment methods, and time loss from participation. Descriptive and/or statistical analysis was then performed for all variables. An independent sample t-test with corresponding p-values were then calculated for foot and ankle protective gear, playing surface, field condition, mechanism of injury, place of injury, and time loss from participation.

RESULTS: Thirty-six syndesmosis and 53 lateral ankle sprains occurred in our cohort of NFL players during the 15-year study period. The mechanism of injury most often resulted from direct impact in the syndesmosis group and torsion in the lateral ankle sprain group (p=0.034). All players in both groups were managed non-operatively. Time loss from participation was 15.4 days in the syndesmosis group and 6.5 days in the lateral ankle sprain group (p<0.001). NFL team physicians vary their treatment for syndesmosis sprains depending upon the category of diastasis, including immobilization for no diastasis, variability of treatment depending upon imaging results for latent diastasis, and surgery for frank diastasis. Most team physicians recommended non-operative management with a form of immobilization and weight-bearing as tolerated for lateral ankle sprains.

DISCUSSION AND CONCLUSION: Syndesmosis sprains in the NFL can be a source of significant disability compared to lateral ankle sprains. Successful return to play with non-operative management can be achieved for both syndesmosis and lateral ankle sprains. With modern treatment algorithms for syndesmosis sprains, more aggressive non-operative treatment is necessitated. Although return to play will be delayed when compared to lateral ankle sprains, the time loss from participation is not as prolonged as previously reported in the literature.

Effectiveness of Physical Therapy in Treating Chronic Achilles Tendinosis

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INTRODUCTION: This study investigated the effectiveness of two physical therapy interventions for treating chronic insertional Achilles tendinosis (within 2 cm from insertion). Previous studies have found eccentric training to be effective in treating mid-portion Achilles tendinosis (2-6 cm) among athletic persons but are inconclusive for populations with the tendinosis at the insertion or with other demographic characteristics. This study not only examined the effectiveness of physical therapy intervention, whether eccentric training or conventional, but also the characteristics of patients who had successful outcomes.

METHODS: The study used a single-blinded, randomized experimental design conducted at an outpatient orthopedic clinic. All study participants experienced symptoms within 2 cm of the Achilles insertion > three months. The control group underwent 12 weeks of conventional physical therapy that involved stretching, heel lifts, night splints, and cryotherapy, whereas the experimental group performed eccentric strengthening of the Achilles tendon in addition to the control group’s treatment. Physicians, blinded to the intervention assigned to subjects, collected patient outcome scores on pain (Visual Analog Scale) and function (Foot Ankle Outcome Questionnaire & Short Form-36) at initial evaluation, six weeks, and 12 weeks. Within each protocol, the difference between initial and follow-up outcome scores were compared using Wilcoxon signed ranks tests and between the two protocols, the Mann-Whitney was used. Chi-squares and Spearman’s rho were used to assess patient characteristics.

RESULTS: Fifty-eight patients enrolled in the study, 32 completed the study--15 in the eccentric group and 17 in the traditional group. Overall, there were significant differences (p<0.05) on all measurements for both groups between baseline and 12 weeks.
However, there were no significant differences in outcomes between protocols, but a significant higher rate for non-completion of the eccentric protocol among obese subjects (BMI > 30). No statistically significant differences in outcomes were found by age, BMI, duration of symptoms, or prior level of activity. However, persons with a self-reported history of osteoarthritis were statistically significant less likely to report decreased pain and improved function (SF-36). Subjects who reported history of migraines were less likely to experience a decrease in pain (VAS) or improvement in total function (SF-36). Subjects with self-reported diabetes were less likely to improve in function (SF-36), and males less likely than females to report decrease in pain per VAS. There was no variable in which subjects failed to improve at a statistically significant level across all scales.

**DISCUSSION AND CONCLUSION:** Physical therapy intervention that comprises a combination of stretching, heel lifts, night splint, and cryotherapy is an effective treatment for insertional Achilles tendinosis. Physicians may observe slower or less improvement among patients with a history of osteoarthritis, migraines, or diabetes, but it is not unreasonable to still expect both decreased pain and improved function. Patients who are obese also improve, but might need more encouragement to complete the intervention, especially if it includes eccentric training.

**PAPER NO. 55**

**Clinical vs. MRI Diagnosis for Acute Achilles Tendon Ruptures: Stochastic Simulation of Economic Implications**

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**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 Institutional Review Board 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 five modeled from the 2008 U.S. Census Estimates. The simulation was iterated 10 times to achieve stable estimates, and the results analyzed.

**RESULTS:** Sixty-six 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 U.S. 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 U.S. of $32,475,603.35 (95%CI $28,000,397.35 to $36,950,809.34) relative to clinical diagnosis.

**DISCUSSION AND 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 U.S.

**PAPER NO. 56**

**Combined Kidner Procedure with Subtalar Arthroereisis for Accessory Navicular with Planovalgus Deformity**

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**INTRODUCTION:** Type II accessory navicular is frequently associated with planovalgus deformity. Surgical treatment for symptomatic patients recalcitrant to nonoperative treatment involves resection, with or without takedown and reattachment of the posterior tibial tendon as described by Kidner. This does not address the planovalgus deformity which may lead to long-term dysfunction. We hypothesized that combination of subtalar arthroereisis to correct the deformity followed by the modified Kidner procedure would lead to improvement of pain and function and correction of the deformity, potentially preventing future problems.

**METHODS:** Institutional Review Board approved, prospectively collected data was reviewed for 20 patients (23 feet) undergoing a combined modified Kidner and subtalar arthroereisis for painful type two accessory navicular with planovalgus deformity recalcitrant to nonoperative treatment. The average age at the time of surgery was 18 years. Patients were evaluated preoperatively and at final follow up clinically, radiographically, and via the visual analog pain scale (VAPS), the AOFAS ankle hindfoot score, and a satisfaction rating. **RESULTS:** Mean follow up was 52.3 months. The mean AOFAS-AH scores improved from 53 preoperatively to 95 at final follow up and the mean VAPS score decreased from 7.4 out of 10 preoperatively to 1.7 at final follow up. Radiographically, the average Meary’s angle improved from 18.5 degrees preoperatively to 3 degrees at final follow-up, with 20 patients having complete pain relief. Nineteen of 20 patients had good or excellent results. Three patients required implant removal due to pain; no recurrence of planovalgus deformity occurred. No patients developed subtalar arthritis.

**DISCUSSION AND CONCLUSION:** The modified Kidner procedure combined with a subtalar arthroereisis results in significant pain and functional improvement. The deformity correction obtained at surgery is maintained at an average 52.3 months, even if the arthroereisis plug has to be removed. The extra-articular plug does not lead to subtalar arthritis.
INTRODUCTION: Anteromedial impingement (AMI) is a common and chronic ankle joint condition characterized by anteromedial talotibial osteophytes, soft tissue synovial hyperplasia and cicatization, thereby causing pain and a mechanical obstruction to normal joint motion. AMI is a common condition found primarily in athletes, but particularly soccer players. The first case series of the arthroscopic resection of AMI has been previously described. The current authors present an update of an ongoing series with the retrospective results of the first 100 patients treated arthroscopically for AMI.

METHODS: Between January 2005 and January 2010, 100 patients underwent arthroscopic resection of AMI under the care of the senior author. Any patient with evidence of pre-existing degenerative arthrosis was excluded. Patients were followed for a minimum one-year time period post-operatively. All patients had pre- and post-operative AOFAS hindfoot and SF-36V2 scores.

RESULTS: The mean patient age was 30.4 years (range, 13-60 years) and the mean follow-up time was 25.1 months (range, 6-81 months). A total of 91% of patients reported good to excellent functional outcomes and would recommend the procedure. Mean AOFAS score improved significantly from 59 points pre-operatively to 92 points at follow up. The SF-36V2 score also improved significantly by a mean 32 points at follow up. Return to play in the athletic population was a mean of seven weeks. Five patients experienced complication (5%).

DISCUSSION AND CONCLUSION: The typical presentation of AMI is medial ankle joint pain while running, kicking, or stair climbing and is explained by the entrapment of soft tissue inflammation between the osteophytes during dorsiflexion of the ankle. In the current authors’ experience, the diagnosis of AMI is often delayed, causing prolonged time lost to injury in athletes. Proper diagnosis should include physical examination in addition to oblique AMI-view radiographs and MRI. When medial ankle joint pain is present, the diagnosis of AMI should be considered until proven otherwise. The poor results of conservative treatment therapies for impingement syndromes of the ankle have led the current authors to advocate arthroscopic debridement as a first line treatment to expedite return to competitive sport. AMI is a common condition seen in athletes and when treated arthroscopically can be expected to do well and return to sport at previous levels.

PAPER NO. 58

Autologous Conditioned Plasma for Nonoperative Treatment of Achilles Tendon Ruptures

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INTRODUCTION: Rupture of the Achilles tendon is one of the most common injuries in the adult population. Randomized trials have shown similar outcomes following operative and non-operative treatment options. Autologous conditioned plasma (ACP) has the potential to create an optimal healing environment by isolating the plasma components of blood and injecting it at the site of injury. To date, there has been no study investigating the effects of treating a torn Achilles tendon with ACP in addition to physical therapy and early mobilization.

METHODS: This study is a prospective cohort study with historical control group. Both groups received identical physical therapy regimens. The ACP group received injections at baseline and two weeks later. We measured isokinetic plantar flexion strength, plantar flexion range of motion, calf-circumference and Leppilahi score at one year post injury.

RESULTS: A total of 145 patients (72 control, 73 ACP) participated in this study. There were 59 males per group and the mean age was 40.8 ± 9.2 years. Gender, age, weight, height and activity at time of injury were balanced between groups. Rerupture occurred in three patients in the control group and in two patients in the ACP group. There were no statistically significant or clinically important differences between groups for strength, range of motion, calf circumference and Leppilahi score. The rate of complications was similar between groups.

DISCUSSION AND CONCLUSION: The addition of ACP to an accelerated nonoperative rehabilitation program featuring early mobilization does not affect the outcome of patients with an acute Achilles tendon rupture at one year post-injury.

PAPER NO. 59

Physiological Heavy Suture Fixation Technique in Treating Disrupted Ankle Syndesmosis

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INTRODUCTION: Various methods of fixation have been used in treating syndesmotic injuries, but significant problems exist. Rigid fixation with metallic or bioabsorbable screws precludes the physiological motion of the syndesmosis. It is inevitable to have loosening or breakage of the implants if weight-bearing was allowed before they were removed. Prolonged protection interferes functional recovery while premature removal of implants may result in loss of reduction. A commercial suture button device has been designed to solve these problems. However, using a soft device in the same manner of a screw raised concerns about rotational and valgus instability. Several complications such as synostosis of ankle, subsidence of device into bone, and pathologic fracture of tibia and fibula were also reported in the literature review. It is considered that a more anatomical configuration may be more appropriate for suture repair of syndesmotic injuries.

METHODS: Twelve patients with or without ankle fractures associated syndesmotic injuries received operative treatment and follow up more than 12 months. After anatomical reduction and fixation of the fibula, Cotton test was used to verify the necessity of the washer and received implant removal at four months. Post reduction at final follow up. One patient complained of irritation and activity at time of injury were balanced between groups. There were 59 males per group and the mean age was 40.8 ± 9.2 years. Gender, age, weight, height and activity at time of injury were balanced between groups.

RESULTS: A total of 145 patients (72 control, 73 ACP) participated in this study. There were 59 males per group and the mean age was 40.8 ± 9.2 years. Gender, age, weight, height and activity at time of injury were balanced between groups. Rerupture occurred in three patients in the control group and in two patients in the ACP group. There were no statistically significant or clinically important differences between groups for strength, range of motion, calf circumference and Leppilahi score. The rate of complications was similar between groups.

DISCUSSION AND CONCLUSION: The addition of ACP to an accelerated nonoperative rehabilitation program featuring early mobilization does not affect the outcome of patients with an acute Achilles tendon rupture at one year post-injury.
DISCUSSION AND CONCLUSION: This heavy suture technique tries to imitate and temporarily provide the function of the inferior tibiofibular ligaments. Immediately post operative range of motion rehabilitation was performed to improve function of ankle. Early weight-bearing and motion (< 4-6 weeks) may be allowed. The problems of screw and suture button fixation may be avoided.

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<th>Radiography evaluation</th>
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<th>postoperative 12 months</th>
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<tbody>
<tr>
<td>tibiofibular clear space (mm)</td>
<td>5.35(3.8-7)</td>
<td>3.25(1.9-4)</td>
<td>3.37(2.7-4.1)</td>
</tr>
<tr>
<td>tibiofibular overlap (mm)</td>
<td>3.04(2.1-6.3)</td>
<td>6.15(5.1-8.4)</td>
<td>6.83(5.1-7.7)</td>
</tr>
<tr>
<td>medial clear space (mm)</td>
<td>6.05(4.7-9)</td>
<td>2.93(1.9-3.9)</td>
<td>3.41(2.9-4)</td>
</tr>
</tbody>
</table>

DISCUSSION AND CONCLUSION: In presumably uninjured specimens, both the ATFL and its footprint on the talus are bifid. The CFL and ATFL have a single confluent footprint on the anterior border of the distal fibula. The CFL footprint on the calcaneus can be located almost 3cm posterior and superior to the peroneal tubercle. This data will assist surgeons in performing anatomic reconstruction of the lateral ligament complex.
Preoperatively and at established follow up were performed. T2-mapping was taken at 24 months follow up. Cells harvesting, concentration, loading onto a scaffold and arthroscopic implantation were performed in the same surgical session.

RESULTS: AOFAS score was 63.73±14.13 preoperatively, 91.76±7.76 at 24 months and 82.19±17.04 (p<0.0005) at 46.8±6.8 months. T2-mapping showed a regenerate with T2-values of 35-45 ms, compatible with hyaline cartilage, in a mean of 78% of the repaired lesion area. The stability of clinical result over time and the percentage of hyaline cartilage evidenced by MRI showed a tendency to correlate at the last follow up (rho 0.497,p=0.06).

DISCUSSION AND CONCLUSION: “One-step” technique permitted good clinical results durable over time, even if a slight decrease in the clinical score was evident at the last follow up. The quality of the regenerate, detected by T2-mapping had an impact on the durability of the clinical result. This confirmed both the validity of the “one step” technique and the capability of MRI T2-mapping to give a reliable qualitative evaluation of the repair tissue.

PAPER NO. 152

Influence of Bisphosphonates on Fresh Osteochondral Allografts during Cold Storage

Zachary Leonard, MD, Auburn Hills, MI
Kevin Baker, MS, Royal Oak, MI
Erin A. Baker, MS, Royal Oak, MI
Paul T. Fortin, MD, Royal Oak, MI

INTRODUCTION: Viability and extracellular matrix production of chondrocytes within osteochondral allograft 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: Ten cylindrical osteochondral cores were taken from five fresh hemi-condyles from two donors. Following harvesting and rinsing with saline, 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. Cores were stored in respective media for 21 to 38 days following their post-mortem harvest. At various timepoints, cores were removed from the storage media sectioned for histology and stained with Safranin-O + Fast-Green to assess proteoglycan content. Terminal deoxynucleotidyl transferase (TUNEL) staining was also employed as a live/dead assessment tool. Caspase-3 immunostaining was used to assess the initiation of cellular apoptosis. Histologic slides were imaged by phase contrast and fluorescence microscopy.

RESULTS: Osteochondral cores from all treatment and control groups exhibited a time-dependent loss of Safranin-O staining to assess the initiation of cellular apoptosis. Histologic slides were imaged by phase contrast and fluorescence microscopy. Positive TUNEL staining (less viability) was greatest for etidronate at high and low doses. Low dose risedronate showed less chondrocyte death compared to control tissue and tissue treated with high dose risedronate. Caspase-3 staining was also highest for both etidronate groups and lowest for low dose risedronate.

DISCUSSION AND CONCLUSION: Maintenance of 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.

Figure. Safranin-O/Fast-Green stained sections of human osteochondral tissue stored in MTF solution (A), MTF solution supplemented with 0.1M Etidronate (B), 0.1M Risedronate (C), 0.01M Risedronate and 0.01M Etidronate.

PAPER NO. 153

Long-term Follow-up after Arthroscopic Treatment of Osteochondral Defects of the Talus

Christiaan JA Van Bergen, MD, Amsterdam, Netherlands
Laura Kox, MSc, Amsterdam, Netherlands
Mario Maas, Amsterdam, Netherlands
Inger Sierevelt, MSc
Gino M. Kerkhoffs, MD, PhD, Amsterdam, Netherlands
C. N. Van Dijk, MD, Abcoude, Netherlands

INTRODUCTION: The objective of this study was to assess the long-term clinical and radiographic outcome of arthroscopic debridement and bone marrow stimulation for talus osteochondral defects (OCDs).

METHODS: We contacted all patients with an OCD who had been treated through anterior or posterior ankle arthroscopy at our institution between 1988 and 2000. Exclusion criteria were concomitant ankle pathology, previous surgery of the affected ankle, recent ankle trauma, or refusal to sign informed consent. The patients were assessed using the Ogilvie-Harris score, Berndt & Harty score, American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score, and Short Form-36 (SF-36), as well as resumption of work and sports. Weight-bearing radiographs of the affected ankles were obtained and compared with preoperative radiographs using the Van Dijk ankle osteoarthritis (OA) classification (see figure). Possible prognostic factors (gender, age, side, traumatic etiology, symptom duration, preoperative OA, follow up, body mass index, lesion size, location and classification) were recorded and analyzed by logistic regression.

