A Prospective Comparison of Clinical, Radiographic and Intra-Operative Features of Hallux Rigidus: Long-Term Follow-Up and Analysis

Andrew D. Elliott, DPM, JD
Andrew J. Borgert, PhD
Thomas S. Roukis, DPM, PhD, FACFAS

Abstract

Forty-seven patients (50 feet) underwent surgical intervention for symptomatic hallux rigidus between February 1998 and April 1999. Thirty-eight patients (41 feet) returned at one-year for a short-term follow-up evaluation. Of these, 20-patients (21 feet) returned for a long-term 15-year follow-up evaluation. In all studies, subjective evaluations were based on the modified American Orthopaedic Foot and Ankle Surgery “Hallux Metatarsophalangeal-Interphalangeal Scale” 100-point score.

Long-term postoperative objective physical examination and radiographic analysis were performed. This data was compared with both the preoperative data and the short-term follow-up data. The subjective evaluation was statistically significant over the long-term with a mean increase of 27.6-points regardless of surgery type. The results of the physical examination and radiographic measurements were more mixed. The long-term dorsal range of motion decreased from the short-term study to a point where long-term change was not significant across surgery type. Radiographically, procedure types were similar in their changes over time, suggesting that neither the joint preservation nor the joint destructive procedures are more stable over time.

The intended role that plantar transposition of the capital fragment had in offsetting the longitudinal shortening of the first metatarsal was not significant within the patients who underwent a periarticular decompression osteotomy, confirming what was identified in the short-term study. For this specific patient population, the long-term results of surgical intervention for hallux rigidus, regardless of procedure type, provided subjective patient improvement and satisfaction, but no statistically significant increase in first metatarsal-phalangeal joint function or dorsal range of motion.

Level of Clinical Evidence: II Therapeutic, Prospective Comparative Study
Surgical Treatment of Peroneus Brevis Tendon Repair With and Without Human Amniotic Allograft: A Comparison Study

J. Joseph Anderson, DPM, FACFAS
Brittany Rice, DPM
Tee Adeleke, DPM
Zflan Swayzee, BS

Abstract

Potential postoperative complications of surgically repaired peroneus brevis tendon tears includes adhesions, which is concerning given the period of immobilization postoperatively. The use of human amniotic allograft (HAA) has been found to have anti-microbial, anti-fibrotic, anti-inflammatory, and analgesic properties. These benefits may help decrease post-operative adhesions and pain.

The study compares outcomes of treating peroneus brevis tendon tears with and without HAA as an adjunct procedure. A total of 129 patients were included in the study and all had a longitudinal peroneus brevis tendon tear surgically treated with the TRIAD procedure (ankle arthroscopy, lateral ankle ligament reconstruction, and peroneal retinacular tightening), tubularization of the tendon, and debridement of low lying peroneus muscle belly if present.

Of the 129 patients, 58 patients additionally had augmentation of the repaired tendon using HAA and the remaining 71 did not. Modified American College of Foot and Ankle Surgeons hindfoot and ankle scores were taken preoperatively and compared to 3, 12 and 24 month post operative scores with no significance seen between the two groups.

The control group was found to have a significantly longer postoperative physical therapy time of 5.21 as opposed to 7.01 weeks ($p = .0002$). Mean postoperative visual analog scales between the human amniotic allograft and control group were 1.24 and 1.62 respectively and also rendered statistical significance.

The authors found the use of human amniotic allograft to be a viable and effective adjunct in peroneal tendon repair with reduced post-operative pain, physical therapy time and minimal complications.

Level of Evidence: 2
Can Procalcitonin Be Used As A Biomarker For Predicting Amputation Level In Lower Extremity Infections?

Matthew Reiner, DPM
Wissam E. Khoury, DPM, FACFAS
Michael B. Canales, DPM, FACFAS
Dr. Richard A. Chmielewski, MD
Kartick Patel, DPM, MS
Mark C. Razzante, DPM, MA
Coleman O. Cloughtery, DPM, MA
Douglas Y. Rowland, PhD

Abstract

Inflammatory markers are essential tools to the decision making process in lower extremity infections. When coupled with objective findings, clinicians can more accurately diagnose and treat these entities.

Typically markers such as white blood cell count, erythrocyte sedimentation rate, and c-reactive protein are used to initially assess these patients or follow progression of medical or surgical therapy. Procalcitonin is a newer inflammatory marker that is specific for an infectious process. Originally procalcitonin was used to follow antibiotic therapy and sepsis for patients in the intensive care setting, but has now been expanded to other facets of medicine. Procalcitonin has been described for its utility in diagnosing infection or osteomyelitis in diabetic foot ulcers. However, there has been limited research comparing inflammatory markers and level of amputation.

At the authors’ institution, we retrospectively reviewed 170 consecutive instances over the course of 25 months which included surgical intervention for a lower extremity infection where a procalcitonin level was obtained. This initial value of procalcitonin was then compared to the level of amputation at the final surgical intervention for that value.

A significant difference was seen when comparing those who underwent a below or above knee amputation (median PCT of 1.72 ng/mL) and those who did not (median PCT of 0.105 ng/mL) (p < 0.001).

Level of Evidence: Level IV: Case series

Key words: Amputation, C-reactive Protein, Erythrocyte Sedimentation Rate, Procalcitonin, PCT
Total Ankle Replacement Survival Rates Based On Kaplan-Meier Survival Analysis of National Joint Registry Data

Annette F.P. Bartel, DPM, MPH
Thomas S. Roukis, DPM, PhD, FACFAS

Abstract

National joint registry data collectively provides unique information about primary total ankle replacement (TAR) survival. We sought to recreate survival curves among published national joint registry data sets using the Kaplan-Meier estimator to determine the survival rates between registries at 1-year intervals. When provided, survival curves based on the Kaplan-Meier estimator were digitized and recreated to determine worldwide trends.