RESULTS: Fifty (88%) of 57 eligible patients were included after a mean follow up of 12 (range, 8-20) years. According to Ogilvie-Harris, 20% scored excellent, 58% good, 22% fair and 0% poor (see table). According to Berndt & Harty, 74% rated
their ankles good, 20% fair and 6% poor. The median AOFAS was 88 (range, 64-100). SF-36 subscales ranged from a median of 70 for the “vitality” component to 100 for the “role physical” and “role emotional” components. Ninety-four percent of the patients had resumed work, 88% had resumed sports. The radiographs (n = 48) were classified as OA grade 0 in 33%, grade I in 63%, grade II in 4%, and grade III in 0%. Compared to the preoperative OA classification, 67% of radiographs showed no progression and 33% showed progression by one grade. None of the prognostic factors was significantly associated with the Ogilvie-Harris score or with progression of OA (p >0.05).

DISCUSSION AND CONCLUSION: This study shows that initial success rates of arthroscopic debridement and bone marrow stimulation for osteochondral ankle lesions last over time.

### Ogilvie-Harris score at follow-up (no. of patients)

<table>
<thead>
<tr>
<th></th>
<th>Poor</th>
<th>Fair</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>0</td>
<td>8</td>
<td>23</td>
<td>19</td>
</tr>
<tr>
<td>Swelling</td>
<td>0</td>
<td>2</td>
<td>12</td>
<td>36</td>
</tr>
<tr>
<td>Stiffness</td>
<td>0</td>
<td>6</td>
<td>20</td>
<td>24</td>
</tr>
<tr>
<td>Limping</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>48</td>
</tr>
<tr>
<td>Activity</td>
<td>0</td>
<td>9</td>
<td>12</td>
<td>29</td>
</tr>
</tbody>
</table>

Final score (the lowest item of each patient determines the final score of that patient) | 0 | 11 (22%) | 29 (58%) | 10 (20%) |

The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
Biomechanical Assessment of Flatfoot Correction Techniques in a Cadaver Model

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Richard R. Glisson, Durham, NC
Mark E. Easley, MD, Durham, NC
James A. Nunley, II, MD, Durham, NC

INTRODUCTION: Using a cadaver flatfoot model, we evaluated the ability of a range of current surgical methods to correct the deformity and resist flattening during ensuing mechanical challenges. Emphasis was placed on determining whether spring ligament repair contributes appreciably to the integrity of the surgical correction.

METHODS: Flatfoot deformity was created in eight fresh frozen lower legs through ligament attenuation and repetitive axial loading coupled with extrinsic tendon loading. In the intact, flat and corrected conditions the angular positions of key bones were documented during post-surgical load cycles 100, 500, 1000 using electronic clinometers attached to the talus, navicular and first metatarsal. The talus-first metatarsal angle was measured in the sagittal plane, and the talus-navicular angle was measured in the coronal plane. Six corrective procedures were sequentially evaluated, and repeated measures ANOVA with Bonferroni post-hoc tests were used to determine differences among the treatments:

1. Lateral column lengthening using an 8 mm wedge. 2. Medial displacement calcaneal osteotomy and flexor digitorum longus (FDL) transfer. 3. Medial displacement calcaneal osteotomy and FDL transfer plus lateral column lengthening. 4. Treatment 3 plus "pants-over-vest" spring ligament repair. 5. Treatment 3 plus "distal posterior tibialis stump to spring" ligament repair. 6. Treatment 3 plus "sutures and anchors" spring ligament repair.

RESULTS: The mean sagittal plane flattening, reflected by the talus-1st MT angle, was 8.5 degrees. As indicated by the graph, all treatments achieved some degree of correction, which gradually decreased during post-operative cyclic loading. Correction afforded by Treatment 1 (lateral column lengthening with 8mm wedge) exceeded that of Treatment 2 (medial displacement calcaneal osteotomy and FDL transfer) at all evaluated time points (p=0.002). Treatment 2 corrected significantly less than each treatment except Treatment 3 (same procedure as 2, plus lateral column lengthening)(p=0.0002-0.036). No differences were distinguishable between the three spring ligament repair techniques. In the coronal plane, flattening produced mean navicular eversion of 5.7 degrees relative to the talus. Treatment 2 talus-navicular angle correction was inferior to all other treatments at all time points (p=0.0002-0.005). Treatments 1, 3, 4, 5 and 6 maintained near-normal talus-navicular angles throughout cyclic loading, with no differences evident among treatments.

DISCUSSION AND CONCLUSION: This study refutes traditional teachings regarding the location of OLT and supports recent studies showing that most lesions are located medially and centrally on the talar dome. Lesion location is not correlated with subject age, lesion chronicity, mechanism of injury, need for surgery, lesion instability or lateral ligament abnormality. While no statistical differences were noted, the medial lesions were larger and the lateral lesions were more often seen in association with ligamentous injury. A larger case series with review of these factors relative to lesion location would be helpful to further investigate these relationships.

Lesion Location and Frequency

<table>
<thead>
<tr>
<th>Location</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Medial</td>
<td>45</td>
</tr>
<tr>
<td>Central</td>
<td>40</td>
</tr>
<tr>
<td>Lateral</td>
<td>35</td>
</tr>
<tr>
<td>Anterior</td>
<td>20</td>
</tr>
</tbody>
</table>

![](image1.png)

Talus - MT1 angle (n=8 specimens)

- Flattened (Mean talus - MT1 angle loss = 8.46 degrees)
INTRODUCTION: The transverse tarsal joint is comprised of the calcaneocuboid and talonavicular joints, and the transverse tarsal locking mechanism has historically been used to describe the kinematics of these joints. This description states that inversion of the calcaneus will “lock” the transverse tarsal joint, creating a rigid midfoot. This allows for more efficient ambulation, and is thought to occur at the later stages of the stance phase of gait. The motion of the transverse tarsal joint is difficult to measure and has never been well quantified. The purpose of this study was to describe the kinematics of the transverse tarsal joint using newly available biplanar fluoroscopy in a cadaveric model of static simulated gait.

METHODS: Seven cadaveric specimens (average age 69.6) underwent simulated static gait with half physiologic axial and extrinsic muscular loads. Prior to testing, one-millimeter tantalum beads were inserted into 10 bones of the foot and ankle. Using biplanar fluoroscopy, images were captured at nine different positions during the stance phase of gait. Bone orientation at each position was determined via marker tracking. Motion of the navicular and cuboid bones relative to the talus were described using helical axes of motion.

RESULTS: The mean orientation of the helical axes of motion for the cuboid and navicular from heel strike to foot flat was 10.5°+7.1° (Figure 1). This finding suggests that the cuboid and navicular are moving together. From foot flat to toe off, the motions of the cuboid and navicular were sufficiently small that the helical axes were inconsistent. Similarly, from heel strike to foot flat the centroid of the cuboid and navicular translated 20.9+8.5 mm and 9.3+3.8 mm in the frontal plane, respectively (Figure 2, left), while from foot flat to toe off, the cuboid and navicular translated 2.1+1.6 mm and 1.2+0.8 mm, respectively (Figure 2, right). This finding suggests that there is little motion through the transverse tarsal joint from foot flat to toe off.

DISCUSSION AND CONCLUSION: This study is the first to quantify the three-dimensional motion of the talar and calcaneocuboid joints using biplanar fluoroscopy and three-dimensional visualization. Our findings suggest that the cuboid and navicular function as a unit. In addition, our findings suggest that the transverse tarsal joint is locked from heel strike to foot flat. The latter finding, however, is contrary to the historical description of the motion across this joint complex, and suggests that the kinematics of the transverse tarsal joint is more complicated than originally thought.

The Influence of Foot Geometry on the Calcaneal Osteotomy Angle Based on Two-dimensional Static Force Analysis

Mikel Reilingh, MD, Amsterdam, Netherlands
Gabrielle JM Tuijthof, PhD
Leendert Blankevoort, PhD, Amsterdam, Netherlands
C. N. Van Dijk, MD, Abcoude, Netherlands

INTRODUCTION: To reduce shear forces in the osteotomy plane after a calcaneal osteotomy, it is recommended to take into account the foot geometry (arch) when deciding on the calcaneus osteotomy angle for hindfoot correction. Malalignment of the hindfoot can be corrected with a calcaneal osteotomy (CO). A well selected osteotomy angle in the sagittal plane will reduce the shear force in the osteotomy plane when walking.

The purpose was to determine the presence of a relationship between the foot geometry and loading of the calcaneus, which influences the choice of the preferred CO angle.

METHODS: A static free body force analysis was made of the hindfoot can be corrected by a calcaneal osteotomy (CO). A well selected osteotomy angle in the sagittal plane will reduce the shear force in the osteotomy plane when walking.

RESULTS: Based on the wish to minimize shear force during walking, a mean CO angle was determined to be 33 degrees (SD8) degrees relative to the foot sole. In pes planus foot geometry, the angle should be higher than the mean. In pes cavus foot geometry, the angle should be smaller.
DISCUSSION AND CONCLUSION: Foot geometry, in particular the relative foot height, is a determinant for the individual angle in performing the sliding calcaneal osteotomy. It is recommended to take into account the foot geometry (arch) when deciding on the CO angle for hindfoot correction.

PAPER NO. 159
《Autologous Matrix-Induced Chondrogenesis (AMIC) for Reconstruction of Osteochondral Lesions of the Talus》
Victor Valderrabano, MD, Basel, Switzerland
Matthias Miska, MD, Basel, Switzerland
Ulri Studler, Basel, Switzerland
Martin Viewierski, MD, Stallikon, Switzerland

INTRODUCTION: Surgical treatment of osteochondral lesions (OCL) of the talus remains a challenging task. Several surgical techniques are available, e.g., autologous chondrocyte implantation (ACI), osteochondral autograft transfer system (OATS), matrix-induced autologous chondrocyte implantation (MACI). Good clinical results are reported; however, certain disadvantages remain (sacrificing healthy cartilage of another joint for grafts, the need for two-stage procedure, high costs). We present the clinical-radiological results of a novel one-step surgical technique for treatment of OCL of the talus. The autologous matrix-induced chondrogenesis (AMIC)-aided procedure combines debridement, spongiosa-plasty from the iliac crest and covering with a collagen I/III membrane.

METHODS: Twenty-five patients (10 female, 15 male; mean age 36 years [range 17-55 years]) were prospectively assessed in our outpatient clinic for OCL of the talus. Clinical examination included the American Orthopaedic Foot & Ankle Society (AOFAS) hindfoot scale and Visual Analogue Scale (VAS). Radiological imaging consisted of conventional radiographs and magnetic resonance imaging (MRI). Surgical procedure consisted of debridement of the OCL, spongiosa-plasty from the iliac crest and coverage with a commercially available I/III collagen membrane. Clinical and radiological follow up was performed after a minimum of 24 months postoperatively.

RESULTS: The preoperative AOFAS hindfoot scale was poor with a mean of 59.8 points (SD 16). At a mean follow up of 28.2 months (range 24-47 months), the score improved significantly (p<0.01) to 89.2 points (SD 12). Pain measured with VAS improved significantly (p<0.01) from 5.1 (SD 1.7) preoperatively to 1.6 (SD 2.1) postoperatively. At follow-up conventional radiographs showed osseous integration of the graft in all cases. MRI showed intact cartilage covering of the lesions in all cases. DISCUSSION AND CONCLUSION: Excellent clinical and radiological results were demonstrated after a mean follow up of 28.2 months. The results are comparable with the results of ACI, OATS and MACI. The AMIC-aided technique is a readily available, economically efficient, one step surgical procedure for treatment of OCL of the talus.

PAPER NO. 160
Radiographic Analysis of Surgical Correction of Adult Acquired Flatfoot Deformity
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Jeffrey E. Johnson, MD, Saint Louis, MO
Jeremy J. McCormick, MD, Saint Louis, MO
Sandra E. Klein, MD, Saint Louis, MO

INTRODUCTION: The purpose of this study is to identify the expected radiographic correction with commonly used bony realignment procedures for adult acquired flatfoot deformity either individually or in combination. Adult acquired flatfoot deformity is a progressive bony deformity of the foot related to both tendon and ligamentous failure. Multiple procedures have been described to treat the wide range of stage II (flexible) disease deformities. In general, the treatment algorithms and recommendations have been based on clinical findings and the presence of “mild” versus “severe” deformity. The purpose of this study is to identify the expected radiographic correction with commonly used bony realignment procedures either individually or in combination. An algorithm for treatment of this condition using previously described clinical and radiographic parameters will be developed.

METHODS: A total of 85 feet in 81 patients were surgically treated for Stage II adult acquired flatfoot between January 1999 and December 2010. Pre and postoperative weightbearing radiographs were available for 72 procedures in 68 patients. The average age of the patients evaluated was 55 years, and final radiographs were evaluated at an average of nine months postoperatively. Operative reports were reviewed, and patients were grouped according to the procedures performed. All patients had a FDL transfer to the navicular in addition to bony realignment. Radiographic parameters measured included: lateral talo-1st metatarsal angle, medial cuneiform-floor distance, calcaneal pitch, AP talo-2nd metatarsal angle and talonavicular coverage angle. Differences in pre and post operative radiographic parameters were analyzed.

RESULTS: Patients were grouped into three primary categories according to whether a medial displacement calcaneal osteotomy, lateral column lengthening or both were performed. Group I consisted of patients undergoing a medial displacement calcaneal osteotomy, lateral column lengthening or both were performed. Group II included patients who received a lateral column lengthening alone. The surgical procedure in group III patients included both medial displacement calcaneal osteotomy and lateral column lengthening. The lateral talo-first metatarsal angle mean difference was 5.1 degrees in group I, 16.2 degrees in group II and 16.5 degrees in group III. The talonavicular coverage angle mean difference was 5.7 degrees in group I, 24.2 degrees in group II and 19.4 degrees in group III.

DISCUSSION AND CONCLUSION: Medial displacement calcaneal osteotomy is frequently used alone with FDL transfer to the navicular to correct a stage II flat foot deformity. However, this procedure does not create a large change in commonly used radiographic parameters. The lateral column lengthening resulted in larger radiographic improvements. When the two procedures were combined, the radiographic results were similar to lateral column lengthening alone. Both clinical and radiographic parameters are a consideration when choosing the bony realignment procedure when treating a flexible flatfoot deformity. When treating a more severe deformity, the lateral column lengthening results in more radiographically measurable improvement in alignment.

PAPER NO. 161
Fresh Osteochondral Allograft for the Treatment of Cartilage Defects of the Talus: A Retrospective Review
Diego C. Villacis, MD, Los Angeles, CA
Armen S. Kelikian, MD, Chicago, IL
Hany El-Rashidy, MD, Deerfield, IL

INTRODUCTION: Osteochondral lesions of the talar dome (OLT) can cause significant functional impairment and present a difficult dilemma for the treating physician. Interest has recently focused on treatment with the use of fresh osteochondral allograft as a promising alternative. The purpose of this study was to evaluate the clinical outcome of osteochondral lesions of the talus (OLT) treated with fresh osteochondral allograft.
METHODS: We performed fresh osteochondral allograft transfer on 42 patients with symptomatic, refractory OLT with persistent pain. Complete post-operative follow-up was obtained on 38/42 patients. The average age was 44.2 years (19-74) and mean follow up was 38 months. Clinical evaluation was performed using the American Orthopedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score and visual analog scale (VAS). All scores were obtained from retrospective chart review and direct patient interview. All patients were also asked about their subjective satisfaction with the procedure. Postoperative MRI to assess graft incorporation, subsidence, articular cartilage congruity, osteoarthritis, and stability using the DeSmet criteria were obtained in fifteen patients.

RESULTS: The average follow up after osteochondral allograft transplantation was 37.7 months. Graft failure occurred in four patients. Including scores prior to revision for those with graft failure, the mean VAS score improved from 8.2 to 3.3 and the AOFAS Ankle-Hindfoot score improved from 52 to 79 points. Patient satisfaction with the outcome was rated as excellent, very good or good by 28 of the 38 patients and fair or poor by 10 of the 38 patients. Of the 15 MRIs done most showed minimal graft subsidence, reasonable graft stability and articular congruence.

DISCUSSION AND CONCLUSION: In our experience, fresh osteochondral allograft transplant is a viable and effective method for treating patients with OLT as evidenced by improvement in patients' pain and function.

PAPER NO. 162

Functional and T2-Mapping MRI Results of Autologous Osteochondral Transplantation of the Talus in 72 Patients

Christopher D. Murawski, New York, NY
John G. Kennedy, MD, New York, NY

INTRODUCTION: Osteochondral lesions of the talus (OLT) are common injuries following acute and chronic ankle sprains and fractures, the treatment strategies of which include both reparative and restorative techniques. Reparative techniques include arthroscopic bone marrow stimulation (i.e., microfracture, drilling) and provide fibrocartilage infill to the defect site. The long-term concern with microfracture, however, is this biologically and mechanically inferior fibrocartilage will degrade over time, particularly in larger lesions. Recently, restorative techniques (i.e., autologous osteochondral transplantation) have been become increasingly popular as a primary treatment strategy, in part due to the potential advantages of replacing “like with like” in terms of hyaline cartilage at the site of cartilage repair. The current study examines the functional results of autologous osteochondral transplantation of the talus in 72 patients.

METHODS: Between 2005 and 2009, 72 patients underwent autologous osteochondral transplantation under the care of the senior author. The mean patient age at the time of surgery was 34.19 years (range, 16-85 years). All patients were followed for a minimum of one year after surgery. The mean follow-up time was 28.02 months (range, 12-64 months). Patient-reported outcome measures were taken pre-operatively and at final follow-up using the Foot and Ankle Outcome Score and Short-Form 12 general health questionnaire. Identiﬁcal questionnaires were used in all instances. Quantitative T2-mapping MRI was also performed on select patients at one year post-operatively to evaluate the collagen microstructure of the repair cartilage using a standardized evaluation protocol.