Overall, 5,152 primary and 591 TAR revisions were included over a 2- to 13-year period with prosthesis survival for all national joint registries of 0.94 (CI 95% 0.90 to 0.97) at 2-years, 0.87 (CI 95% 0.82 to 0.91) at 5-years and 0.81 (CI 95% 0.74 to 0.88) at 10-years. For national joint registries that included the Ankle Evolutive System (AES), Buechel-Pappas (BP) or Scandinavian Total Ankle Replacement (STAR) as ≥ 35% of total prostheses implanted the survival rate was 0.78 to 0.89 at 5-years compared with registries with < 35% of these implants being 0.90 to 0.93 at 5-years.

Future studies and national joint registry datasets should continue to strive for completion of data presentation to include revision definitions, modes of failure, time of failure and patients lost to follow-up or death for complete accuracy of the Kaplan-Meier estimator.

Level of Clinical Evidence: Prognostic, Level 3: Case Control Study
Realignment Midfoot Osteotomy
Bradley M. Lamm, DPM, FACFAS
Matthew J. Hentges, DPM, AACFAS
Emily Pugh, DPM, AACFAS
Martin G. Gesheff, BS

Abstract

Deformities of the midfoot are often treated with midfoot osteotomies. The goal of the midfoot osteotomy is to create a plantigrade forefoot to hindfoot relationship. Many different techniques are described for performing midfoot osteotomies. Our goal is to present an objective intra-operative method for accurate realignment and discuss our short-term results.

We retrospectively reviewed 18 patients, 10 female (56%) and 8 female (44%), that underwent realignment midfoot osteotomy. The mean follow-up was 25 months (range, 4 to 120). The mean age at the time of surgery was 53 years (range, 21 to 76).

Statistically significant improvement in radiographic alignment was found in anteroposterior talo-first metatarsal angle (P=0.002) and the mechanical axis deviation of the foot (P=0.02). The results this study support our conclusion that proper multiplanar realignment of the forefoot to hindfoot will lead to short-term success, and likely long term success, of midfoot osteotomies.

Level of Clinical Evidence: 4

Keywords: Midfoot, Midtarsal joint, Osteotomy, Deformity Correction, CORA
Long Second Metatarsals are Associated with Progressive 2nd Metatarsophalangeal Joint Plantar Plate Tears

Adam E. Fleischer, DPM, MPH
Erin E. Klein, DPM, MS
Maheen Ahmad, MPH
Shivang Shah, MS
Fernanda Catena, MD
Lowell Weil, Jr., DPM, MBA
Lowell Scott Weil, Sr., DPM

Abstract

Progressive plantar plate injuries are common yet it is unclear whether, and to what extent, length of the 2nd metatarsal contributes to these deformities.

We conducted a retrospective case-control (1:2) study to examine radiographic risk factors for plantar plate tears. Cases were defined as patients with non-acute, isolated, plantar plate injury of the 2nd MTP joint confirmed by intraoperative inspection at a single foot and ankle specialty practice from June 1, 2007 to Jan 31, 2014. Patients presenting for pain outside of the forefoot served as the control group. Controls were matched on age (+/- 2 yrs), gender and year of presentation.

Weight bearing foot x-rays were assessed for several predetermined angular relationships by a single rater. Conditional logistic regression was used to identify risk factors for plantar plate injury. One-hundred patients (age 55.7 ±12.3 yrs) with plantar plate injuries and 200 healthy controls (age 56.3 ±11.3 yrs) were included. A long 2nd metatarsal, defined as a metatarsal protrusion index >4mm, was the only significant risk factor for plantar plate injury in both the univariate and multivariate analyses (multivariate odds ratio 2.5 [95% CI 1.8-3.3, P=0.002]).

We conclude that a long second metatarsal is a strong risk factor for developing 2nd MTP joint plantar plate tears. This knowledge may aid foot and ankle surgeons when deciding on the final resting position of corrective shortening 2nd metatarsal osteotomies (e.g., Weil osteotomy) and when contemplating the possible need for 2nd metatarsal osteotomy during corrective hallux valgus surgery.

Level of evidence: Prognostic level 3
Intraoperative Radiation Exposure During Revision Total Ankle Replacement

Kelli Iceman, BS
Andrew D. Elliott, DPM, JD
Thomas S. Roukis, DPM, PhD, FACFAS

Abstract

Intraoperative C-arm image intensification is required for primary total ankle replacement implantation. Significant radiation exposure has been linked to these procedures; however, radiation exposure during revision total ankle replacement remains unknown. Therefore, we sought to evaluate radiation exposure encountered during revision total ankle replacement.

Forty-one patients were retrospectively analyzed from a prospective database: 19 Agility to Agility; 4 Agility to Custom Agility; 9 Agility to INBONE II; 5 Agility to Salto Talaris XT; 2 STAR to Salto Talaris XT; and 2 INBONE I to INBONE II revision total ankle replacements were performed.

Two broad categories were identified: partial revision (Agility to Agility, Agility to Custom Agility, INBONE I to INBONE II) and complete conversion (Agility to INBONE II, Agility to Salto Talaris XT, STAR to Salto Talaris XT). The mean radiation exposure per case was significant at 3.49 ± 2.21 milliGray. Complete conversions, specifically Agility to INBONE II, exhibited the greatest radiation exposure and C-arm time. Revision implant selection and revision type (complete or partial) directly contributed to radiation exposure.

Accordingly, revision systems requiring less radiation exposure are preferable. Surgeons should strive to minimize intraoperative complications and limit additional procedures to those necessary as both lead to additional radiation exposure.