RESULTS: The mean FAOS scores improved from 52.67 points pre-operatively to 86.19 points post-operatively (range, 71-100 points). The mean SF-12 scores also improved from 59.40 points pre-operatively to 86.19 points post-operatively (range, 71-100 points).

Three patients reported donor site knee pain after surgery and one patient required the decompression of a cyst that developed beneath the graft site approximately two years after the index procedure. Quantitative T2-mapping MRI demonstrated relaxation times that were not signiﬁcantly different to those of native cartilage in both the superficial and deep halves of the repair tissue. DISCUSSION AND CONCLUSION: Autologous osteochondral transplantation is a reproducible and primary treatment strategy for large osteochondral lesions of the talus and provides repair tissue that is biochemically similar to that of native cartilage on quantitative T2-mapping MRI. This may ultimately allow the ankle joint to function adequately over time.

PAPER NO. 163

Metal Implantation for Secondary Osteochondral Defects of the Talus: A Prospective Study

Christiaan JA Van Bergen, MD, Amsterdam, Netherlands
Mikel Reilingh, MD, Amsterdam, Netherlands
C. N. Van Dijk, MD, Abcoude, Netherlands

INTRODUCTION: Osteochondral ankle defects (OCDs) mainly occur in a young, active population. In 63% of cases the defect is located on the medial talar dome. Arthroscopic debridement and microfracture is considered the primary treatment for defects up to 15 mm. To treat patients with a secondary OCD of the medial talar dome and avoid donor site morbidity, a 15 mm diameter metal implant was developed. The set of 15 offset sizes was designed to correspond with the geometry of the various talar dome curvatures. Recently, two independent groups published biomechanical cadaveric studies that provided rationale for clinical use. The present study was undertaken to evaluate the clinical effectiveness of the metal implantation technique for osteochondral lesions of the medial talar dome.

METHODS: This is a prospective case series. The inclusion criteria were the combination of a large OCD (0 >12 mm) of the medial talar dome, persistent complaints >1 year after treatment, and clinically relevant pain levels. The exclusion criteria were: age <18 years, OCD size >20 mm, ankle osteoarthritis grade 2 or 3, concomitant ankle pathology and diabetes. The primary outcome measure was the Numeric Rating Scale pain (NRS) rest, walking, running and stairclimbing. Secondary outcome measures were: Foot Ankle Outcome Score (FAOS), American Orthopaedic Foot and Ankle Society (AOFAS) Ankle-Hindfoot score and clinical and radiographic complications. The Wilcoxon signed ranks test was used to calculate p-values.

RESULTS: Based on the inclusion and exclusion criteria, 10 of 13 consecutive patients were included between October 2007 and March 2009. The median follow up was two years (range, two to three years). All patients had had one or two earlier operations without success. On preoperative CT scanning, the median lesion size was 15 (range, 12-20) × 11 (range, 8-14) mm. The NRS rest improved from a median of 3 (0-7) preoperatively to 0.5 (0-2) at final follow-up (p = 0.017), NRS walking from 6.5 (4-8) to 1 (0-4) (p = 0.005), NRS running from 9 (6-10) to 3 (0-10) (p = 0.024) and NRS stair climbing from 6 (4-8) to 1 (0-7) (p = 0.012). The FAOS improved signiﬁcantly on four of ﬁve subscales (see table). The AOFAS improved from a median of 70 (47-75) before surgery to 89 (69-100) at final follow up (p = 0.008). There were three temporary complications: hyposensibility about the scar in two and a superficial wound infection in one. There were no radiographic complications (see figure). All patients indicated they would undergo the procedure again.

DISCUSSION AND CONCLUSION: The metallic implantation technique appears to be a promising treatment for secondary OCDs.
of the talus but more patients and longer follow up are required to draw firm conclusions.

### Foot and Ankle Outcome Score (median and range)

<table>
<thead>
<tr>
<th></th>
<th>Preoperatively</th>
<th>Final follow-up</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pain</td>
<td>61 (36-78)</td>
<td>82 (47-100)</td>
<td>0.005</td>
</tr>
<tr>
<td>Symptoms</td>
<td>63 (21-86)</td>
<td>68 (36-93)</td>
<td>0.235</td>
</tr>
<tr>
<td>Function</td>
<td>64 (43-85)</td>
<td>93 (68-100)</td>
<td>0.005</td>
</tr>
<tr>
<td>Sports</td>
<td>38 (2-70)</td>
<td>80 (35-95)</td>
<td>0.005</td>
</tr>
<tr>
<td>Quality of life</td>
<td>19 (0-44)</td>
<td>54 (13-88)</td>
<td>0.005</td>
</tr>
</tbody>
</table>

### DISCUSSION AND CONCLUSION

The dorsalis pedis and posterior tibial arteries branch to supply blood flow to the navicular. In some specimens, there is a zone of avascularity in the central dorsal region of the bone, but in most adult cadaver specimens, the navicular has a dense intraosseous vascular supply throughout.

**PAPER NO. 165**

**Operation after Regional Anesthesia by Ultrasound-guided Femorosciatic Nerve Block**

Chan Kang, MD, Jung-Gu, Republic of Korea  
Deuk-Soo Hwang, MD, Taejon, Republic of Korea  
Young-mo Kim, Prof, Dae Jeon, Republic of Korea  
YONG-BUM JOO, Daejeon, Republic of Korea  
Soo-Min Cha, Daejeon, Republic of Korea  
Seung-Hyun Lee, Daejeon, Republic of Korea

**INTRODUCTION:** This study is to report the results of performing foot, ankle and lower leg operations safely under ultrasound-guided femorosciatic nerve block (USG-FSNB) by orthopaedic surgeon.

**METHODS:** Three hundred-twelve cases that underwent operation below the knee joint under ultrasound-guided femorosciatic nerve block (USG-FSNB) from January 2010 to May 2011, were chosen for the study. There were 197 cases (185 patients) of male and 115 cases (92 patients) of female, and mean age of the whole cases was 47.5 (15-88) years old. Operations consisted of eight cases of internal fixation for distal tibia fracture, 48 cases of internal fixation for ankle fracture, 26 cases of internal fixation for tarsal bone fracture, nine cases of tibiocalcaneal external fixation, 41 cases of metal removal of distal tibiofibula, 11 cases of Achilles tendon rupture operation, 13 cases of ankle instability and arthroscopic surgery, 19 cases of skin graft or local flap, 31 cases of amputation, 72 cases of other foot surgery and 34 cases of other ankle joint or lower leg operation. For regional anesthesia, mixture of 1% lidocaine and 0.75% ropivacaine was injected under guidance of ultrasound to block the femorosciatic nerve. For perioperative sedation, midazolam was injected 3mg intramuscularly and 2mg intravenously. We surveyed and investigated the procedure time of nerve block, the complete anesthetic induction time, the duration of analgesic effect, the anesthesia complication, the sedatives complication and VAS (visual analogue scale) score for evaluating patient's satisfaction about the anesthesia.

**RESULTS:** It took an average of 4.5 minutes (2~12) to nerve block, and average of 48 minutes (15~120) were taken until the complete anesthetic induction, and the average duration of analgesic effect was 12.8 hours (6~24). There were no complications of nerve stimulation or nerve injury due to nerve block, and also there were no cases that converted to spinal or general anesthesia due to failure of nerve block. There was no other complication due to anesthesia or sedatives. The mean VAS satisfaction score was 9.1 (5~10) points. On the question of choosing the anesthesia method under the hypothesis that they undergo the same operation in the future, 295 cases (95%) chose USG-FSNB and 17 cases (5%) chose general anesthesia.

**DISCUSSION AND CONCLUSION:** Ultrasound-guided femorosciatic nerve block done by orthopaedic surgeon is a quick and easy procedure. Since it has less complication of nerve injury and high success rate of anesthesia, it could be used safely on operation for foot, ankle and lower leg.
INTRODUCTION: Tibiotalar arthritis in the young, active patient is a debilitating condition with limited treatment options, including ankle arthrodesis and arthroplasty. Arthroplasty can be associated with a high reoperation and failure rate, while arthrodesis may lead to compromised motion, function and adjacent joint degeneration. Bipolar tibiotalar fresh osteochondral allograft (OCA) transplantation was conceived as a possible alternative to overcome the limitations of these two treatments and to restore function in this patient population. We report our experience with bipolar ankle OCA for tibiotalar joint arthritis. We hypothesized that bipolar ankle OCA would lead to clinical outcome similar or better than previously reported series, with revision, reoperation and satisfaction rates equal to arthroplasty and arthrodesis. METHODS: Between 1999 and 2008, one of two surgeons (WB, MB) performed 91 bipolar ankle allografts (87 patients, mean age 45 (18-71)). All patients declined arthroplasty or arthrodesis. We used external fixation, ankle distraction, anterior approach and an arthroplasty jig for bony resections and allograft fixation. Patients reMed non-weightbearing for three months. Evaluation included an ankle assessment score for pain and function, AOFAS ankle-hindfoot score and patient satisfaction. Radiographs were evaluated for joint space narrowing, collapse, fracture and cysts. Clinical endpoints included reoperation for any reason including OCA failure resulting in revision OCA, total ankle arthroplasty, arthrodesis or amputation. RESULTS: Sixty-two of 91 ankles had minimum two-year follow up (mean 49 months; range, 24-124 months). Twenty-two of 62 (32%) allografts had repeat surgery since implantation: eight revision OCA, four total ankle arthroplasty conversions, five debridements, three arthrodeses and two below knee amputation secondary to intractable pain. Forty patients completed questionnaires. Mean post-operative Ankle Survey score was 60 (15-95). Mean AOFAS Ankle Hindfoot score was 75 (15-100). Radiographic evaluation was available for 48 patients. Fifteen (31%) had >50% joint space narrowing, with eight undergoing reoperation. Of 58 patients completing satisfaction questionnaires, 46 (79%) were satisfied, 55 (95%) indicated an improvement in ankle condition and 48 (86%) stated they would have the surgery again. DISCUSSION AND CONCLUSION: Fresh bipolar ankle OCA for tibiotalar arthritis resulted in acceptable outcome in this difficult population, with most patients having improved objective and subjective outcome measures. The reoperation rate of 32%, while relatively high, is comparable to arthroplasty in a similar population. Maintenance of tibiotalar motion may be an important advantage, with improved function and less risk to surrounding joints. Subjective measures of satisfaction were very high in spite of the reoperation rate. Importantly, OCA failure did not limit further surgical options. We conclude that bipolar ankle allografting is a useful alternative in carefully selected patients with advanced tibiotalar arthritis who either decline or are contraindicated for total ankle arthroplasty or arthrodesis.
to OA (62 and 52) and RA (43 and 34) group (p<0.02). At 2 years, the trend continued with PTOA group reporting better scores for three domains (p<0.05) when compared to the other two groups.

**DISCUSSION AND CONCLUSION:** Two-year results of total ankle arthroplasty comparing outcomes by diagnosis demonstrate that PTOA patients have superior outcomes compared to patients with OA and RA.

**PAPER NO. 439**

**Mobility Total Ankle Replacement: The Canadian Experience**

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**INTRODUCTION:** Total Ankle Replacement (TAR) is increasingly being offered to patients as an alternative to arthrodesis for the operative management of debilitating end-stage ankle arthritis. Longstanding concerns with accelerated degeneration of adjacent joints, alterations in gait mechanics, limitations in activity and the rate of non-union compelled surgeons to pursue the theoretical advantages offered by TAR. The Mobility Total Ankle System is a third-generation design consisting of three component, cementless, unconstrained, mobile-bearing prosthesis. This study reports the early results of a multi-center prospective study of the Mobility prostheses. This is the first such report by independent researchers.

**METHODS:** The senior authors implanted 88 consecutive Mobility prostheses in 85 patients. The underlying diagnosis was primary osteoarthritis (OA) in 24 ankles, secondary OA in 47 ankles (post-traumatic 38 / instability nine) and inflammatory arthritis in 17 ankles (14 patients). There were 41 males (mean age 67 / range 51-87) and 44 females (mean age 60 / range 29-72). The mean body mass index (BMI) was 28 (range 22-36) for males, and 28 (range 20-39) for females. Previous ankle operations were performed in 24 patients, 22 of which were for fracture fixation. Ankles were classified according to the COFAS end-stage ankle arthritis classification system. Coronal plane deformity was quantified pre-operatively. Patients were reviewed at regular intervals post-operatively with clinical and radiological assessment. Clinical outcome was assessed using the AOFAS ankle-hindfoot score. Radiological assessment was performed from weight-bearing radiographs, documenting post-operative alignment, osseous integration, edge-loading and heterotopic bone formation. The mean follow-up time was 40 months (range 30-60). Survival analysis was calculated according to the Kaplan-Meier method. Failure was defined as exchange of any component of the TAR, arthrodesis or amputation.

**RESULTS:** Type 1 ankle arthritis was demonstrated in 44 ankles (50%). No patient had pre-operative coronal plane angulation > 20°. In 32 ankles (36%), the pre-operative coronal alignment was neutral, and in 34 ankles (39%), the deformity was < 10°. The mean AOFAS ankle-hindfoot score improved from 37.4 (range 12-59) pre-operatively to 77.9 (range 51-100) post-operatively. Eighty-nine (91%) of prosthetic components were implanted within 5° of the optimal position. Bone-implant interface abnormalities were identified in 33 ankles with retained prostheses (43%). In total, eight TARs required revision, six for aseptic loosening, one for component malpositioning and one for deep infection. There was one conversion to arthrodesis, and one below knee amputation (BKA) for complex regional pain syndrome (CRPS). Forty-six simultaneous procedures were performed in 31 patients. The most common was subtalar fusion. There were eight re-operations, most commonly for impingement due to peri-articular ossifications. Delayed wound healing occurred in three patients, and there was one case of superficial infection. Five patients sustained fractures of the medial malleolus: two were intra-operative and underwent internal fixation. Six patients are being investigated for ongoing pain. The two-year survival was 95.4% (95% CI 88.1-98.5) and three-year survival was 89.9% (95% CI 80.9-94.8).

**DISCUSSION AND CONCLUSION:** Although early results of the Mobility TAR are encouraging for independent researchers, they do not match those reported by designer surgeons. Most patients achieve good pain relief and improved function post-operatively.

**PAPER NO. 440**

**Validity, Reliability and Responsiveness of the Self-reported Foot and Ankle Score (SEFAS)**

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**INTRODUCTION:** Currently there exists no validated, patient administrated score that is regarded as the gold standard when evaluating function in patients with foot and ankle disorders. Therefore we evaluated the reliability, validity and responsiveness of the Self-reported Foot and Ankle Score (SEFAS).**

**METHODS:** A self-reported ankle questionnaire was introduced by the New Zealand Arthroplasty Registry when evaluating the outcome of total ankle replacement surgery. The questionnaire was translated to Swedish according to a standardized procedure. It was sent to 135 patients with ankle arthritis, scheduled or subjected to surgery, together with the Foot and Ankle Outcome Score (FAOS), Short Form-36 (SF-36) Score and Euroqol (EQ-5D) Score. Construct validity was evaluated by Spearman’s correlation coefficient when comparing SEFAS with FAOS, SF-36 and EQ-5D, content validity by calculating floor and ceiling effects, test-retest reliability by intra-class correlation coefficient (ICC), internal consistency by Cronbach’s alpha (n=62), agreement by a Bland Altman Plot and responsiveness by effect size and standardized response mean (n=20).

**RESULTS:** SEFAS correlated with the other scores and sub-scores with a coefficient above 0.40 in most comparisons. There were no floor and ceiling effects. ICC was 0.92 (CI 95% 0.88-0.95), Cronbach’s alpha 0.96, effect size 1.28 and the standardised response mean 0.89.

**DISCUSSION AND CONCLUSION:** SEFAS is a self-reported foot and ankle score with high validity, high reliability and good responsiveness, indicating that the score can be used safely when evaluating patients with ankle arthritis and outcome of ankle surgery.

**PAPER NO. 441**

**Lower Limb Alignment Compensation of Knee Deformity Occurs Through the Subtalar Joint**

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**INTRODUCTION:** Lower extremity malalignment, particularly at the knee joint, will affect hindfoot orientation, requiring...
compensation for proper gait. This study was performed to elucidate the degree of compensation occurring at three locations of the hindfoot (distal tibia, ankle and subtalar joint) in response to altered lower extremity kinematics due to knee deformity.

METHODS: A total of 378 total knee arthroplasties (TKAs) in 304 patients were evaluated. Standing full-leg-length anteroposterior and Saltzman hindfoot alignment view radiographs were used to determine the mechanical axis angle, the degree of hindfoot malalignment, the anatomic lateral distal tibial angle (αLDTA) and the ankle joint line convergence angle (ankle JLCA). The relationship between knee deformity, as well as hindfoot deformity, and the αLDTA, ankle JLCA and the subtalar joint (STJ) were assessed for linear correlation. Student t-tests were performed to determine the difference in the αLDTA, ankle JLCA and the STJ between knees and hindfeet with varus and valgus deformity. Intraclass correlation coefficients were used to evaluate intra- and interobserver reliability.

RESULTS: The mechanical axis angle correlated with the αLDTA, ankle JLCA and the STJ in the entire cohort and in a sub-group of patients with ≥10° knee deformity. The hindfoot angle was correlated with the αLDTA, ankle JLCA and the STJ in the entire cohort. The difference in the αLDTA, ankle JLCA and the STJ between knees with varus and valgus deformity were significant in the ≥10° knee deformity cohort. The difference in the αLDTA, ankle JLCA and the STJ between hindfeet with varus and valgus deformity were significant in the entire cohort. Intra- and interobserver reliability analysis showed excellent reliability in all measurements.

DISCUSSION AND CONCLUSION: This study demonstrates that in patients with hindfoot malalignment, due to knee deformity, there exists a strong, significant correlation between the hindfoot angle and the STJ. The majority of compensation within the hindfoot occurs through the STJ while the αLDTA and ankle JLCA have a minimal role in the overall compensatory ability of the hindfoot. These findings have direct implications for treating patients with both knee and foot/ankle problems.

Long-Term Clinical Outcomes of Total First Metatarsophalangeal Joint Implants
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INTRODUCTION: Management of late-stage degenerative joint disease of the first metatarsophalangeal (MTP) is a complex topic that is frequently the source of debate among foot and ankle surgeons. One of the most contested of these treatments is implant arthroplasty of the first MTP. In 1971, we reported on the early success of a silicone implant (introduced by Alfred Swanson, MD), for the treatment of "subluxated hallux valgus deformity." After a few years, it was obvious that this implant would deteriorate, causing detritic, silicone synovitis, bone cysts and loss of bone stock. The implant, named by the acronym, "Hemi-toe," was soon replaced by Swanson with a more robust replica of the metacarpophalangeal joint, hinged silicone implant used in patients with rheumatoid arthritis of the fingers and wrist. Thereafter, following positive outcomes of the use of titanium grommets to protect the bone-implant interface, we participated in a “Swanson Hinged Great Toe, Silastic Implant with Titanium Grommets” clinical trial to establish safety and efficacy of this device. For the past 35 years, we have used this device, almost exclusively, as an option for female patients between the ages of 45-75 years old, who had a diagnosis of end stage hallux rigidus deformity and who refused the option of great toe arthrodesis. METHOD: Medical records, from consecutive patients who underwent a Silastic Hinged Toe (with titanium grommets) operation between January 1978 to December 2002, were retrospectively reviewed. A total of 96 patients (122 feet) were included in the study that had at least 24 months of follow up. Clinical data was recorded, included post-operative range of motion and the clinical rating from the American Orthopaedic Foot and Ankle Society for Hallux MTP scale. Post-operative complications and revision rate was also recorded.

RESULTS: The average age of the patients was 58.9 years with an average follow up of 82.6 months (range 24 to 208 months). Of 96 patients, 54 patients had a mean AOFAS rating 91.6 while the mean post-operative range of motion was 47.2 degrees of dorsiflexion and 8.7 degrees of plantarflexion. There was a 36% minor complication rate which resolved in time (chronic swelling, second metatarsalgia, minor wound dehiscence) and 16% of patient’s required revisional surgery to the first MTP implant.

DISCUSSION AND CONCLUSION: Our long-term series demonstrated that there is a high survival rate (84%) and satisfaction rate (88%) in the long-term results using a silastic hinged toe first MTP implant for hallux rigidus in females between the ages of 45-75 years old.
Early Prospective Clinical Results of a Modern Fixed-Bearing Total Ankle Replacement

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INTRODUCTION: Several fixed-bearing total ankle arthroplasty (TAA) systems are available in the United States (U.S.). We report on the early results of the largest U.S. series of patients in whom a modern fixed-bearing prosthesis has been implanted for end-stage ankle arthritis.

METHODS: We prospectively followed 75 patients implanted with a modern fixed-bearing TAA at a single institution. Patients completed standardized assessments including visual analog scales (VAS), American Orthopaedic Foot and Ankle Society (AOFAS) Hindfoot scores, Short Form (36) Health Surveys (SF-36) and Short Musculoskeletal Function Assessments (SMFA), along with physical examination, gait analysis and radiographic evaluation, both preoperatively and at most recent follow up.

RESULTS: Implant survival was 99% (n=74) using any component revision or removal as an end point, with a mean follow up of 31 months. Patients demonstrated significant improvement in VAS, AOFAS Hindfoot, several SF-36, SMFA and gait scores at most recent follow up (p < 0.0001). Two patients developed aseptic loosening, both involving the tibial component. Of these, one underwent revision to another TAA system. Fifty patients underwent at least one additional procedure at the time of their index surgery. The most common concurrent procedure performed was a deltoid ligament release (n=21), followed by removal of previous hardware (n=17) and gastrocnemius recession (n=14). Nine patients required additional surgery following their index procedure, most commonly debridement for medial and/or lateral impingement (n=5).

DISCUSSION AND CONCLUSION: Early clinical results indicate that this modern fixed-bearing TAA system can provide significant improvement in pain, quality of life, and function in patients suffering from end-stage ankle arthritis. The majority of patients require at least one concurrent procedure, most commonly to address varus hindfoot deformity, hardware removal and equinus contracture.
Revision Arthroplasty for Failed Ankle Prostheses: Mid- to Long-Term Results of 90 Consecutive Cases

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INTRODUCTION: Once a total ankle replacement (TAR) fails, arthroplasty has been advocated as the treatment of choice. With the availability of a wide spectrum of implants, however, re-arthroplasty may become a viable alternative. The main question is, however, to which extent an ankle where bone loss to the tibia or the talus has occurred may be able to be revised by a new prosthesis.

METHODS: Prospective study of 86 patients with 90 revision TARs, approved by the ethics committee. There were 49 male and 37 female patients with a mean age of 58.9 years (range, 31 - 81 years). The mean time between the primary TAR and revision TAR was 4.4 years. The reasons for revision were divided into three groups: only component related reasons (21), component- and non-component related reasons (49), and only non-component related reasons (20). Clinical evaluation included measurement of range of motion, visual analogue scale (VAS) for pain assessment and AOFAS hindfoot score.

RESULTS: The mean follow up was 49 months (range, 24 - 98). In 10 patients a second revision surgery (ankle fusion or revision TAR) was necessary at a mean of 27 months (range, 6 - 69) after revision TAR. In the entire patient cohort, a significant pain relief and functional improvement were observed postoperatively.

DISCUSSION AND CONCLUSION: This series has proven that revision arthroplasty may be a promising option for a patient with a failed total ankle. More experience is needed, however, to better define the possibilities and limitations of revision arthroplasty.
Proposing a New Predictive Risk Assessment Model

Nonunion Risk Assessment in Foot & Ankle Surgery: Proposing a New Predictive Risk Assessment Model

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INTRODUCTION: Heterotopic ossification is a well-known phenomenon occurring after joint arthroplasty. However, its incidence and clinical effects have not yet been clearly identified with total ankle arthroplasty (TAA). We evaluated the incidence of heterotopic ossification and determine whether the degree of heterotopic ossification was associated with clinical outcomes in arthritic patients undergoing TAA.

METHODS: Between 2004 and 2009, 90 ankles in 81 consecutive patients underwent TAA and the degree of heterotopic bone formation was assessed by proportional involvement in the ankle joint. The association between heterotopic ossification and patient's symptoms and function was investigated by correlation analysis. We also measured ankle range of motion (ROM) to identify heterotopic ossification's biomechanical effects. For the clinical effects, the visual analogue scale (VAS) and the American Orthopaedic Foot and Ankle Society (AOFAS) score were evaluated in correlation with the occurrence of heterotopic ossification.

RESULTS: The degree of heterotopic ossification was significantly correlated with VAS for pain and AOFAS ankle score. However, there was no statistical correlation with ROM. A receiver operating characteristic (ROC) curve was plotted to demonstrate the discriminatory potential of this risk scoring system. The area under the curve was 0.77 with a confidence interval (0.64 - 0.88). A predict model using multivariate logistic regression analysis with nonunion as the dependent variable, when adjusted for age and gender as covariates, suggests the lack of fusion site stability and a raised body mass index were significantly predictive of nonunion.

DISCUSSION AND CONCLUSION: Quantitative nonunion risk assessment is a novel and valuable tool to better estimate the degree of patient risk. It allows for peri-operative management and risk modification to be tailored for each individual to minimize the risk of nonunion. For the future, the advent of a risk score will also aid in comparing different patient groups when assessing the efficacy of nonunion interventional modalities in the literature.

PAPER NO. 450

Heterotopic Bone Formation after Total Ankle Arthroplasty

PAPER NO. 449

Nonunion Risk Assessment in Foot & Ankle Surgery:

For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.
Treatment of Advanced Hallux Valgus and H. Rigidus with a Crescentic Oblique Basilar Resection Arthroplasty (COBRA)

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INTRODUCTION: The surgical treatment of advanced hallux valgus and hallux rigidus in the low-demand population has long-relied on the Keller resection arthroplasty for surgical correction. This procedure, which resects the basilar third of the proximal phalanx of the hallux, may result in cockup deformity, transfer metatarsalgia, hallux shortening, as well as recurrent hallux valgus or hallux varus. For these reasons, many surgeons have abandoned this procedure. A modification of the Keller procedure has been developed, which entails a crescentic oblique resection of the base of the proximal phalanx, which prevents hallux shortening while preserving the plantar plate and sesamoid complex, thus avoiding the potential pitfalls of the Keller procedure. This paper describes the mid-term results with this technique.

METHODS: Between May 2000 and August 2010, 60 patients (52 F, 8 M, mean age: 72.7 yr.s) underwent a crescentic oblique basilar resection arthroplasty (COBRA) procedure, performed for hallux valgus (49), hallux rigidus (9) or failed silastic implant (2). Thirty-three patients have > 24 mo. follow up. Patients were not considered good candidates for bunion correction with osteotomy or fusion due to their low-demand status, advanced deformity, poor bone quality, and/or concomitant medical conditions. The COBRA utilizes a dorsal longitudinal incision, which includes a formal lateral web space release and medial eminence resection for patients with hallux valgus, or resection of the dorsal 30% of the first metatarsal articular surface for patients with hallux rigidus. The basilar resection is performed with a crescentic reciprocating sawblade in an oblique fashion, starting distally, and aimed proximally to exit superior to the inferior base of the proximal phalanx, thus maintaining the integrity of the plantar plate and sesamoid complex. The correction is maintained with two .062 K wires placed longitudinally across the hallux and MTP joint.

RESULTS: Fifteen patients were enrolled in this prospective study. The average age was 24.1 (range 19 - 35) with three females and 12 males. Six patients (40.0%) had evidence of tibiofibular syndesmosis malreduction on their initial post-operative axial CT scans. In five (83.3%) of the six malreductions, the anterior measurement was greater than the posterior measurement indicating posterior translation of the fibula. In the post-syndesmosis screw removal CT scan, five (83.3%) of six malreductions showed adequate reduction of the tibiofibular syndesmosis. In the five initial malreductions that became reduced after syndesmosis screw removal, the average difference in the anterior and posterior fibula-incisura distance was 2.54 mm (range 2.0 - 3.5). In the one initial malreduction that reMed malreduced after syndesmosis screw removal, the difference in the anterior and posterior fibula-incisura distance was 6.0 mm. DISCUSSION AND CONCLUSION: Tibiofibular syndesmosis injuries are common with ankle fractures and require surgical fixation. In 2006, Gardner et al. showed an alarming 52% tibiofibular syndesmosis malreduction rate on immediate post-operative CT scans. Weening & Bhandari in 2004, reported a much lower 16% malreduction rate using plain radiographs, and also showed that adequate reduction of the syndesmosis was the only statistically significantly predictor of functional outcome. To our knowledge, this study is the only prospective study evaluating the rate of tibiofibular syndesmosis malreduction with CT scans, as well as the only study to report the effect of syndesmosis screw removal.
on tibiofibular syndesmosis reduction. Similar to Gardner et al., we also found a high rate of tibiofibular syndesmosis malreduction of 40.0%. Despite this high rate of initial malreduction, 83.3% of the malreduced syndesmoses spontaneously reduced after screw removal. Further correlation with functional outcomes is necessary. Syndesmotic screw removal may be advantageous to achieve final anatomic reduction of the distal tibiofibular joint and continues to be recommended.

PAPER NO. 618
Jones Fracture Fixation: Biomechanical Comparison of Partially Threaded Versus Tapered Variable Pitch Screws
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INTRODUCTION: Stabilization of fifth metatarsal Jones fractures with intramedullary screw fixation is the most common method for surgical fixation when operative treatment is indicated. Conventional partially threaded screws of various diameters are routinely used for Jones fracture fixation. Recently, the use of tapered variable pitch screws has become popular, but information regarding their performance in Jones fracture fixation is limited. No previous studies have compared conventional and tapered variable pitch screws in Jones fracture fixation under physiologic cyclic loading conditions. The purpose of this study is to determine whether biomechanical differences exist between appropriately sized conventional partially threaded and tapered variable pitch screws under physiologic cyclic loading conditions with regard to Jones fracture fixation.

METHODS: Simulated Jones fractures were created in 23 matched pairs of fresh frozen fifth metatarsals. One bone from each pair was stabilized with a conventional partially threaded screw and the contralateral bone with a tapered variable pitch screw. Initial compression was compared between groups, as well as fracture site compression, angulation, and bending stiffness throughout 1,000 physiologic cyclic loads.

RESULTS: Conventional partially threaded screws obtained significantly greater initial compression compared to tapered variable pitch screws. Significantly greater compression was maintained throughout cyclic loading with conventional screw fixation compared to tapered variable pitch screws. Fracture site angulation was significantly greater using tapered variable pitch screws from the tenth load cycle through completion of cyclic loading. Despite a trend toward increased fracture site bending stiffness using conventional screws, no difference in fixation stiffness was demonstrable between the two screw types.

DISCUSSION AND CONCLUSION: In this cadaveric Jones fracture fixation model, conventional partially threaded screws provided improved fracture site compression and decreased fracture site angulation but offered no advantage in improving fracture site stiffness compared to tapered variable pitch screws. While the use of tapered variable pitch screws is a potential alternative for fixation of fifth metatarsal Jones fractures, conventional partially threaded screws may provide better biomechanical stability, the impact of which on fracture healing is unknown. These results provide empirical evidence to guide implant-selection decision making for operative fixation of Jones fractures.

Keywords: Fracture; Jones; Intramedullary; Metatarsal; Screw
RESULTS: A total of 1,045 additional studies of either the knee or foot were ordered in 873 patients (63.72%). Of those, 75/761 patients (9.85%) had additional proximal fractures, most commonly proximal fibula (71 fractures), and 29/284 (10.21%) had foot fractures. Forty-seven isolated proximal fibula fractures (62.66%) were identified in the setting of no ankle bony injury, and 24 Maisonneuve fractures or fracture equivalents (3.15%) were seen, 11 of which were identified on ankle x-rays. The majority of isolated proximal fractures had an expected injury mechanism that involved direct blow, bumper type fractures, or exam details that involved local point tenderness, and knee injury. Foot injuries involved mainly metatarsal fractures in 22/29 patients (75.86%) with 18 fractures also visible on ankle x-rays (62.07%). A CT scan was ordered in 123 patients (8.98%) usually for further fracture characterization or pre-operative management. Overall, only 5.47% of patients with ankle injury had other lower extremity fractures proximally to ankle and 2.12% of patients had additional foot fractures requiring dedicated imaging.

DISCUSSION AND CONCLUSION: Even though x-rays are low cost, the additional time, resources, emergency room crowding, and radiation deserve improved indications for diagnostic imaging. Despite that, recent reports peg as many as one third of all orthopaedic imaging studies a consequence of defensive medicine. We show that the addition of knee and foot radiographs to the evaluation of ankle fractures is very low yield, and specific indications or rules should take into consideration the injury mechanism, clinical exam, and patient details.

PAPER NO. 621

Percutaneous Arthroscopic Calcaneal Osteosynthesis (PACO): Case Series of a Novel Technique

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INTRODUCTION: Traditional open reduction internal fixation is fraught with a high level of wound complications. We demonstrate the success of percutaneous arthroscopic calcaneal osteosynthesis (PACO) as a novel technique to address the fixation of calcaneal fractures.

METHODS: From July 1, 2010 to February 1, 2011, all patients with Sanders type 2 and type 3 calcaneal fractures were operated on the next available specialist operating list. Irrespective of conventional contra-indications to operative fixation, which include age, co-morbidities and soft tissue swelling, these patients were still suitable to receive PACO. Intra-operatively, the patient is positioned in the half lateral position. Two lateral sub-talar portals were placed into the depressed cavity created by the fracture. Indirect methods of fracture reduction included an inferior percutaneous calcaneus punch used to elevate the articular depression. Direct reduction of displaced articular fragments was done through the arthroscopic portal under direct visualisation. Between two and four percutaneous 3.5mm cortical fully threaded cannulated screws were inserted from lateral to medial, perpendicular to the vertical fracture lines that cross the posterior facet. 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did have superficial wound infection which was successfully treated using oral co-amoxiclav. All fractures went to union. There have were no deep infections or failure of metalwork. DISCUSSION AND CONCLUSION: We have demonstrated the success of a novel technique to address the fixation of calcaneal fractures (Sanders types two and three). Direct visualisation of the fracture reduction allows improvement to the Bohler’s angle and accurate percutaneous fracture fixation. Our patients have a short time to operation from injury and a short hospital stay. The small wounds with minimal wound complications allow this technique to be used on a wide number of patients with multiple co-morbidities.

PAPER NO. 622
Corrective Supramalleolar Osteotomy for Malunited Pronation-Lateral Rotation Fractures of the Ankle
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Alexej Barg, MD, Liestal, Switzerland
Markus Knupp, MD, Liestal, Switzerland

INTRODUCTION: In this prospective study, we analyzed the outcome of 48 malunited pronation-external rotation fractures of the ankle treated by realignment osteotomies. The aim was to determine the potential benefit of realignment osteotomies of the distal tibia in addition to reconstructive osteotomies of the fibula to restore the integrity of and physiologic load on the malunited ankle joint.