Level of Evidence: Level III-Therapeutic Study (Retrospective Comparative Series)
A Review of 399 Total Ankle Replacements: Analysis of Ipsilateral Subtalar Joint Arthrodesis and Associated Talar Component Subsidence

Mark A Prissel, DPM
Christopher F Hyer, DPM, MS
Gregory C Berlet, MD

Abstract
Total ankle replacement (TAR) is an accepted treatment for end-stage ankle arthritis. When concurrent subtalar joint pathology exists, ipsilateral subtalar joint arthrodesis (STJA) can be performed; however, limited data exist on the effect of talar component subsidence and prosthesis survivorship. The study purpose was to evaluate the effect of STJA on talar component subsidence following primary TAR and its impact on TAR survivorship.

All patients minimum 18 years old, from a single institution with modern generation TAR and one-year minimum follow-up were evaluated. The study group identified patients who additionally underwent STJA, while the control group (no STJA) was matched 1:1 for age, sex and prosthesis. Initial weightbearing post-operative and most recent weightbearing radiographs were compared for talar component subsidence.

We reviewed 399 primary TAR from 2004 through 2012. Forty-one patients with ipsilateral STJA were identified, ultimately 33 met inclusion criteria with an appropriate control group match. In the study group, eight patients returned to surgery with four revisions and four reoperations at 740 days median follow-up. Of the 33 matched controls, nine patients returned to surgery with four revisions and five reoperations at 1167 days median follow-up.

There were no statistically significant radiographic differences between groups. Primary TAR and ipsilateral STJA were infrequently required (41 of 399, 10.3%). STJA does not demonstrate decreased survivorship when performed with ipsilateral TAR at early follow-up. Further study is warranted to determine difference in previous, simultaneous or subsequent STJA with ipsilateral TAR and matched longitudinal analysis is needed to determine longer-term survivorship.

Level of Clinical Evidence: 3
Ankle Arthrodesis: A Retrospective Review Comparing Single Column, Locked Anterior Plating to Crossed Lag Screw Technique

Mark A. Prissel, DPM
G. Alex Simpson, DO
Sean A. Sutphen, DO
Christopher F. Hyer, DPM, MS
Gregory C. Berlet, MD

Abstract

Ankle arthrodesis is performed to eliminate pain due to end stage osteoarthritis, regardless of etiology. This procedure remains the gold standard treatment for end stage ankle arthritis, despite recent advancements in total ankle replacement. The objective of this study is to retrospectively evaluate the radiographic and clinical fusion rates and time to bony fusion for patients who underwent ankle arthrodesis via an anterior approach with a single column locked plate construct versus crossed lag screws.

We identified 358 patients who underwent ankle arthrodesis between January 2003 and June 2013, of those 83 (23.2%) met inclusion criteria for study. Of the 83 included patients, 47 had locked anterior (or anterolateral) plate fixation, while 36 had crossed lag screw constructs. The overall nonunion rate was 6.0% (n=5) with 1 nonunion in the anterior plate group (2.1%) and 4 nonunions in the crossed lag screw group (11.1%), (p=0.217). No differences were identified between groups for normal talocrural angle ($\chi^2(1)=0.527; p=0.468$), normal tibial axis–talar ratio ($\chi^2(1)=0.004; p=0.952$) and lateral dorsiflexion angle (p=0.565). Against the current body of literature, our cohort for single column anterior locked plate fixation represents one of the largest reported series.

Based on our findings in similar demographic groups, ankle arthrodesis via locked anterior plate fixation is a safe technique with similar complication rate and radiographic outcomes to crossed lag screws, while this preliminary evidence suggests the potential for superior outcome regarding union if appropriate sample size can be obtained.

Level of Clinical Evidence: 3
Determining Radiographic Union Scoring Scale for Determining Union Rates in the Calcaneus

Michael L. Sganga, DPM
N. Jake Summers, DPM, AACFAS
Brandon Barrett, DPM
Michael Matthews, DPM
Timothy Karthas, DPM
Lindsay Johnson, DPM, FACPAS
Jeremy J. Cook, DPM, MPH, FACPAS
Philip Basile, DPM, FACPAS
Emily A. Cook, DPM, MPH, FACPAS

Abstract

Reliable evaluation of osseous consolidation following hindfoot osteotomies can be difficult. Given that concomitant hindfoot osteotomies often dictate the advancement of weight bearing and radiographs are the mainstay imaging tool due to cost, efficiency and radiation exposure. Understanding radiographic parameters which reliably determine osseous healing is paramount. Yet, there is currently no reliable or validated means to determine osseous healing of hindfoot osteotomies in irregular bones of the foot.

The purpose of this study was to develop a radiographic healing scoring system that would enhance the diagnostic healing assessment for elective calcaneal osteotomies. We adapted existing orthopedic scales validated for healing in the leg for application in irregular bones of the foot. 168 cases were evaluated by 6 blinded assessors to test the interrater reliability of subjective healing assessment compared to the proposed scoring system. Radiographs were classified by post-operative period: ≤ 4 weeks, 5-12 weeks, and >12 weeks. The proposed scale was found to have high interrater reliability but was burdensome. Using a priori item reduction protocols, a limited 6 item scale further improved internal consistency while reducing burden.

The result was excellent interrater reliability (α =0.98, SD = 0.02 95% CI (0.91-0.96)) among all assessors when using the scoring scale as compared to unacceptable reliability (α =0.438) for subjective osteotomy healing. Reliability of this system appeared superior to subjective assessment of osseous healing alone even in the absence of clinical correlates following an osteotomy of the calcaneus.

Level of Evidence: 1
Charcot Pathogenesis: A Study of RANKL and OPG Gene Expression

James Connors, DPM
Lauren Kishman, DPM, AACFAS
Mark Hardy, DPM, FACFAS
Georgeann Botek, DPM, FACFAS

Abstract

Charcot osteoarthropathy is a rare but often difficult to manage disease in the neuropathic patient. Early signs such as unremarkable edema, marginal trauma or minor infection can activate a cascade of bony destruction and lead to gross prominence or deformity with dire consequences. The exact molecular mechanism is poorly understood. Current theory states that an inflammatory reaction leads to the activation of osteoclasts mediated by specific cytokines.