METHODS: Between 1995 and 2008, 48 patients (25 females; 23 males; age 45 [21 - 69] years) were treated for malunion after pronation-external rotation fractures of the ankle with the use of a varisation osteotomy of distal tibia and correcting osteotomy of fibula. Using Weber’s classification, 43 had type C fractures (eight of which were Maisonneuve type), and five had type B fractures. The primary treatment was conservative in three patients and operative in 42. In three, the fracture was overlooked. The interval between the injury and reconstruction was a mean of 20.2 months (3 to 98). All patients were prospectively followed with clinical and radiological assessments after 7.1 (2 - 15) years.

RESULTS: In all cases, valgus misalignment of the distal tibia and positioning of the malunited fibula were corrected. In some cases, additional osteotomies were performed. Patients were seen on a regular basis, with a mean follow up of 7.1 (2 to 15) years. Good or excellent results were obtained in 42 patients (89%), indicating that reconstructive surgery including realignment osteotomy of distal tibia was effective in most. The beneficial effects did not reduce over time. Congruent ankles without a tilted talus (Takakura stage 0 and 1) were obtained in all but five cases.

DISCUSSION AND CONCLUSION: Osseous balancing is crucial in salvaging a malunited ankle after fracture, and preserving it from further destruction and degenerative disease. Reconstructive osteotomies of fibula in combination with realigning osteotomies of distal tibia may postpone the ongoing osteoarthritic process and, if performed at an early stage, may help the patient avoid fusion or total ankle replacement at mid- to long-term. Further studies are required to prove this hypothesis.

PAPER NO. 623
A Biomechanical Comparison of Locked and Nonlocked Hallux Metatarsophalangeal Fusion Plates
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Cameron Barr, MD, Stanford, CA
Derek P. Lindsey, MS, Palo Alto, CA
Loretta Chou, MD, Redwood City, CA

INTRODUCTION: First metatarsophalangeal (MTP) arthrodesis is a common procedure for various painful conditions of the
great toe. Dorsal plate fixation is a popular treatment methods for this indication. Recently, locking plates have been used increasingly for this and other procedures in the foot with varying success rates. The biomechanical advantages and disadvantages of locked plates for use in the foot are currently unknown. The purpose of this study was to compare the planter gap formation during cyclic loading, load to failure, and stiffness of locked and nonlocked plates used for hallux MTP fusion.

METHODS: The first ray of nine matched pairs of fresh frozen cadaveric feet underwent dissection, preparation with cup and cone reamers, and fixation of the MTP joint with a compression screw and either a nonlocked or locked stainless steel dorsal plate. Each specimen was loaded in a cantilever fashion to 90N at a rate of 3 Hz for a total of 250,000 cycles (this approximates six weeks of post operative weight bearing in a walking cast). The amount of planter MTP gap was recorded using a calibrated extensometer. Load to failure testing was performed for all specimens that endured the entire cyclical loading. Stiffness (N/mm) was calculated from the final load to failure test.

RESULTS: The locked plate group demonstrated significantly less planter gapping during fatigue endurance testing from cycle 10,000 through 250,000 (p<0.05). Mean stiffness was significantly greater in the locked plate group compared to the nonlocked plate group (70.32±11.55 N/mm vs. 43.07±5.53 N/mm, respectively; p = 0.02). There was no significant difference in load to failure between the two groups (locked 375.92±44.06 N, nonlocked 324.36±16.04 N; p = 0.27). Six of the nine specimens in the locked plate group failed by bone fracture, and six of the nine specimens in the nonlocked group failed by plate bending.

DISCUSSION AND CONCLUSION: Compared to nonlocked plates, locked hallux MTP arthrodesis plates exhibit significantly less planter gapping after 10,000 cycles of fatigue endurance testing and significantly greater stiffness in load to failure testing. Our findings indicate that locked plates provide additional sagittal plane rigidity which may allow for earlier weightbearing. However, we recently reported clinical results with a trend toward a higher nonunion rate in patients treated with titanium locked plates compared to stainless steel nonlocked plates for hallux MTP fusion.

It is possible, if there is inadequate bony contact when a locked implant is applied, that the increased stiffness of locked plates may produce insufficient interfragmentary motion and be detrimental to bony healing. The optimal dorsal plate construct would allow adequate interfragmentary compression and bony contact, while providing sufficient stiffness to allow early protected weight-bearing without compromising fixation or union rates. As the use of locked plate technology is becoming increasingly common for arthrosis and fracture fixation in the foot, an understanding of the biomechanical characteristics of these implants is paramount to optimizing their indications and clinical results.

PAPER NO. 624

**Hallux Valgus Reconstruction in Rheumatoid Arthritis**

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Chris T. Royer, MD, Frisco, TX  
Stephen L. Tocci, MD, Mission Viejo, CA  
James W. Brodsky, MD, Dallas, TX

INTRODUCTION: Rheumatoid arthritis manifests itself with painful deformities of the forefoot, including a hallux valgus deformity. The standard treatment has been arthrodesis of the first metatarsophalangeal (MTP) joint. There is very little literature regarding the use of hallux valgus procedures which preserve the first MTP joint in rheumatoid patients. We investigated the radiographic and clinical outcomes of joint-sparing surgery for hallux valgus in a series of rheumatoid arthritis to evaluate the result of non-arthrodesis reconstruction.

METHODS: Forty-four feet in 32 patients with rheumatoid arthritis, hallux valgus, and a joint-sparing procedure of the first MTP joint were analyzed radiographically and clinically. Average follow-up was 28.6 months. Radiographs were evaluated pre- and post-operatively for hallux valgus angle, 1-2 intermetatarsal angle, and degenerative narrowing of the first MTP joint, rated as none, mild, moderate and severe. Clinical outcomes were measured using pre- and post-operative SF-36, AOFAS forefoot scale and VAS questionnaires.

RESULTS: The patients had an average increase of 37.3 points on the AOFAS score, a 2.4 point improvement on the VAS, a 2.0 decrease in the SF 36 physical component, and a 1.0 decrease in the SF 36 mental component. Seventeen of 44 feet had one grade of progression of joint space narrowing at last follow up. Most (31/44) were mild to moderate in degree. Range of motion was essentially unchanged comparing pre- and post-operative measurements. The average hallux valgus angle improved from 34.1 degrees pre-operatively to 14.7 degrees post-operatively. The average 1-2 intermetatarsal angle improved from 13.5 degrees pre-operatively to 5.1 degrees post-operatively. There were six feet (14%) that required a return to surgery: three wound infections, two for arthrodesis for progression of first MTP arthritis, and one revision for recurrence.

DISCUSSION AND CONCLUSION: Rheumatoid patients who undergo a bunionectomy rather than arthrodesis in order to preserve the first MTP joint have satisfactory clinical and radiographic outcomes. This procedure appears to be a reasonable alternative for first MTP fusion.

<table>
<thead>
<tr>
<th></th>
<th>Pre-op average (range)</th>
<th>Post-op average (range)</th>
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<tr>
<td>AOFAS</td>
<td>46.1 (15-70)</td>
<td>63.4 (52-100)</td>
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<tr>
<td>VAS</td>
<td>4.5 (1-8)</td>
<td>2.1 (0-7)</td>
<td>2.4</td>
</tr>
<tr>
<td>SF 36 PCS</td>
<td>59.4 (26-56.4)</td>
<td>37.4 (11.9-58.2)</td>
<td>20.9</td>
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<tr>
<td>SF 36 MCS</td>
<td>55.4 (37.8-67.4)</td>
<td>54.4 (37.8-66.2)</td>
<td>1.0</td>
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</table>

1st MTP joint ROM:

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<tr>
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<th>Moderate restriction - 29</th>
<th>Severe restriction - 3</th>
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<tr>
<td>HVA</td>
<td>34.1 (9-52)</td>
<td>14.7 (9-41)</td>
<td>(19.4)</td>
</tr>
<tr>
<td>TMA</td>
<td>13.5 (4-21)</td>
<td>51 (1-12)</td>
<td>(8.4)</td>
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1st MTP joint narrowing:

<table>
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<th>Mild - 23</th>
<th>Moderate - 2</th>
<th>Severe - 1</th>
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<tr>
<td>Noose</td>
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<td>Moderate</td>
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<tr>
<td>Severe</td>
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 eccentricity (♂ 75°), moderate restriction (20-74°), severe restriction (<30°)

PAPER NO. 625

**Minimally Invasive Osteosynthesis Versus Open Reduction and Internal Fixation in Displaced Calcaneal Fractures**

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Matteo Cadossi, MD, Bologna, Italy  
Maria Teresa Miscione, MD, Bologna, Italy  
Francesco Acri, MD, Bologna, Italy  
Mohammadreza Chehrassan, MD, Bologna, Italy  
Valentina Persiani, MD, Bologna, Italy  
Paola Capra, MD, Bologna, Italy  
Deianira Luciani, MD, Bologna, Italy

INTRODUCTION: The goal of the treatment of displaced articular calcaneal fractures (DCAF) is to restore the calcaneal...
height and width, and restore the subtalar and calcaneocuboid articular surface in order to avoid pain, stiffness and early degenerative changes of the joints. The aim of this study is to compare minimally invasive osteosynthesis (MIO) versus open reduction and internal fixation (ORIF) in the DACF. METHODS: A total of 108 DACF type 2 and 3 Sanders classification were selected in 103 patients (range 18-57 years). In 63 patients (66 feet), surgical treatment consisted in lateral 3cm skin incision, reduction of articular part and stabilization (MIO). In 40 patients (42 feet), treatment consisted in standard lateral approach to the calcaneus and ORIF of the fracture. Mean follow-up time was 6 years. RESULTS: In patients treated by MIO, no skin complications or infections were encountered. All fractures healed and mean healing time was three months. In patients treated by ORIF, there were five skin complications, two infections and one sural nerve injury. All fractures healed and mean healing time was four months. The results with MIO were: 31 excellent, 22 good, nine fair and four poor. The results with ORIF were: 19 excellent, 11 good, seven fair and five poor. DISCUSSION AND CONCLUSION: In the DACF type 2 and 3 Sanders classification treated by MIO, the results are excellent and good in more than 80% and in comparison with ORIF have less postoperative complications. In fact, if soft tissues are preserved by surgical trauma, dangerous complications like infection and skin problems can be avoided.

PAPER NO. 626

Randomized Controlled Trial of Halux Valgus Treated with Medial-opening vs. Chevron Metatarsal Osteotomy

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Gordon Boyd, MD, Halifax, NS, Canada
Mark Glazebrook, MD, Halifax, NS, Canada

INTRODUCTION: Hallux valgus with an increased intermetatarsal is usually treated with a proximal metatarsal osteotomy. The proximal first metatarsal chevron (CHEV) osteotomy is commonly utilized but technically difficult. This study compares the opening-wedge osteotomy (OWO) of the proximal first metatarsal to the CHEV osteotomy in the treatment of hallux valgus with increased intermetatarsal angle. METHODS: This prospective, randomized, multi-centered study conducted at three centers was powered for 75 patients based on clinical outcome scores using SF-36, AOFAS forefoot score and Visual Analogue Scale (VAS) for pain, activity and patient satisfaction. Subjects were assessed prior to surgery and at 12 months. Surgeon preference was evaluated based on questionnaires and surgical times. Radiologic outcome measurements were also assessed. RESULTS: No significant difference was found in any of the patients’ clinical outcome measures between the two procedures. OWO shortens and CHEV shortens the first metatarsal length. OWO takes on average longer to complete compared to CHEV ostetotomy. OWO is preferred by participating orthopedic surgeons. DISCUSSION AND CONCLUSION: Opening-wedge and proximal chevron osteotomies have comparable patient pain, satisfaction, and functional outcomes. OWO shortens and CHEV shortens the first metatarsal. OWO was deemed to be less technically demanding, quicker to perform and preferred by orthopedic surgeons participating in this study.
Minimally Invasive Chevron Osteotomy; Functional Outcome and Comparison with Open Chevron Osteotomy

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Simon Palmer, FRCS, Angmering, West Sussex, United Kingdom

INTRODUCTION: Symptomatic hallux valgus is a common clinical problem, current trend is towards minimally invasive procedures. The goal of this study is to evaluate the outcome of minimally invasive chevron osteotomy, comparing it with a matched group who had open chevron osteotomy.

METHODS: Prospective study with 54 patients. MIS group 25 patients between October 2009 and November 2010. Open group 29 patients between February 2008 and October 2010. Inclusion criteria included mild to moderate hallux valgus, no previous history of foot surgery, no history of inflammatory arthritis, or metatarsophalangeal joint (MTPJ) arthritis. All the operations were performed by the senior author. Functional outcome and pain were evaluated using pre and post operative Manchester Oxford Foot and ankle questionnaire (MOXFQ).

It is a 16 item questionnaire assessing three domains, walking, footpain and social interaction, the lower the score the better. Radiologically, pre and post operative intermetatarsal angle (IMA) and hallux valgus angle (HVA), avascular necrosis and union were assessed. Complications and satisfaction were recorded.

RESULTS: In the MIS group (25 patients) two patients lost to follow up, 23 were available for analysis. Mean age at operation was 55 (23-79). Twenty-four patients were female and the operation was on the left side in 14 patients. The MIS group showed significant improvement in all the domains of the MOXFQ. Walking (preop. 48/100 (SD 26), postop 28 (SD 32) <0.018), foot pain (preop. 54(SD 24), postop. 33(SD 29) <0.013), social interaction (preop. 56 (SD 26), postop 22 (SD 32) <0.001). Radiologically the mean HVA and IMA corrections were 11.8° and 6.3°, respectively, which is statistically significant (p < 0.001). There were no cases with nonunion, malunion, overcorrection, transfer metatarsalgia or osteonecrosis. In the open group (29 patients) four patients lost to follow up, 25 patients were available for analysis. Mean age at operation was 55 years (34-75). Twenty-three patients were female and the operation was on the left side in 16 patients. The open group showed significant improvement in all domains of the MOXFQ, walking (pre 52(SD 23), post 27 (SD 22) <0.0001), foot pain (pre. 52 (SD22). Post 33(SD23) <0.002), social interaction (pre. 56(SD17), post 22(SD17) <0.0001). The HVA and IMA were 10.5 and 5.9 degrees respectively and was statistically significant. The improvement in MOXFQ and HVA and IMA corrections were not statistically significant between the MIS and open groups.

DISCUSSION AND CONCLUSION: Recentlly chevron osteotomy is being performed using minimally invasive techniques. It has the advantage of minimal soft tissue dissection and consequently less risk of avascular necrosis, less pain and faster recovery. Our results showed that the MIS chevron osteotomy is an effective procedure with minimal complications and satisfactory functional outcome and comparable to the open standard chevron osteotomy. Larger sample size is required to confirm our findings. The results of our randomized controlled trial are awaited.
smaller fragments may be best left unfixed, especially anterior collicular fractures.

PAPER NO. 630
The Effect of Obesity on Early Failure of Operatively Treated Syndesmosis Injuries
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Daniel M. Zinar, MD, Torrance, CA
Thomas G. Harris, MD, Altadena, CA

INTRODUCTION: Obesity has reached epidemic proportions in the United States, and has been shown to increase postoperative complications after certain orthopaedic procedures. Obesity has been studied as a risk factor for complications in ankle fractures, but the results of these studies are conflicting. Furthermore, no study has focused on the effect of obesity on failure after syndesmotic fixation. We hypothesized that obese patients with syndesmotic injuries have a higher incidence of early postoperative loss of reduction compared to nonobese patients.

METHODS: From 9/2007 to 12/2010, a retrospective cohort study was performed of consecutive patients that presented to our level I trauma center with operative syndesmotic injuries. We hypothesized that obese patients with syndesmotic injuries have a higher incidence of early postoperative loss of reduction compared to nonobese patients. The primary outcome was early failure of fixation, defined as revision surgery within three months for syndesmosis reduction failure. Patients were divided into two cohorts: obese (defined as a body mass index [BMI] ≥ 30 kg/m²) and nonobese (BMI < 30 kg/m²). All syndesmotic injuries were confirmed by intraoperative stress testing. The syndesmosis was reduced and stabilized with constructs of varying screw diameters (3.5mm, 4.5mm), number, and length (tricortical, quadricortical). After surgery patients were kept nonweightbearing for eight weeks and immobilized with a short-leg cast for four to six weeks prior to transitioning to a walker boot. The primary outcome was early failure of fixation, defined as revision surgery within three months for mortise subluxation or impending malunion of the syndesmosis.

Simple screw breakage without displacement of the mortise or syndesmosis was not considered a failure. Other variables analyzed included diabetes mellitus, smoking, fixation construct, and injury severity measured by the initial tibiofibular clear space.

RESULTS: A total of 213 patients were identified with operative syndesmosis injuries, of which 102 (48%) were obese and 111 (52%) were nonobese. The mean BMI of the obese group (37.1 ± 9.3) and tibfib space (6.1 ± 2.6mm) was significantly greater than the mean BMI (25.6 ± 2.7) and tibfib space (5.5 ± 2.4mm) of the nonobese group (p<.05). Otherwise, the obese and nonobese cohorts were similar: age (35yrs vs. 33yrs, p = .24), history of smoking (23% vs. 30%, p = .23), diabetes mellitus (10% vs. 6%, p = .35), and types of fractures sustained (% Weber C, 62% vs. 65%, p = .64). Fifteen percent (n=15) of patients in the obese cohort failed compared to 2% (n=2) of patients in the nonobese cohort (p = .001). The only other variable found to be significantly associated with syndesmosis failure was the magnitude of widening of the tibiofibular clear space (p = .0001). Diabetes mellitus, smoking status, and the type of construct used (e.g. screw caliber, number of screws, number of cortices) were not predictive of loss of reduction.

In a multivariate logistic model controlling for these variables, failures were independently associated with obesity (odds ratio 15.9 [95% CI,1.8-141.8 ]; p = .013) and a greater tibiofibular clear space on injury radiographs (OR 1.3 [95% CI,1.1-1.6]; p = .015).

DISCUSSION AND CONCLUSION: There was a strong association between obesity and loss of reduction after operative treatment of the syndesmosis. Injury severity, measured by the magnitude of displacement of the tibiofibular clear space, was also predictive of loss of reduction, however diabetes mellitus, smoking, and the type of fixation construct utilized were not associated with failure.

Further research is warranted to determine whether a stronger mechanical construct (4.5mm screws or ≥2 screws) or a more conservative postoperative protocol (prolonged nonweightbearing or cast immobilization) are warranted to reduce the number of postoperative complications in obese patients that sustain a syndesmotic injury.

POSTER NO. P206
Ankle Distraction Arthroplasty: How Much is Enough?
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S. R. Rozbruch, MD, New York, NY

INTRODUCTION: Distraction arthroplasty is an alternative to arthrodesis or traditional arthroplasty for ankle arthritis. Distraction arthroplasty relies on external fixation and distraction to unload the talotibial articular cartilage. This unloading is thought to promote cartilage regeneration. The minimum distraction required to adequately unload the articular cartilage during walking loads is desirable, but has not been rigorously characterized.

METHODS: We mounted frames on nine cadaver ankles using three tension wires in the hind foot and two half-pins in the tibia. We fitted the talotibial joint with a pressure sensitive film and used a specially designed press to apply 0N (no weight), 350N (half body weight / bipedal x-ray), 700N (full body weight / walking) loads while serially distracting the ankle. At each load and distraction a lateral radiograph was used to measure joint space. We continued this until the pressure sensitive film showed no contact between the articular surfaces at 700N of applied load.

RESULTS: The average joint space at which articular surfaces did not contact despite 700N of applied load was 2.4 (1.6-4.0) mm. The average critical joint distraction was 4.4 (range, 3.7-5.8) mm at 350N of load and 4.9 (3.7-7.0) mm at 0N of load.

DISCUSSION AND CONCLUSION: The goals of distraction arthroplasty is to apply the minimum distraction at which no load is transferred across the articular cartilage during walking loads. As this goal cannot be easily measured in clinical practice, we use a minimum additional joint space target. This target, or critical joint distraction, is the additional joint space needed, above the joint space present on an undistracted film, to unload the articular surfaces despite application of 700N of axial load. The required distraction depends on the load under which the radiographs are made. If bipedal films are used, the critical distraction is 4.4 mm. If nonweightbearing films are used, the critical distraction is 4.9 mm. We believe these numbers give insight into the least morbid distraction that will achieve the therapeutic goals of distraction arthroplasty.
Microfracture and Postoperative Hyaluronan Injection in Talus Osteochondral Lesions: Functional Results

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Onur Bilge, Konya, Turkey
Gürhan Dönmez, MD, Gaziantep, Turkey
Güray G. Batmaz, III, Ankara, Turkey
Ahmet O. Atay, MD, Istanbul, Turkey
Akin Uzunçugil, ANKARA, Turkey

INTRODUCTION: Osteochondral lesions of talus are rarely seen. The aim of this study is to report the functional results of the treatment of the talus osteochondral lesions with arthroscopic microfracture technique and postoperative intraarticular hyaluronan injection.

METHODS: Fifty-seven patients (29 men, 28 women) were included in this prospective, randomized clinical study between the years 2003 and 2009. The mean age was 40.5 +/- 13.0 SD. The patients had chronic ankle pain irreversible to conservative follow-up. Forty-five had previous history of ankle trauma. Thirty-two and 25 patients had right and left ankle pain, respectively. Their MRI revealed osteochondral lesion on the medial and central parts of the talus. All the patients were treated with arthroscopic debridement and microfracture by the same surgeon. The patients were mobilized non-weight bearing on postoperative first day and full-weight bearing on postoperative third week. Forty-one patients randomized by envelope were selected to apply intraarticular half dose hyaluronan injection, starting from postoperative third week, weekly for three weeks. The Freiburg and AOFAS scoring systems were used for functional and pain evaluation. The surveys were filled by all the patients preoperatively and second-year postoperatively.

RESULTS: The patients were followed up for two years. The postoperative functional and total scores in Freiburg system were found to be significantly higher than the preoperative values in both groups (p<0.001). This increase was significantly more in the injection group (p<0.001) (Table 1). The pain scores in Freiburg system were found to increase in both groups but not significantly (Table 1). The pain in Freiburg system was found to increase in both injection and non-injection groups with AOFAS scoring system (Table 2).

DISCUSSION AND CONCLUSION: Different methods have developed in the treatment of talus osteochondral lesions. As a result of this study, arthroscopic debridement and microfracture were found to decrease the pain and to increase the functional performance. The effect of intraarticular hyaluronan injection is found to be significantly better compared with the non-injection group. Multi-centered, prospective and randomized studies are needed for further confirmative evaluations.

Table 1. Results of Freiburg Ankle Scoring System in both groups (Mean Values +/- SD in functional and total scores, median values in pain scores)

<table>
<thead>
<tr>
<th></th>
<th>Injection Group</th>
<th>Non-injection Group</th>
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<tr>
<td>Preoperative</td>
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<tr>
<td>Functional Score</td>
<td>25.8 +/- 10.5</td>
<td>30.4 +/- 8.6</td>
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<tr>
<td>Total Score</td>
<td>40.2 +/- 12.8</td>
<td>46.0 +/- 11.2</td>
</tr>
<tr>
<td>Pain Score</td>
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<tr>
<td>Postoperative</td>
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<td>Functional Score</td>
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<tr>
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<td>70.2 +/- 10.7</td>
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</table>

Table 2. Results of AOFAS Scoring System in both groups (Mean Values +/- SD in functional and total scores, median values in pain scores)

<table>
<thead>
<tr>
<th></th>
<th>Injection Group</th>
<th>Non-injection Group</th>
</tr>
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<tbody>
<tr>
<td>Preoperative</td>
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<td></td>
</tr>
<tr>
<td>Functional Score</td>
<td>18.78 +/- 9.1</td>
<td>24.1 +/- 7.3</td>
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<tr>
<td>Total Score</td>
<td>40.0 +/- 18.1</td>
<td>47.9 +/- 17.1</td>
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<tr>
<td>Pain Score</td>
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<tr>
<td>Postoperative</td>
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<tr>
<td>Functional Score</td>
<td>31.9 +/- 9.1</td>
<td>29.8 +/- 9.3</td>
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<tr>
<td>Total Score</td>
<td>72.8 +/- 11.8</td>
<td>69.1 +/- 14.3</td>
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<tr>
<td>Pain Score</td>
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</tbody>
</table>

POSTER NO. P208

The Anterior Distal Tibial Angle: Published Values are Misleading

Matthew L. Graves, MD, Jackson, MS
K. P. Powell, MD, Jackson, MS
Sean E. Nork, MD, Seattle, WA
George V. Russell, Jr, MD, Jackson, MS

INTRODUCTION: The anterior distal tibial angle defines the relationship of the tibial plafond articular surface to the tibial shaft anatomic axis as noted on the lateral tibial radiograph. Normal has previously been defined as an average of 80 degrees [range, 78 - 82]. This published finding was based on lateral tibial radiographs. Full-length lateral tibial radiographs are not readily available intraoperatively at the time of tibial plafond fracture reconstruction. We hypothesized that the average value of the anterior distal tibial angle as measured intraoperatively using the available smaller fluoroscopic field of view would be higher than the published value (i.e. a larger angle closer to 90 degrees). The significance of this hypothesis lies in defining and evaluating sagittal plane reductions of pilon fractures. The purpose of the study was to redefine the normal anterior distal tibial angle based on intraoperative fluoroscopic lateral films.

METHODS: As a part of our standard protocol for ankle and tibial plafond fracture fixation, intraoperative fluoroscopic views are taken of the contralateral uninjured side and saved to assist in fracture reconstruction. These intraoperative films of the uninjured extremity of 72 consecutive patients were retrospectively reviewed to determine the average and range of the anterior distal tibial angle based on imaging that is available intraoperatively. Two observers reviewed the films at two different settings. The average anterior distal tibial angle for an uninjured extremity was calculated and the inter- and intraobserver reliability were evaluated.

RESULTS: The average anterior distal tibial angle as measured on intraoperative fluoroscopic lateral views was 86 degrees (standard deviation of 3 degrees). A one-sample t-test was used as a comparison to the previously published average. Based on the one sample t-test, the p-value was <.001, revealing a statistically significant difference between the value that is noted intraoperatively using fluoroscopic imaging and the value that is published using full-length lateral tibial radiographs. High inter and intraobserver reliability were noted.

DISCUSSION AND CONCLUSION: The hypothesis was accepted. Using the published value for the anterior distal tibial angle could lead to sagittal plane malreductions of the tibial plafond. The malreductions could be clinically significant as one standard deviation could lead to more than a 10 degree error. Similarly, using the previously published value as a standard postoperatively for research to determine pilon fracture reduction on lateral ankle
radiographs could lead to the impression of a high percentage of malreductions. This finding should help guide future publications with respect to sagittal plane reduction of pilon fractures.

POSTER NO. P209
ALTERNATE PAPER: FOOT AND ANKLE I

Jumping Capability in High-demand Athletes Surgically Treated for Acute Achilles Tendon Rupture
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Raffaele Iorio, MD, Rome, Italy
Angelo De Carlì, MD, Rome, Italy

INTRODUCTION: Achilles tendon ruptures are common among high-demand athletes. Operative treatment represents the favorite choice of orthopaedics in the treatment of this pathology. In this study we report the functional results of a group of 36 high-demand athletes surgically treated with a mini-open technique modified by Kakiuchi, with the aim to assess the effectiveness of such a technique by testing the clinical outcome through functional tests. METHODS: Between 2000 and 2010, 36 high-demand athletes (34 males, two females) with age less than 40 years old with complete spontaneous Achilles tendon rupture were surgically treated with combined mini-open and percutaneous technique as described by Kakiuchi M. Achilles tendon ruptures occurred in all cases during sports activities (24 patients playing soccer, seven playing tennis, one skiing, one jogging, one during sailing, and two during rings in gymnastics). All patients were evaluated at a mean follow up of 46 months with an accurate physical examination, the VISA-A questionnaire and the Hannover scale. The jumping capacity of the patients was evaluated using the Ergo-Jump Bosco System. Patients were assessed with the aim of testing maximum strength (Squat Jump test), elasticity (Counter Movement test) and endurance (Ten Repetition Counter Movement test) of the repaired musculotendinous unit, in a side-to-side (S/S) evaluation. RESULTS: At a mean follow up of 46 months, we registered no re-ruptures but minor complications such as late skin adhesions and wound healing delay in five patients (14%). The ROM (S/S) was complete in 33 patients (91.6%), while there was a loss of 5° in dorsal flexion in three patients. Thickness of the repaired tendon (S/S) was twice the contralateral in 34 patients (94%), more than twice in one patient (3%), and similar to the contralateral in the other one (3%). The jumping capacity of patients assessed using the Ergo-Jump Bosco System showed (S/S) a 1.3% mean deficit of the affected limb with the Squatting Jump test, a 2.2% mean deficit of the affected limb with the Counter Movement Jump test, and a +6% mean improvement of the involved side with the Repetitive Jump test. Twenty-eight athletes (77.7%) returned to sports after a mean time of 2.8 months: 25 patients (69.4%) resumed the same sports activities and 24 patients (66.6%) returned to their same pre-injury level. DISCUSSION AND CONCLUSION: The treatment of acute complete rupture of Achilles tendon in high-demand athletes always represents a challenge both for the surgeon and the patient. The choice of the right type of treatment for a successful long-term follow up positive clinical outcome is what the surgeon must always look for. In this study we tested the functional results of a group of high-demand patients, regularly involved in sports activities, with the aim of assessing the efficacy of such a technique, already considered as reliable in patients involved in regular sports activities. According to the results of the tests performed, we confirmed the positive clinical results recorded with the physical examination and the evaluation scales used. The combined mini-open and percutaneous technique as described by Kakiuchi M. seems to be effective and reliable in providing a satisfactory clinical and functional result in patients affected by acute complete rupture of the Achilles tendon.

POSTER NO. P210

Functional Outcomes after Ankle Arthrodesis in Elderly Patients
Norman S. Turner, III, MD, Rochester, MN
Nicholas L. Strasser, MD, Charlotte, NC

INTRODUCTION: Ankle arthrodesis has long been the gold standard of operative treatment for ankle arthritis refractory to non-operative treatment. While multiple studies have documented outcomes after ankle fusion, none have looked specifically at outcomes in elderly patients. Our purpose was to evaluate the outcome of ankle fusion in patients over the age of 70. We focused on the rates of fusion, postoperative complications and overall subjective functional outcomes. Our hypothesis is that patients over the age of 70 who undergo ankle fusions have similar outcomes to those previously cited in the literature in regard to fusion rate, functionality and postoperative complications. METHODS: We retrospectively identified 30 consecutive patients over the age of 70 treated with isolated ankle fusion between January 1, 1999 and December 31, 2004. Medical records were studied paying attention to the diagnosis, type of fixation, medical comorbidities, and postoperative complications. Radiographs were used to grade the degree of ankle and subtalar arthritis, time to fusion and formation of adjacent joint arthritis. The patients were contacted and the Foot and Ankle Ability Measure (FAAM) and American Foot and Ankle Society Hindfoot Score (AOFAS) were used to assess functional outcomes. We also identified 30 patients (30 ankles) over the age of 70 who had undergone ankle fusion. Average age at the time of surgery was 74.5 years (+/- 3.7). Seven patients were deceased at final follow up. The preoperative diagnosis was post-traumatic in 17 patients, osteoarthritis in 10, infected fibular nonunion with ankle arthritis in two, and rheumatoid arthritis in one. Radiographs were followed until union with an average follow up of 2.17 years. Union was achieved in 27 of 30 ankles (90%) with an average time to union of 17.81 +/- 8.08 weeks. Two patients had a delayed union (>6 months) but were united by one year after surgery. Postoperative radiographs showed 11 (36.6%) patients who had progression of their subtalar arthritis.

RESULTS: The FAAM was obtained postoperatively in 22 of the 23 patients still living. The average postoperative FAAM score was 81.47 (+/- 18.3) with an average follow up of 8.5 years (+/-1.7). Subjectively, when asked to compare present function to their prearthritic state the average response was 75.1% (+/- 19.6). The average AOFAS hindfoot score was 73.0 (+/- 11.5). Complications included delayed union, nonunion, deep infection and adjacent joint arthritis. Two delayed unions did not require any additional surgery. Two nonunions went on to require revision fusion. One nonunion reMed asymptomatic and elected to avoid any further surgery. There was one deep infection which required irrigation and debridement with subsequent hardware removal. Two patients went on to have a subtalar fusion at a later date due to symptomatic subtalar arthritis.

DISCUSSION AND CONCLUSION: In our clinical cohort, we found ankle fusion to be effective in the treatment of ankle arthritis. Functional outcome was satisfactory in our patients and the rate of union was comparable to that previously reported in the literature for younger patients. While total ankle arthroplasty is becoming increasingly popular, ankle arthrodesis is an effective surgical treatment option in an elderly patient population.
A Mathematical Approach to Hemiepiphysiodesis of the First Metatarsal

Jennifer D’Amico, DPM
John E. Herzenberg, MD, Baltimore, MD

INTRODUCTION: Guided growth is often used for angular deformities about the knee in children. Growth rates of the femur and tibia determine timing for hemiepiphysiodesis. These techniques are well described for the knee. Few studies discuss guided growth of the first metatarsal, and no studies show a mathematical formula to guide timing of hemiepiphysiodesis in the first metatarsal. Conventional wisdom advises delaying bunion surgery in children. However, hemiepiphysiodesis is a minimally invasive procedure that may help avoid future bunion surgery. We developed a mathematical formula to determine timing of hemiepiphysiodesis of the first metatarsal for hallux valgus.

METHODS: We used trigonometric calculations to theoretically determine the time at which hemiepiphysiodesis should be performed. We derived growth remaining data (Nelson JP. Mechanical arrestment of bone growth for the correction of pedal deformities. J Foot Surg. 1981;20(1):14-6.) of the metatarsal and interpolated the data to create graphs of growth remaining for boys and girls. With this data and a formula that we developed, we can determine the theoretical ideal timing for such procedures.

RESULTS: We developed the formula: L = r sin theta, where r is the width of the growth plate (measured on an anteroposterior view foot radiograph), theta is the desired angular correction of the intermetatarsal (IM) angle, and L is the growth remaining in the metatarsal (see illustration). After the value of L is calculated, the growth remaining graphs (see graphs) can be used to determine the corresponding age at which the correction should be performed.

DISCUSSION AND CONCLUSION: A mathematical approach to hemiepiphysiodesis of the first metatarsal may yield more predictable outcomes. Bunion deformities could be corrected at a younger age. This approach may reduce the need for more invasive bunion procedures. This paper presents theoretical methodology and awaits clinical validation.
underneath the great toe and higher values at the medial and lateral midfoot region (p<0.05) at 10 years whereas at 19 years no significant differences could be detected underneath the great toe but still significantly lower values in the medial forefoot and higher values in the medial and lateral midfoot region (p<0.01).

In conclusion we noticed a “trend to center” in clinical evaluations at long-term follow up with less excellent but also less poor results without statistical differences and therefore no deterioration. However, even patients with poor results reported no or only little impairment in activities of daily life. Pedobarographically we observed pressure loading during gait at long-term follow up compared to the 10-year data indicating an improvement of plantar pressure distribution over time.