Our study sought to test the genetic expression of certain biomarkers in diabetic patients with and without Charcot compared to patients with and without diabetes or neuropathy. Thirty patients total participated in the study, 17 males and 13 females. Peripheral blood samples were drawn and gene expression was measured by real-time polymerase chain reaction.

The expression levels of Receptor Activator of Nuclear Factor Kappa B ligand, Osteoprotegerin, and Tumor Necrosis Factor-alpha showed no significant difference in each group. These results demonstrate a need for further investigation into alternative molecular pathways to determine the mechanism of the disease process.

Level of Evidence: 1
Evaluating Blood Loss & the Effect of Antiplatelet Treatment in Foot/Ankle Amputations

David Schweer, BS, MD Candidate
Daniel Jupiter PhD
Timothy Ball, MD, PhD
J. Randolph Clements, DPM

Abstract

Aim: The goal of this study is to address the surgical impact of continuing or discontinuing antiplatelet therapy prior to foot/ankle amputation.

Introduction: There is a well-documented interrelationship between diabetes mellitus and cardiovascular disease, and, secondary to the latter, the use of antiplatelet therapy. While diabetes and related vascular manifestations are driving forces behind lower extremity amputations, there is little data on the risks of perioperative antiplatelet therapy in foot and ankle amputations.

Methods: The following data were retrospectively collected: blood loss, pre and post-operative hematocrit and hemoglobin, operative time, amputation type, age, diabetic status, antiplatelet treatment, and number of transfusions during the perioperative period. Perioperative antiplatelet therapy was defined as exposure to aspirin or clopidogrel within 3 days before surgery. To compare outcomes between groups, the following were analyzed using bivariate analyses and then multivariate regression models: 1) transfusions, 2) high blood loss (>50ml), 3) volume of blood loss, and 4) operative time. The non-inferiority of continued anti-platelet use was assessed in terms of operative time and blood loss, using a non-inferiority margin of 10 minutes or 10ml respectively.

Results: Antiplatelet therapy was not a statistically significant risk factor for any of the above outcomes on multivariate analysis. Equivalence testing revealed that continuing antiplatelet therapy is non-inferior to discontinuing perioperative therapy in terms of both blood loss and operative time.

Conclusion: Multivariate analysis of the data suggests that antiplatelet therapy had no statistically significant impact on blood loss, transfusion rates, or operative time.

Level of Evidence: Therapeutic Study - Level 3
Correlation of SF-36 and SF-12 Component Scores in Patients with Diabetic Foot Disease

Tresa L. Sambenedetto, DPM
Natalie M. Mota, DPM
Natalie C. Suder, MPH
Dane K. Wukich, MD

Abstract

Assessment of patient outcomes is becoming increasingly important in all areas of medicine including foot and ankle surgery. The Medical Outcomes Study Short Form 36 is widely used as a generic measure of quality of life; however, patients find the included 36 questions cumbersome. Consequently, the Short Form 12 has been developed.

We hypothesized that there would be a high correlation between Short Form 12 and Short Form 36 component scores in patients with diabetic foot disease. We retrospectively reviewed 300 patients with diabetes and foot and ankle pathology who completed a Short Form 36. The included 12 questions of the Short Form 12 were abstracted from the Short Form 36. The overall median score for the Short Form 36 physical component summary was 34.70 compared to the overall Short Form 12 physical component summary of 36.75 (p=0.04). The intraclass correlation coefficient was 0.93688. The overall median score for the Short Form 36 mental component summary was 52.40 compared to the overall Short Form 12 mental component summary of 51.25 (p=0.34). The intraclass correlation coefficient was 0.95449.

Based on our study of 300 patients with DM, it appears that the component scores of the Short Form 36 and Short Form 12 are comparable instruments to utilize as outcome instruments in patients with diabetic foot disease. A strongly positive linear relationship was present our cohort of 300 patients. The only exception was found when assessing mental component scores in diabetic patients who underwent major amputation.

Level of Clinical Evidence: 3
Abstract

Early protected weight bearing following closed rotational ankle fractures in healthy patients is gradually becoming more accepted among foot and ankle surgeons. However, in patients with diabetes mellitus, early weight bearing after an ankle fracture remains controversial. The goal of the present study was to evaluate the incidence of complications and identify the risk factors associated with early protected weight bearing following closed rotational ankle fractures in patients with diabetes.

Using a retrospective review, 73 diabetic patients with operatively and non-operatively treated ankle fractures were identified electronically in a large integrated healthcare population. The mean patient age was 64 years. The mean follow up period was 27 weeks. All patients were allowed to begin protected weight bearing in a cast or a removable boot at 2 weeks following the index injury or surgery. Complications occurred in 14 (29.2%) operatively-treated patients and 2 (8%) non-operatively treated patients. Wound dehiscence was the most common complication in operatively treated patients (18.8%).

Patients aged 60 and above had a significantly higher incidence of postoperative complications compared to patients younger than 60 ($p=0.0179$). Presence of peripheral neuropathy and trimalleolar type of ankle fracture appeared to correlate with higher incidence of complications, though no statistically significant difference was observed.

The results of the present study support early protected weight bearing following closed rotational ankle fractures in diabetic patients without significant co-morbidities.

Level of Evidence: 4
Percutaneous Plating of Distal Fibular Fractures

Amol Saxena, DPM, FACFAS
Andrew Yun, DPM

Abstract
The purpose of this study was to describe a minimally invasive percutaneous technique for plating distal fibular fractures, and evaluate its efficacy by measuring patient outcomes and hardware removal rates.