POSTER NO. P213

◆ Total Ankle Arthroplasty Clinical Outcomes and Radiostereometric Analysis Results

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Michael Dunbar, MD, Halifax, NS, Canada
David A. Wilson, MSc, BENG, Halifax, NS, Canada
Allan Hennigar, Halifax, NS, Canada
Patricia Francis, RN, Dartmouth, NS, Canada
Mark Glazebrook, MD, Halifax, NS, Canada

INTRODUCTION: The purpose of this study was to assess the clinical outcomes for total ankle arthroplasty (TAA) over two years using Short-Form-36. Foot Function Index and Ankle Osteoarthritis Scale, and to compare these with radiostereometric analysis longitudinal migration and inducible displacement results.

METHODS: Twenty patients underwent TAA and were assessed at 3mth, 6mth, 1yr and 2yr follow-up periods by model-based radiostereometric analysis for longitudinal migration (LM) and inducible displacement (ID). The same subjects completed clinical outcome questionnaires at these follow-up periods for Short Form-36 (SF-36; Physical Component Scores (PCS) and Mental Component Scores (MCS)), Foot Function Index (FFI) and Ankle Osteoarthritis Scale (AOS). Descriptive statistics and Pearson correlations (alpha = 0.05) were calculated using statistical software.

RESULTS: For the PCS of SF36, FFI and AOS the scores were significantly different at 2yr follow up when compared to preoperative values; p = 0.005, 0.0002 and 0.0003 respectively. The PCS on average increased by 25 points with respect to preoperative (SD = +/-18) and AOS on average deceased by 23 points with respect to preoperative (SD = +/-12). The FFI on average decreased by 23 points with respect to preoperative (SD = +/-13) while the MCS on average did not change with respect to preoperative (SD = +/-18) and AOS on average deceased by 23 points with respect to preoperative (SD = +/-21).

There were several correlations for the 2yr results: AOS to FFI of r = 0.92 (p = 0.000), AOS to PCS of r = -0.67 (p = 0.005); AOS to MCS of r = -0.51 (p = 0.046); AOS to talar component ID of r = 0.70 (p = 0.004); AOS to the talar component LM of r = 0.62 (p = 0.046). PCS related better than MCS to both AOS and FFI. The LM of the talar component and tibial component were not significantly correlated, r = 0.18 (p = 0.62). The ID of the talar component and tibial component were not significantly correlated, r = 0.48 (p = 0.07). The latter result may be too underpowered to determine a significant difference as a result of the small sample size.

DISCUSSION AND CONCLUSION: The outcome scores of AOS, FFI, SF-36 (PCS) and SF-36 (MCS) were correlated to each other. The strongest outcome score relationships were AOS to FFF, followed by AOS to SF-36 (PCS). The correlation of AOS to the talar component LM and ID suggests that the implant performance may be related to the stability or the talar component.
eight and 12 weeks. At the latest follow up, no loss of correction was observed clinically and radiologically in all but one patient with UNICP fixation. In this obese patient (BMI 49 kg/m²), an UNICP staple was used. All patients were satisfied with the results of this procedure and stated that they would undergo the surgery again. All patients were able to wear normal shoes without insoles.

DISCUSSION AND CONCLUSION: In the flatfoot with breakdown of the arch, combined ST and NC-fusion are effective in correcting the deformity and stabilizing the hindfoot and the medial arch. In some patients, additional medial sliding osteotomy of calcaneus may be necessary to achieve full correction of the hindfoot. The use of a tension-bending plate may yield superior stability at NC-fusion site.

A Retrospective Review of Total Ankle Arthroplasty versus Arthroscopically Assisted Ankle Fusion Outcomes
Joan R. Williams, MD, Chicago, IL
Jamie L. Lynch, MD, Chicago, IL
Steven A. Kodros, MD, Chicago, IL
Armen S. Kelikian, MD, Chicago, IL

INTRODUCTION: The use of noncemented anatomic total ankle prostheses are gaining widespread use in the United States. However, ankle fusion remains the gold standard procedure for end stage ankle arthritis. The goal of our study was to perform a retrospective evaluation of the safety and efficacy of a noncemented prosthesis to treat end stage ankle arthritis and compare the outcomes to arthroscopically assisted ankle fusion. We evaluated both cohorts based on the following outcomes: 1-postoperative complications, 2-visual analogue pain scale, 3-SF-36 outcome scores, 4-return to and level of activity after surgery. All data was collected at a minimum of 12 months postoperatively. METHODS: Patients undergoing total ankle arthroplasty or arthroscopically assisted ankle fusions were asked to fill out AOFAS, SF-36, and visual analog scores both pre-operative and post-operative. They also all underwent full radiographic assessment with AP, lateral, dorsiflexion, and plantarflexion views of the operative ankle at least 12 months after surgery. These radiographs were assessed for adjacent joint changes and measurements of component placement, dorsiflexion and plantarflexion. Charts were reviewed to obtain any post-operative complications. The results were then analyzed using a paired t-test. All procedures were performed by the senior authors and all of the total ankle arthroplasties were done with the same brand of prosthesis. RESULTS: The charts of patients undergoing arthroscopic ankle fusions and total ankle arthroplasty performed by the senior authors between 2006 and 2011 were reviewed. In total there were 32 fusions and 56 total ankle replacements. In the total ankle group there were five reported complications, which included varus malalignment, wound dehiscence, subtalar changes, and posterior tibial tendinitis. In the fusion group, there were seven complications, which included primarily subtalar arthritis and nonunions requiring revision. Both groups showed an improvement in the physical component of the SF-36 score, however, this was only statistically significant for the total ankle arthroplasty group (p < 0.0004). Additionally, both groups had improvement in their AOFAS scores post-operatively. Again, this was only statistically significant for the total ankle arthroplasty group (p < 0.001). The average degree of dorsiflexion and mechanical axis were the same in both groups. DISCUSSION AND CONCLUSION: We found that noncemented total ankle prostheses performed as well as arthroscopically assisted ankle fusions in patients of similar ages with end stage arthritis. In addition, the total ankle group had fewer complications requiring secondary procedures. While both procedures can be associated with subtalar degenerative joint changes, total ankle arthroplasty is a safe and effective alternative to ankle fusion in patients with end stage arthritis.

Percutaneous Tenotomy of the Toe Flexor Tendon is a Simple and Efficient Method in Treating Checkrein Deformity
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Pei-yu Chen, MD, Taipei, Taiwan
Yi-Yen Chiang, MD, Taipei, Taiwan
Chung-Li Wang, MD, Taipei City, Taiwan

INTRODUCTION: Dynamic claw toes deformity after distal tibia fracture was first reported by Clawson in 1974, which was also known as checkrein deformity. It represents a “fixed length phenomenon” of the flexor hallucis longus (FHL) because of the tethering effect. When the affected foot is actively or passively dorsiflexed, the clawing deformity of the big toe becomes prominent because the interphalangeal and metatarsophalangeal joints are passively flexed. The deformity becomes subtle or even vanished when the foot is plantar-flexed. Surgical intervention is the treatment of choice and plenty of methods were proposed. The purpose of the present study was to evaluate the outcomes and complications of percutaneous tenotomy of the toe flexor tendon when treating the checkrein deformity. METHODS: We reviewed 10 patients with checkrein deformity who underwent surgery in our institution between 2002 and 2010. There were seven males and three females with a mean age of 31 years (20 to 56). The mean follow-up period was two years. All patients underwent percutaneous tenotomy of the toe flexor tendons. Hallux Metatarsophalangeal-Interphalangeal Scale (hallux MTP-IP scale) and Foot and Ankle Outcome Score (FAOS) questionnaire were used to evaluate the functional outcomes. RESULTS: All of our patients gained symptom relief after the procedure. And they are able to walk smoothly without their toes kicking to the ground and foot pain in shoes. During the follow-up period, no clawing deformity recurrence was noted. The patients lost their toes’ grasping ability in which tenotomy were performed, but no one complained about any disturbance in their daily living or functional dissatisfaction. Their mean hallux MTP-IP scale was 88.5 and FAOS was 100, 94.6, 100, 92.5, and 96.2 in pain, symptoms, activity of daily living (ADL), sports/recreation, and quality of life (QOL), respectively. DISCUSSION AND CONCLUSION: Surgical intervention is the treatment of choice when dealing with the checkrein deformity. The condition can be corrected by doing a tenolysis at the site.
of fracture. The procedure, however, usually requires a larger dissection and the neurovascular bundles near the affecting site are at risk because of the adhesion secondary to the previous injury or operation. The method we used, percutaneous tenotomy, is even simpler and has a lower risk of neurovascular damage. Our patients have high hallux MTP-IP scales. They are free from pain, lead a normal ADL and have high quality of lives after the surgery. And of most importance, there have been no complications and recurrence yet. Through those tiny incisions, the correction of the chekcrein deformity is rapid, safe and efficient and can be an outpatient surgery.

POSTER NO. P218
ALTERNATE PAPER: FOOT AND ANKLE III
Change in Bone Mineral Density in Ankle after Total Ankle Replacement - Two-Year Follow Up
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Dave Rawlings, Newcastle-upon-Tyne, United Kingdom
Malik S. Siddique, MD, Newcastle-upon-Tyne, United Kingdom

INTRODUCTION: There is no published series describing change in bone mineral density (BMD) after ankle replacement. We present the results of a prospective study examining the effect of total ankle replacement (TAR) upon local bone mineral density (BMD). The aim was to design a method and assess the effect of TAR loading on local ankle bones, by analyzing the BMD of different areas around ankle before and after mobility TAR. METHODS: Twenty-three patients undergoing Mobility ankle arthroplasty for osteoarthritis had pre-operative bone densitometry scans of the ankle, repeated at one and two years after surgery. BMD of 2 cm² areas around ankle were measured. Pre- and post-operative data were compared. RESULTS: Mean BMD within the lateral malleolus decreased significantly from 0.55 g/cm² to 0.42 g/cm² (17%, P > 0.01), at one and two years postoperatively. Mean BMD within medial malleolus decreased slightly from 0.67 g/cm² to 0.64 g/cm² at the same period. However BMD at medial side metaphysic of tibia increased by 7%. DISCUSSION AND CONCLUSION: Absence of stress shielding around distal tibia, just proximal to tibial component and talus, indicates that ankle replacements implanted within the accepted limits for implant alignment, load distal tibia and talus. However, there was stress shielding over the lateral malleolus resulting in decreased BMD in lateral malleolus. Increase BMD at tibial metaphysis, proximal to medial malleolus indicates an increase in mechanical stress which may explain occasional postoperative stress fracture of medial malleolus or medial side ankle pain.

POSTER NO. P219
The Sentinel Vein: An Anatomical Guide to Localization of the dorsomedial cutaneous nerve in hallux surgery
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Arunav Kumar, MD, Swansea, United Kingdom
Nilesh Makwana, FRCS ORTH, Shropshire, United Kingdom

INTRODUCTION: The dorsomedial cutaneous nerve (DMCN) supplies the medial side of the hallux and is at risk in hallux surgery. This can lead not only to sensory loss over the big toe, but also to painful scars or neuroma formation. Painful neuromas can be severely disabling and are difficult to treat. The purpose of our study is to describe a consistent anatomical landmark to help identify the nerve during surgery and thus help reduce the incidence of nerve injury and its disabling sequel. METHODS: We undertook a clinico-anatomic study to investigate the anatomical relationship of the DMCN. We dissected 16 cadaver feet to study the relationship between the DMCN and the dorsal-plantar venous network. We further correlated our cadaveric findings in 116 prospective patients (142 operations) undergoing various hallux procedures (108 operations for hallux valgus, 25 cases of metatarso-phalangeal joint (MTPJ) arthrodesis and nine cases of dorsal cheilectomy). RESULTS: We consistently found a single vessel approximately 2 centimeters proximal to the MTPJ in the dissected specimens (mean 2.1 cm, range 1.9-2.4 cm). The vein was positioned transversely across the wound and communicated with both the dorsal and plantar venous arches. On deeper dissection the DMCN was found immediately deep to the venous network and (figure 1) crossed under the venous network at the point where the communicating vein entered the dorsal venous arch. In the two specimens where the communicating vein was absent the plantar and dorsal venous arches directly united more proximally (3.2-3.4 cm). The DMCN was still visible lying oblique immediately deep to the venous arch. We identified the DMCN in vivo in 119/142 (84%) of the procedures. In vivo we found the vein to be situated approximately 2 cm from the MTPJ joint (mean 2.38 mm, range 2.1-3.0 mm). The in vivo distance correlated well with that found in cadaveric dissection (mean 2.1 cm, range 1.9-2.4 cm). DISCUSSION AND CONCLUSION: We describe a previously unrecognized anatomical structure lying in close proximity to DMCN. We wish to name this vessel as the “sentinel vein.” The purpose of our clinico-anatomical study was to accurately document the anatomical relationship of the DMCN in relation to the sentinel vein and guide the surgeon safely through this part of the dissection. We found the sentinel vein to be an important and consistent landmark in our clinical practice that is very helpful to identify and preserve the DMCN and to avoid the consequences of injury to it.

POSTER NO. P220
Planovalgus Deformity Surgical Correction in Ambulatory Children with Cerebral Palsy
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Freeman Miller, MD, Wilmington, DE
Laurens Holmes, PhD, DrPH, Wilmington, DE

INTRODUCTION: Planovalgus foot deformity is common in diplegic and quadriplegic patients. It results from the disturbed relationship between tarsal bones. The talar head subluxates medially and inferiorty and it becomes part of the weight bearing area of the deformed foot. Surgery is the definitive treatment to restore the alignment of talus, calcaneus and navicular bones. The aim of this study was to compare the effectiveness
of subtalar fusion and calcaneal lengthening, and to examine the recurrence in ambulatory children with cerebral palsy (CP).

**METHODS:** This is a retrospective study of 78 patients with 138 feet diagnosed with planovalgus deformity and underwent surgical correction using subtalar fusion or calcaneal lengthening. All the medical records, radiographs, gait analysis reports and videos were reviewed. Range of motion, radiographic indices, kinetic, kinematic, and pedobarograph data were used to evaluate the severity of the deformity and the results of surgery. General motor function classification system GMFCS was used to examine the functional abilities of the patients pre and postoperatively.

**RESULTS:** Most of the patients were diplegic (87.2%). Mean age at the first surgery for foot correction was 11.94 ± 2.9 (range 4.7 - 18.3 years), with mean follow up of 5 ± 4.4 years (range 1 - 15.4 years). Sixty-three feet were treated with calcaneal lengthening and 75 feet with subtalar fusion. Both surgery groups were effective in correcting planovalgus foot deformity in our sample of feet, with relative high efficiency of subtalar fusion given the severity of the feet treated with this operation. Medial column fusion was the main surgery performed to correct recurrence cases. Age at the first surgery was a significant predictor of recurrence after adjustment for body mass index. Every one unit increase in age, there was a 33% decrease risk of recurrence, OR= 0.78, 95% CI (0.62 - 0.97), p = 0.03.

**DISCUSSION AND CONCLUSION:** Surgery is effective in the treatment of planovalgus deformity in ambulatory children with CP. Feet with milder deformity have good results with calcaneal lengthening. Severe and rigid planovalgus feet can effectively be treated with subtalar fusion with careful attention to complete midfoot correction. Surgery in young patients has good results as the deformity is not severe but it has higher recurrence rate.

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**Table 2: Potential predictors for the recurrence of planovalgus deformity among ambulatory CP kids treated with calcaneal lengthening or subtalar fusion**

<table>
<thead>
<tr>
<th>Variable</th>
<th>OR (95% CI)</th>
<th>P value</th>
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<tr>
<td>Demographic</td>
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<tr>
<td>Age at 1st surgery (yrs)</td>
<td>0.78 (0.62 - 0.97)</td>
<td>0.03</td>
</tr>
<tr>
<td>BMI</td>
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<tr>
<td>Underweight (kg/m²)</td>
<td>1.47 (1.24 - 1.84)</td>
<td>0.675</td>
</tr>
<tr>
<td>Normal</td>
<td>1.00</td>
<td>Referent</td>
</tr>
<tr>
<td>Overweight (kg)</td>
<td></td>
<td>Referent</td>
</tr>
<tr>
<td>Clinical</td>
<td></td>
<td></td>
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<tr>
<td>GMFCS</td>
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<tr>
<td>Good ambulators (GMFCS 1)</td>
<td>1.00</td>
<td>Referent</td>
</tr>
<tr>
<td>Poorly ambulators (GMFCS 3-5)</td>
<td>3.07</td>
<td>0.109</td>
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<tr>
<td>Ankle plantar flexion</td>
<td>0.04 (0.98 - 1.00)</td>
<td>0.168</td>
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<tr>
<td>Ankle dorsiflexation with knee extension</td>
<td>0.04 (0.98 - 1.10)</td>
<td>0.183</td>
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<td>Radiographic</td>
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<tr>
<td>Pitch angle (°)</td>
<td>0.72 (0.4 - 1.3)</td>
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<tr>
<td>Talonavicular angle (°)</td>
<td>0.39 (0.19 - 0.81)</td>
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<td>Kinematics</td>
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<tr>
<td>Stride length (m/s)</td>
<td>0.73 (0.51 - 0.97)</td>
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<td>Forward velocity (°)</td>
<td>0.99 (0.94 - 1.05)</td>
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<td>Tibial foot angle (°)</td>
<td>0.99 (0.96 - 1.00)</td>
<td>0.996</td>
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<td>Foot progression angle (°)</td>
<td>0.99 (0.96 - 1.00)</td>
<td>0.258</td>
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<tr>
<td>Knee extension at initial contact (°)</td>
<td>0.99 (0.96 - 0.99)</td>
<td>0.664</td>
</tr>
<tr>
<td>Maximum knee extension in stance (°)</td>
<td>0.99 (0.90 - 1.00)</td>
<td>0.987</td>
</tr>
<tr>
<td>Pedobarograph</td>
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<tr>
<td>CPIF</td>
<td>1.01</td>
<td>0.675</td>
</tr>
<tr>
<td>1ST</td>
<td>0.99</td>
<td>0.78</td>
</tr>
</tbody>
</table>

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*OR implies the prevalence odds ratio, CI= confidence interval range (95 to 99%)
†+ odds ratio could not be calculated due to small number of cases
‡ the significance level was 0.01 due to multiple comparison in order to avoid type 1 error.