38 patients undergoing ORIF or percutaneous plating of a distal fibular (Weber B) fracture were retrospectively studied. 21 patients underwent ORIF and 17 had percutaneous plating. A 4 to 6 hole semi-tubular plate with 3 screws was utilized for percutaneously plating. Roles and Maudsley (RM) score was used to assess activity level.

All fibular fractures were healed clinically and radiographically by 8 weeks post surgery. There was no difference in pre- and post-operative RM scores of either group, which both improved significantly. Return to activity was $4.8 \pm 2.8$ months for the ORIF patients and $4.3 \pm 2.0$ months for the percutaneous group, which was a half a month faster. Hardware removal was done on 4 patients in the ORIF group and 3 patients in the percutaneous group. There was no difference in bone healing time or hardware removal rate when a fibular fracture was percutaneously plated.

The results of this study demonstrate that percutaneous plating is an effective surgical option for treating distal fibular fractures.

Level of Clinical Evidence: 3
Is Subtalar Joint Cartilage Resection Necessary For Tibio-Talo-Calcaneal Arthrodesis Via Intramedullary Nail? A Multi-Center Evaluation

Jennifer L. Mulhern, DPM, AACFAS
Nicole M. Protzman, MS
Maxwell J. Levene, DPM, AACFAS
Scott M. Martin, DPM
Justin J. Fleming, DPM, FACPAS
J. Randolf Clements, DPM, FACPAS
Stephen A. Brigido, DPM, FACPAS

Abstract

Tibio-talo-calcaneal arthrodesis with intramedullary nailing is traditionally performed with formal preparation of both the subtalar and ankle joint. However, the authors believe that subtalar joint preparation is not necessary to achieve satisfactory outcomes in patients undergoing tibio-talo-calcaneal arthrodesis with a retrograde intramedullary nail. The primary aim of this retrospective study was to evaluate outcomes in patients who underwent a tibio-talo-calcaneal arthrodesis with an intramedullary nail, without formal subtalar joint cartilage resection.

A multi-center chart review was performed to identify consecutive patients. Pain was assessed using a visual analog scale and osseous union at the tibio-talar joint was defined as bony trabeculation across the arthrodesis site in all three radiographic views. Progression of joint deterioration was evaluated across time at the subtalar joint, using a modified grading system developed by Takakura and colleagues.

Forty consecutive patients (aged 61.9 ± 12.9 years, 17 men) met the inclusion and exclusion criteria. Compared with the pain reported preoperatively (6.4 ± 2.7), there was a statistically significant decline in pain following surgery (1.2 ± 1.8) (P < .001). The mean time to consolidated arthrodesis at the ankle joint was 3.8 ± 1.5 months. A statistically significant increase in deterioration at the subtalar joint was observed across time (t(36) = -6.200, P < .001).

Compared with previously published data employing subtalar joint cartilage resection, the present study demonstrated a similar decline in pain with a high rate of union, and also showed a decrease in operative time when preparation of the subtalar joint was not performed.

Level of clinical evidence: 4

Keywords: arthrodesis, end-stage osteoarthritis, intramedullary nail, pantalar; subtalar joint
A Multicenter Evaluation of Morbidity and Clinical Outcomes Associated with a Total Ankle Replacement System Implanted Through a Lateral Approach

Jennifer L. Mulhern, DPM, AACFAS
Nicole M. Protzman, MS
Garrett M. Wobst, DPM, AACFAS
Frank A. Luckino III, DPM, AACFAS
Lawrence A. DiDomenico, DPM, FACFAS
Stephen A. Brigido, DPM, FACFAS

Abstract

Since its introduction in the 1970s, total ankle replacement has been performed through an anterior incision. To reduce the risk of postoperative complications that arise from stressing neurovascular structures and disrupting angiosomes, a resurfacing total ankle replacement system, utilizing a lateral transfibular approach for implantation, was developed. The literature regarding the morbidity of this new approach and new implant is limited. Therefore, a multicenter study was undertaken to evaluate the initial criticisms. The study specifically examined complications and 1-year clinical outcomes.

Twenty-three consecutive patients (aged 52.2 ± 14.4 years, 5 men) met the inclusion and exclusion criteria and were included in the present study. The overall wound complication prevalence was 17%, which is comparable to total ankle replacements implanted through an anterior approach. Furthermore, the complications encountered were typical to total ankle replacement. Bony union of the fibular osteotomy was achieved in all cases. Significant improvements in pain, disability, and use of an assistive device were also confirmed 1-year following implantation ($p < 0.001$).

Upon immediate post-operative radiographic evaluation, it appeared as though 4 (17.4%) patients would have benefited from a downsized talar component, had it been available, to avoid crowding of the ankle gutters. This initial review demonstrates a similar incidence and type of complications with this new generation prosthetic, and the short-term clinical outcomes proved similar to those achieved with alternate systems.

Additional comparative investigations are needed to further evaluate the utility of this total ankle replacement system implanted through a lateral approach.

Level of Clinical Evidence: 4

Keywords: bony resection, end-stage osteoarthritis, lateral approach, total ankle arthroplasty
The “All-Inside” Arthroscopic Brostrom Procedure with an Additional Suture Anchor Augmentation: A Prospective Study of 45 Consecutive Patients

James M. Cottom, DPM, FACFAS
Joseph S. Baker, DPM, AACFAS
Phillip E. Richardson, DPM

Abstract

Lateral ankle sprains are a common injury that typically respond well to non-operative therapy. When patients fail non-operative therapy and develop chronic lateral ankle instability, they may become candidates for surgical repair. The current study examines forty-five arthroscopic Broström repair using a new double row suture anchor construct.