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**POSTER NO. P221**

**Correction of Medial/Lateral Subluxation of Lesser MP Joints with Extensor Brevis Transfer/MP Release**

Elizabeth A. Young, Rochester, NY
Scott Ellis, MD, New York, NY
Jonathan T. Deland, MD, New York, NY

**METHODS:** Twenty patients (20 female, 0 male) having undergone correction of medial or lateral subluxation of a lesser metatarsal-phalangeal (MTP) joint (15 second toes, five third toes), with a transfer of the extensor digitorum brevis (EDB) tendon were assessed at an average of 17.9 months (12 to 34 months) after surgery. The technique was indicated when MTP and medial or lateral partial plantar plate release alone were not sufficient to correct deformity. The EDB was released proximally and passed through drill holes in the proximal phalanx and metatarsal neck to replicate the collateral ligament. It was then secured to the dorsal metatarsal with a screw post. If the toe reMEd elevated, a plantar dermodesis was added. The radiographic MTP angle, physical exam (impingement on the adjacent toe, MTP tenderness, MTP elevation off the floor, and MTP joint range of motion), and subjective outcomes (toe-specific survey, the Foot and Ankle Outcome Score) were assessed. A toe-specific survey was created to capture more detailed information concerning the shoe wear, impingement on adjacent toes, and patient satisfaction.

**RESULTS:** The average MTP angle improved from 2º (±13.33) in varus to 15.15º (±12.56) in valgus. On exam, impingement on the adjacent toe was found in one case, MTP tenderness in two cases, and toe elevation in three cases. The average MTP joint range of motion was 63º (±11.06) dorsiflexion and 10.85º (±2.11) plantarflexion. As reported on the toe-specific survey, 18 patients were either highly satisfied or satisfied with the procedure. The majority of patients (18/20) reported that they would undergo this procedure again. Average post-operative FAOS scores improved in all categories.

**DISCUSSION AND CONCLUSION:** The extensor brevis tendon transfer technique described in conjunction with a plantar plate release can successfully correct medial and lateral deviation. It can be considered when MTP and partial plantar plate release are insufficient to correct the deformity. This combined procedure is powerful, and minimal release of the
medial or lateral plantar plate and not over-tightening the transfer is recommended.

POSTER NO. P222
Correlation of Knee and Hindfoot Deformities in Patients with Advanced Knee Arthritis
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Annunziato Amendola, MD, Iowa City, IA
Phinit Phisitkul, MD, Iowa City, IA
Steve S. Liu, MD, Iowa City, IA
Siwadol Wongsak, MD, Iowa City, IA
Catherine Fruehling-Wall, BA, Iowa City, IA
John J. Callaghan, MD, Iowa City, IA
INTRODUCTION: Synchronous interaction between the joints of the lower extremity is essential for proper gait. Since the relationship between knee and hindfoot alignment is unclear, this study was completed to investigate and elucidate the relationship between knee deformity and corresponding hindfoot alignment. METHODS: A total of 401 total knee arthroplasties (TKAs) in 324 patients were evaluated. Standing full-leg-length anteroposterior and Saltzman hindfoot alignment view radiographs were used to determine the mechanical axis angle and the degree of hindfoot malalignment using the Saltzman measurement and the Saltzman hindfoot angle. The relationship between knee deformity and hindfoot alignment was assessed for linear correlation. Intra-class correlation coefficient was used to evaluate intra- and interobserver reliability. RESULTS: The mechanical axis angle correlated with both the Saltzman hindfoot measurement and the Saltzman hindfoot angle in the entire cohort (p-value = 0.0001). The difference in hindfoot alignment between knees with varus and valgus deformity were significant in the entire cohort and the ≥ 10° knee deformity sub-group (p-value = 0.0001). Intra- and interobserver reliability analysis showed excellent reliability in all measurements. DISCUSSION AND CONCLUSION: This study found significant correlation between knee and hindfoot deformities in patients with advanced knee arthritis and ≥ 10° knee deformity. Patients with a varus knee tend to have a valgus hindfoot and patients with a valgus knee tend to have a varus hindfoot. Complete understanding of the limb malalignment and corresponding deformities can be helpful to surgeons treating patients with advanced knee arthritis with or without foot and ankle problems.

POSTER NO. P223
Intermediate to Long Term Outcome of One Manufacturer’s Total Ankle Arthroplasty
Hongmou Zhao, MD, Shanghai, China
Yu Guangrong, Prof, Shanghai, China
INTRODUCTION: The purpose of this study was to provide cumulative data about the intermediate to long term outcome of one manufacturer’s total ankle prostheses in the literature, and to provide a summary of survival rate, implant failure rate and reasons. METHODS: A comprehensive search for all relevant articles published in English from January 1995 to December 2010 was conducted. Two reviewers evaluated each study to determine whether it was eligible for inclusion and collected the data of interest. The intermediate to long term outcome was concluded. Meta-analytic pooling of results across studies was performed for the survival rate and failure rate. RESULTS: Twelve primary studies with 2,005 implants were identified. The mean AOFAS score was 77.6. The pooled mean five-year survival was 84.7% (95%CI:80.0 to 89.3), and the pooled mean 10-year survival was 72.5% (95%CI:62.3 to 82.5). The pooled mean failure rate was 14.2% (95%CI: 10.6 to 17.8). The first three reasons associated with implant failure were aseptic loosening (6.8%), malalignment (2.8%) and pain (2.5%). DISCUSSION AND CONCLUSION: We found that total ankle arthroplasty has achieved encouraging results about intermediate to long term outcome. The five-year and 10-year survival rates were acceptable. The first reason for implant failure was aseptic loosening.

POSTER NO. P224
Treatment of Open Calcaneal Fractures
Yu Guangrong, Prof, Shanghai, China
Hongmou Zhao, MD, Shanghai, China
INTRODUCTION: This study is to review our series of open calcaneal fractures and to discuss the clinical outcome and evaluate the effect factors associated with the prognosis. METHODS: Between 2004 and October 2009, 427 calcaneal fractures were treated at our hospital, and 22 of these fractures in 22 patients were open, 15 feet of 15 patients were available for follow up. Nine male and six female with a mean age of 34.7 years (range 18~66). According to the Sanders classification, there were two type-I, three type-II, 6 type-III and four type-IV. According to the Gustilo classification, there were one type-I, four type-II, five type-IIIA, and five type-IIIB open fracture. According to the Open Calcaneal Injury Subtypes (OCIS), there were one type-I, two type-II, seven type-III, two type-III and three type-IIIIB. All patients were treated with intravenous antibiotics, immediate and repeat irrigation and debridement, temporary wound coverage, and initial stabilization of the limb. Clinical examination, radiographs and AOFAS ankle-hindfoot scores were used for outcome measurement. RESULTS: The average time of follow up was 16.4 months (8~31 months). The mean AOFAS score was 74.6 (range 58~94). There were four feet that required tissue transfer for wound coverage. An infection developed at the sites of five fractures, four of which were Gustilo type-III, two deep infections with osteomyelitis developing at the site of one patient; no patient required amputation. DISCUSSION AND CONCLUSION: Our findings do not reflect as high a deep infection and osteomyelitis rate for open calcaneal fractures as previously reported. If early and satisfying debridement, evaluate the soft tissue injury carefully, and choose the right time and indications for internal fixation. In addition, early internal fixation should be avoided for Gustilo type-III and OCIS type-B calcaneal fractures.

Complications of open calcaneal fracture

<table>
<thead>
<tr>
<th>Gustilo classification</th>
<th>Cases</th>
<th>Superficial infections</th>
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<tr>
<td>I</td>
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<tr>
<td>II</td>
<td>4</td>
<td>1</td>
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<td>III A</td>
<td>5</td>
<td>2</td>
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<td>0</td>
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<td>III B</td>
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<td>2</td>
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<td>III C</td>
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< The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use). For full information refer to page 14. An alphabetical faculty financial disclosure list can be found starting on page 19.>
Safe Zone for the Approach to the Posterior Sole (Heel)
Vivek Mahajan, MD, Mangalore, India

INTRODUCTION: Surgical approach to the posterior sole or heel is commonly used for retrograde nailing for tibiototalcalcaneal arthrodesis and the Gaenslen split-heel approach for chronic osteomyelitis of the calcaneum. Both the above procedures involve a significant risk of damage to soft tissues and neurovascular structures, especially the lateral plantar nerve and the nerve to the abductor digiti minimi. The purpose of this study was to define the safe zone for the surgical approach to the posterior sole to minimize the risk of injury to neurovascular structures and identify radiographic and anatomical landmarks that would be accurate and useful intraoperatively.

METHODS: Eleven fresh-frozen cadaver feet were used in this cadaver study. We measured the entire foot length (D1), distance of the lateral plantar nerve from the heel (D2), distance of the calcaneocuboid joint from the heel (D3), distance of the nerve to abductor digiti minimi from the heel (D4), and distance of the lateral plantar nerve from the calcaneocuboid joint (D5). We took the angle of the lateral plantar nerve to the midline axis (A). With the above observations and measurements, we calculated the ratios (R1) of D2:D1, (R2) of D5:D1, and (R3) of D4:D1. RESULTS: D1 was 229.1 ± 11.8 mm. D2 in the dissecting midline axis was at a mean of 93.5. D3 was located at a mean of 75.7 (range 70-85) mm from the heel in the midline axis. The nerve to abductor digiti minimi was located (D4) at a mean of 48.1 (range 41-55) mm from the heel. The lateral plantar nerve was located (D5) at a mean of 19.4 (range 16-23) mm distal to the calcaneocuboid joint in the midline axis. We recorded the angle (A) at which the lateral plantar nerve crossed the dissecting midline axis at a mean of 13.8 degrees (range 9-20). The ratio (R1) of location of lateral plantar nerve from heel (D2) to the entire foot length (D1), the ratio (R2) between D5 to D1; and the ratio (R3) between distance of the nerve to abductor digiti minimi from the heel (D4) to the entire foot length (D1) were 0.408 ± 0.018, 0.077 ± 0.009, and 0.210 ± 0.009, respectively. DISCUSSION AND CONCLUSION: Intraoperative localization of the calcaneocuboid joint and the anatomical landmark from the calcaneal tuberosity over the heel can help reduce intraoperative injury to the lateral plantar nerve and the nerve to the abductor digiti minimi. There are no studies to our knowledge describing the optimal or safe zone for the posterior sole. Based on our observations, we defined the safe zone for the surgical approach to the heel as anterior to the nerve to the abductor digiti minimi (D4) in the midline axis, and posterior to the calcaneocuboid joint (D3). A recommended safe zone, based on our data, should be approximately 48 mm distal from the heel (D4) and posterior to calcaneocuboid joint (D3), which lies approximately 76 mm from the heel. Because the nerve to the abductor digiti minimi is located just on the medial tubercle of calcaneal tuberosity, we can practically define the proximal safe margin under fluoroscopy. There were no significant neurovascular structures observed in this zone. A surgeon can reliably use these landmarks intraoperatively to approximate the safe zone at the planter aspect of the heel. We conclude that by using the safe zone for tibiototalcalcaneal retrograde nailing and the split heel approach, even for other surgical procedures in the posterior sole, damage to important neurovascular structures can be minimized, helping create a favorable outcome.

Arthroscopic Treatment of Ankle Anterior Bony Impingement: The Long-Term Clinical Outcome
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Roberto Buda, Bologna, Italy
Francesca Vannini, MD, Bologna, Italy
Alberto Ruffilli, MD, Bologna, Italy
Marco Cavallo, MD, Bologna, Italy
Alberto Ferruzzi, MD, Bologna, Italy
Sandro Giannini, MD, Bologna, Italy

Introduction: The arthroscopic treatment of anterior bony impingement provides good results, which tend to decrease over time. The purpose of this study was to analyze the statistically significant factors affecting long-term results.

Methods: 80 consecutive patients with a mean age of 37.3 years were treated between 2000 to 2004. Impingement lesions were identified according to Scratch-McDermott classification. Preoperative ankle osteoarthritis was documented by van Dijk scale upon the X-rays. Bone spurs were analyzed and classified according to localization and size. The associated chondral lesions were classified following the ICRS criteria. Patient data, foot morphology, previous traumas were documented. Patients were evaluated after 104.6 (mean) months follow-up, following the AOFAS scale. The incidence of the various factors on the outcomes was statistically analyzed.

Results: The mean preoperative AOFAS score was 50.9, while at follow-up it scored 70.7 (p<0.05). The Scratch-McDermott classification did not affect the results but only the preoperative stage. At follow-up it scored 70.7 (p<0.05). The Scratch-McDermott classification did not affect the results but only the preoperative stage. Tibial localized spurs had better recovery at follow-up. The grade of the chondral lesions affected the outcome. Other factors negatively affecting the results were increasing age, cavus foot morphology and previous ankle fracture.

Discussion and Conclusion: Arthroscopic treatment provides good overall results, but the long-term presence of contemporary associated conditions such as chondral lesions, age, previous trauma is relevant as prognostic factors. Based on these results a new classification is needed.

- The FDA has not cleared the drug and/or medical device for the use described in this presentation (i.e. the drug or medical device is being discussed for an off label use).

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**Total Ankle Replacement Using a Non-Constrained, Three-Component System**

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Lukas Zwicky, MSc
Markus Knupp, MD, Liestal, Switzerland
Andrew E. Anderson, PhD, Salt Lake City, UT
Beat Hintermann, MD, Liestal, Switzerland

**Introduction:** Total ankle replacement (TAR) is increasingly recommended treatment for patients with end-stage ankle osteoarthritis (OA). This comprehensive study used radiographic measures and clinical evaluation instruments to identify prosthesis survivorship, alignment of prosthesis components, clinical outcome, and patients’ satisfaction. Additionally, the feasibility of TAR in patients with different OA aetiologies was evaluated.

**Methods:** Prospective study of 409 patients with 429 primary TARs, approved by the ethics committee. All ankles were evaluated preoperatively and postoperatively based on weight bearing radiographs. Revision of a metallic implant or conversion into ankle fusion was taken as the endpoint for survivorship analysis. The alignment of prosthesis component was assessed by measurement of anteroposterior offset ration (AOR). Clinical evaluation included measurement of range of motion, visual analogue scale (VAS) for pain assessment, and AOFAS hindfoot score.

**Results:** Five ankles were revised to ankle fusion, and in 10 ankles revision TAR was performed resulting in a 93.4% survivorship at 6 years. In the entire patient cohort a significant pain relief and functional improvement were observed postoperatively. In patients with neutrally aligned prosthesis (AOR = 0) the postoperative pain level was significantly lower compared to both AOR > 0 and AOR < 0 (p < 0.001). Also, functional outcome, measured using the AOFAS hindfoot score, and range of motion was significantly higher in the AOR = 0 group (p = 0.002 and p < 0.001, respectively). The mid-term results were promising in patients with different OA aetiologies.

**Discussion and Conclusion:** The prosthesis survivorship in this study was comparable to other recently published series. Our data suggest TAR in patients with end-stage ankle OA is associated with significant pain relief and functional improvement including range of motion.

**Minimally Invasive Osteosynthesis Versus Open Reduction and Internal Fixation in Displaced Calcaneal Fractures**

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Cesare Faldini, MD, Bologna, Italy
Matteo Cadossi, MD, Bologna, Italy
Maria Teresa Miscione, MD, Bologna, Italy
Francesco Acri, MD, Bologna, Italy
Mohammadreza Chehrassan, MD, Bologna, Italy
Paola Capra, MD, Bologna, Italy
Valentina Persiani, MD, Bologna, Italy
Deianira Luciani, MD, Bologna, Italy

**Introduction:** The goal of the treatment of displaced articular calcaneal fractures (DACF) is to restore the calcaneal height and width, and restore the subtalar and calcaneocuboid articular surface in order to avoid pain, stiffness and early degenerative changes of the joints. The aim of this study is to compare Minimally invasive osteosynthesis (MIO) versus Open Reduction and Internal Fixation (ORIF) in the DACF.

**Methods:** 108 DACF type 2 and 3 Sanders classification were selected in 103 patients (range 18-57 years). In 63 patients (66 feet) surgical treatment consisted in lateral 3cm skin incision, reduction of articular part and stabilization (MIO). In 40 patients (42 feet) treatment consisted in standard lateral approach to the calcaneus and ORIF of the fracture. Mean follow-up time was 6 years.

**Results:** In patients treated by MIO no skin complications or infections were encountered. All fractures healed and mean healing time was 3 months. In patients treated by ORIF 5 skin complications, 2 infections and 1 sural nerve injury. All fractures healed and mean healing time was 4 months. The results with MIO were: 31 excellent, 22 good, 9 fair and 4 poor. The results with ORIF were: 19 excellent, 11 good, 7 fair and 5 poor.

**Discussion and Conclusion:** In the DACF type 2 and 3 Sanders classification, treated by MIO the results are excellent and good in more than 80% and in compare with ORIF has less postoperative complications. In fact, if soft tissues are preserved by surgical trauma, dangerous complications like infection and skin problems can be avoided.