Twenty-seven females and eighteen males were followed for a mean of 14 (range 12-20) months. Mean time to weight bearing with crutches was 3.3 (range 2-4) days, and full weight bearing was initiated at a mean of 14.4 (range 12-16) days. All patients participated in structured physical therapy, which was started at 21.6 (range 18-23) days. Patients were transitioned to regular shoe gear with a stirrup-style ankle brace at 28.7 (range 26 to 31) days.

AOFAS scores improved from an average preoperative score of 48.7 (range 45 to 55) to 95.4 (range 90 to 100) postoperatively. The average VAS decreased from 8 (range 6 to 10) preoperatively to 0.6 (range 0 to 5) postoperatively at the last follow up visit. The Karlsson Peterson score postoperatively was 87/100.

We have shown that patients with this new arthroscopic Broström technique modified with a proximal suture anchor can begin weight bearing earlier than previously reported, without adverse effects in terms of pain, functional outcomes scores and clinical outcomes.

Level of Clinical Evidence: 3

Key Words: Ankle, Ligament, Sprain, Instability, Arthroscopy
A Retrospective Comparison of Operative and Nonoperative Treatment of Diabetic Charcot Arthropathy of the Foot and Ankle

David Sadoskas, DPM
Mitchell S. Fourman, MD
Nicholas Vaudreuil, MD
Dane K. Wukich, MD

Abstract

Introduction. Diabetic Charcot arthropathy is a devastating deformity that often affects the foot and ankle. This abnormality can lead to ulceration, infection, and ultimately to amputation in many cases. The current study is a retrospective review on a single surgeon’s experience with nonoperative and operative intervention of diabetic Charcot arthropathy.

Methods. A total of 200 patient charts with diabetic Charcot arthropathy were reviewed. One hundred fifty seven patients were treated operatively (Group 1) and 43 nonoperatively (Group 2).

Results. The two groups were similar to age, sex, body mass index, diabetes duration, insulin dependence, mortality, and location of charcot. Group 1 had an increased incidence of ulceration at initial presentation (60% vs. 29%, \( p = 0.0001 \)) and nonplantigrade foot (8% vs. 70%, \( p=0.001 \)). Group 1 patients that had a below knee amputation were more likely to have ulceration at presentation [(OR 5.61, CI 3.40 – 9.24), \( p < 0.001 \)] and a preoperative infection [(OR 2.26, CI 1.37 – 3.74), \( p = 0.002 \)]. No difference was noted for postoperative infection or mortality.

Conclusion. This study reveals an overall limb salvage rate of 83.5%, for those that underwent surgical intervention the rate decreases to 79%. The presence of a preoperative foot ulcer and/or diabetic foot infection increased the rate of major amputation significantly.

Level of Clinical Evidence: Level III. Retrospective, case control study.

Key words: Charcot, reconstruction, amputation, infection, deformity, salvage, ulcer
Anatomic Reconstruction versus Traditional Rebalancing in Lesser MTPJ Reconstruction

Authors:
Jeremy J. Cook, DPM, MPH, FACFAS
Emily A. Cook, DPM, MPH, FACFAS
Philip Basile, DPM, FACFAS
N. Jake Summers, DPM, AACFAS
Michael Sganga, DPM
Brandon Barrett, DPM
Timothy Karthas DPM
Michael Matthews, DPM

Abstract

Traditional rebalancing techniques, such as capsulotomies and capsulorraphies, are commonly performed during complex hammertoe and lesser metatarsal osteotomy procedures involving metatarsophalangeal joint (MTPJ) contractures but floating toes, digital instability and malalignment are concerns. The purpose of this study was to critically analyze outcomes following anatomic reconstruction of plantar plate and collateral ligaments versus traditional rebalancing techniques.

A case-control study was conducted on 54 patients who had undergone surgical correction of lesser MTPJ imbalances due to complex hammertoe deformities (Power 80%, Type I error 0.05). Cases were defined as consecutive patients treated with anatomic plantar plate and collateral ligament reconstruction. Controls had undergone traditional lesser MTPJ rebalancing, matched to cases based on age, gender, follow-up duration (minimum 12 months) and concomitant procedures of the same lesser ray.

Multivariate logistic regression demonstrated that patients treated with anatomic reconstruction had greater digital stability (negative dorsal drawer and negative paper pull-out test) at final follow-up compared to controls. ACFAS Forefoot module scores were higher in the anatomic group in all domains, P<0.05. Controls had higher post-operative radiographic MTPJ angles than cases post-operatively, with no differences detected between the two groups regarding VAS scores or PIPJ angle measurements.

The importance in restoration of plantar plate and collateral ligament integrity as a digital stabilizer is generally accepted but not well studied. We found that anatomic reconstruction yielded greater digital stability, higher ACFAS Forefoot module scores and better radiographic MTPJ alignment than controls. Additional studies are warranted to assess the long-term viability of anatomic lesser MTPJ reconstruction.

Level of Clinical Evidence: III
Risk Factors Associated with Nonunion Following Elective Foot and Ankle Reconstruction: A Case-Control Study

Kyle R. Moore, DPM
Michael A. Howell, DPM
Karl R. Saltrick, DPM, FACFAS
Alan R. Catanzariti, DPM, FACFAS

Abstract

Background: Postoperative nonunion is not uncommon in the lower extremity, and significant morbidity can be associated with nonunion of the foot and ankle following surgical reconstruction. For the purpose of this study, we have retrospectively reviewed and compared a cohort of patients who have undergone elective foot and ankle reconstruction to better assess modifiable risk factors associated with postsurgical nonunion. The authors have hypothesized that the presence of endocrine and metabolic abnormalities will be associated with nonunion after foot and ankle surgical reconstruction.

Materials and Methods: To assess the prevalence of certain modifiable risk factors known to have an association with nonunion after foot and ankle arthrodesis, the authors formulated a matched case-control study that included twenty-nine patients suffering from nonunion, and a control group with twenty-nine patients who progressed to successful fusion. Modifiable risk factors assessed included BMI, tobacco use, diabetes mellitus, vitamin D abnormality, thyroid dysfunction, and parathyroid disease.

Results: There was a statistically significant (p<0.05) difference between the groups regarding the presence of endocrine and metabolic disease diagnosis in the medical records of the 58 patients identified. This equaled 76% vs. 26% (p <0.05) in patients with nonunion compared to those with successful arthrodesis respectively. Patients with a diagnosis of Vitamin D deficiency or insufficiency were found to be 8.1 times as likely to be associated with nonunion (95% CI: 1.996 – 32.787). No statistically significant differences were found between the groups in terms of age, sex, tobacco use, BMI, or procedure selection (p-values 0.56, 0.43, 0.81, 0.28, 1.0 respectively).

Conclusion: A higher prevalence of endocrine abnormalities, particularly vitamin D deficiency and insufficiency, was associated with patients who suffered nonunion after elective foot and ankle reconstruction. Patients with such abnormalities appear to be at greater risk of developing nonunion after arthrodesis procedures.

Level of Evidence: Case-control, level III
Feasibility of Intraoperative Use of the “Tibiofibular Line” at the Time of Distal Tibiofibular Syndesmosis Reduction and Fixation: A Cadaveric Study

Christopher W. Reb, DO
Corey M. Fidler, DPM, AACFAS
Benjamin C. Watson, DO
Gregory C. Berlet, MD
Christopher F. Hyer, DPM, MS, FACFAS

Abstract

The “tibiofibular line” (TFL) is a new axial CT parameter for assessing syndesmosis reduction which references bony landmarks easily visualized using a lateral approach to the fibula. We designed this cadaveric study to assess the practical aspects of measuring the TFL intraoperatively.

Three observers simulated the TFL using surgical instruments in three measurement series: intact syndesmosis, post ORIF fibula with lateral plate and screws, and post syndesmosis reduction without plate and screws. Intraobserver variability ranged from poor to excellent (ICC range, 0.116 to 0.849, Fleiss kappa range, 0.019 to 0.396) and interobserver reliability was only generally in the fair range (ICC range, 0.494 to 0.607, Fleiss kappa range, 0.019 to 0.397).

Taken as a whole, our findings suggested that intraoperative use of the TFL is quite feasible but not advisable. Based upon our experience, however, there appears to be a role for further refinement of this study protocol to determine if better control of confounding variables reveals better observer reliability.

Level of Evidence: 2
Investigating the Effects of Harmonic Cold Plasma in the Management of Full-Thickness Wounds in a Diabetic Murine Model

N. Jake Summers, DPM
Nicole M. Protzman, MS
Jennifer L. Mulhern, DPM, AACFAS
Marc Jacofsky, PhD
Courtney McDonnell, BS
Stephen A. Brigido, DPM, FACFAS

Abstract

Chronic inflammation and bacterial colonization are known factors that impair wound healing. Recent advances in plasma medicine indicate that certain combinations of gases used in cold plasma application can lead to decreased bacterial colonization and aid in wound healing. The purpose of the present report was to investigate the effects of cold plasma for the management of full-thickness wounds in diabetic mice.

The study specifically examined growth factor concentrations and healing rates at two sacrifice points (Day 5 and Day 15). A total of 160 mice were used in this study. Two trials were performed, and in each trial, 80 mice were divided into 4 treatment groups: (1) untreated controls, helium for 60 seconds twice daily (n=20), (2) helium-cold plasma treatment for 30 seconds twice daily (n=20), (3) helium-cold plasma treatment for 60 seconds twice daily (n=20) and (4) helium-cold plasma treatment for 90 seconds once daily (n=20). The data demonstrated that treating wounds with cold plasma causes a rapid release of growth factors within the first 5 days, and as wound healing progresses, the cytokine messenger densities decrease.

A statistically significant difference was observed in healing rates at Day 5 between the 60 second treatment and untreated control group (P = .0466). While these preliminary results show promise, additional investigations are needed to assess the translation to humans and to determine the best gas combinations to optimize cold plasma treatments.

Level of Clinical Evidence: 5
Absorbable Suture as a Preferred Option for Lateral Ankle Instability Repair

J. Joseph Anderson, DPM, FACFAS  
Dallin Greene, DPM  
A. Tee Adeleke, DPM  
Nathan Judd, DPM, MHA,  
Zflan Swayzee, BS

Abstract

About 70% of ankle stability comes from soft tissue constraints. Inversion ankle sprains remain the most common cause of disrupting these attachments. Literature reports that 50% of the patients who suffer an inversion injury may develop ankle pathology and up to 20% will develop chronic lateral ankle instability. Typically, those that develop chronic ankle instability will need to undergo surgical intervention, usually utilizing the modified Brostrom procedure. This is a well-documented procedure that has historically relied primarily on the characteristics of suture material. Several studies and case reports have shown complications attributed to the use of non-absorbable suture. In this study we examine the use of absorbable suture for the modified Brostrom procedure and compare it to expected outcomes of the procedure.

In this cohort, 352 patients who underwent the Brostrom procedure using absorbable suture were reviewed. Visual analog score decreased from 6.28 to 1.09. American College of Foot and Ankle Surgeons scores increased from 72.82 pre-operatively to 89.53, 92.01 and 90.49 at 3, 12 and 24 months respectively with all values deemed statistically significant. Only 6 patients (1.7%) required revision due to re-injury.

Our results indicated that the use of absorbable suture is a viable means of performing the Brostrom procedure with a low complication rate which leads to long-term patient satisfaction as illustrated by improved American College of Foot and Ankle Surgeons scores and visual analog scores. These results are comparable to the historical use of non-absorbable suture.

Level of Evidence: 3
Preoperative MRI Findings vs. Surgical Findings of Peroneal Tendon Pathology, a Comparative Analysis

Matthew R. Feltner, DPM
Jonathan J. Sharpe, DPM, FACFAS

Abstract

Background: Previous studies have compared the pre-operative MRI findings with surgical findings in regard to peroneal tendon pathology. To date, there has been no consensus on the accuracy when comparing these findings. Multiple studies suggest that peroneal tendon pathology is difficult to consistently diagnose and identify in the foot and ankle.

Purpose: To evaluate the accuracy between observed pre-operative MRI findings as read by musculoskeletal radiologists and intraoperative surgical findings of peroneal tendon pathology as observed by the surgeon.

Methods: Pre-operative MRI findings compared with intraoperative surgical observations. These findings were retrospectively studied in 80 patients who had surgical intervention over a period of 8 years (2007-2015). Inclusion criteria states that the patients all had pre-operative MRI and either directly had peroneal tendon surgical intervention or the tendons were examined and evaluated when an adjacent surgery was performed.

Results: This study correlates with previous studies that overall accuracy rate is 78.8% for diagnosing peroneal tendon pathology. Sensitivity and specificity for peroneus brevis split tear were 62.9% and 93.3%, respectively. Sensitivity and specificity for peroneus longus split tear 16.7% and 91.9%, respectively. Sensitivity and specificity for peroneus brevis low-lying muscle belly was 10.2% and 90.3%, respectively.

Conclusion: Although, MRI is diagnostically specific but not sensitive in detecting peroneal tendon pathology, it can still be beneficial as an adjunct diagnostic modality. When making a diagnosis it should be combined with thorough physical exam and careful consideration of type and pattern of suspected pathology.

Level of Evidence: 3
Elevated Levels of Erythrocyte Sedimentation Rate and C-Reactive Protein as Markers of Poor Treatment Outcomes in Diabetic Foot Osteomyelitis

Suzanne AV Van Asten, MD
Moez Mithani
Andrew Mastro
Javier La Fontaine, DPM, FACFAS
Kathryn Davis, PhD
Daniel C Jupiter, PhD
Lawrence A Lavery, DPM, MPH

Abstract

Aim: To evaluate the effectiveness of the inflammatory serum markers Erythrocyte Sedimentation Rate (ESR) and C-Reactive Protein (CRP) to monitor treatment of osteomyelitis in the diabetic foot (DFO).

Methods: We screened 150 charts of patients admitted to our hospital with DFO, confirmed by positive results of bone culture and/or histopathology. We only included patients that had an initial value of ESR/CRP within 72 hours of admission and 2 reported follow-up values within 12 months. We grouped patients based on the clinical outcomes wound healing, re-infection, recurrent ulceration, re-hospitalization, additional surgery, re-amputation, death and visualized the trajectories of the markers over time.

Results: 122 subjects were included, 65 patients (53.3%) had a combination of positive culture results and histopathology criteria consistent with osteomyelitis. Factors associated with healing were a lower mean white blood count at admission (p=0.004), a higher mean GFR at admission (p=0.01), longer mean wound duration before admission (p=0.01), a location of the ulcer on the great toe (p=0.01), and higher HbA1c value at admission (p=0.03). Logistic analysis demonstrated correlations between healing and X-ray changes (OR 0.21) and an ulcer on the great toe (OR 0.15). Trajectories of the inflammatory markers showed stagnating values of ESR and CRP in the patients with poor clinical outcomes.

Conclusions: In this study population, the trajectories of both ESR and CRP during 12 months follow-up suggest a predictive role of inflammatory markers when monitoring treatment of DFO.

Evidence Level: 2

Keywords Diabetic Foot Infection: Osteomyelitis; Biomarkers; Erythrocyte Sedimentation Rate; C-reactive Protein
A Biomechanical Comparison of 3 Different Arthroscopic Lateral Ankle Stabilization Techniques in 36 Cadaveric Ankles

James M. Cottom, DPM, FACFAS
Joseph S. Baker, DPM, AACFAS
Phillip E. Richardson, DPM

Abstract

Arthroscopic lateral ankle stabilization has become an increasingly popular option among foot and ankle surgeons to address lateral ankle instability, as it combines a modified Broström-Gould procedure with the ability to address any intra-articular pathology at the same time. This study evaluated three different constructs in a cadaveric model.

Thirty-six fresh frozen cadaver limbs were used, and the anterior talofibular ligament was identified and sectioned. The specimens were then placed into one of three groups. Group 1 received a repair with a single row, two suture anchor construct; Group 2 received repair with a novel, double-row, four anchor knotless construct; and Group 3 received repair with a double-row, three anchor construct. Specimens were then tested for stiffness and for load to ultimate failure with a customized jig. Stiffness was measured in each of the groups as 12.10 ± 5.43 (range 5.50 - 22.24) N/mm for Group 1, 13.40 ± 7.98 (range 6.71 - 36.28) N/mm for Group 2, and 12.55 ± 4.00 (range 6.48 - 22.14) N/mm for Group 3.

No significant difference was found between the three groups in terms of stiffness ($p=0.939$). The groups were tested to failure, with observed force measurements of 156.43 ± 30.39 (range 83.69 - 192.00) N for Group 1, 206.62 ± 55.62 (range 141.37 - 300.29) N for Group 2, and 246.82 ± 82.37 (range 164.26 - 384.93) for Group 3. Statistical significance was noted between Group 1 and Group 3 ($p<0.05$).

This study shows that a previously reported arthroscopic lateral ankle stabilization procedure, when modified with an additional proximal suture anchor into the fibula, showed a statistically significant increase in strength in terms of maximum load to failure. Additionally, we describe a previously unreported, knotless technique for arthroscopic lateral ankle stabilization.

Level of Clinical Evidence: V

Keywords: Lateral ankle stabilization, arthroscopy, ankle instability, ankle sprain, Brostrom