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## What's New in Foot and Ankle Surgery

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## SPECIALTY UPDATE

## What's New in Foot and Ankle Surgery

By Oladapo A. Alade, MD, and Mark S. Mizel, MD

The following is a brief overview of recent studies related to foot and ankle surgery that were published or presented between July 2005 and July 2006. The sources of these studies included *The Journal of Bone and Joint Surgery (American Volume)*, *Foot and Ankle International*, and the proceedings of the Winter and Summer meetings of the American Orthopaedic Foot and Ankle Society (AOFAS) (held on March 25, 2006, in Chicago, Illinois, and on July 14 through 16, 2006, in La Jolla, California).

**Ankle and Metaphyseal Tibia Fractures**

Ankle fractures are among the most common injuries treated by orthopaedic surgeons. However, few studies have examined the functional recovery following ankle fracture surgery. Egol et al. were the first to analyze factors that may predict short-term functional recovery following surgical stabilization of ankle fractures<sup>1</sup>. In that study, 232 patients who had sustained a fracture of the ankle and were managed surgically were followed prospectively, for a minimum of one year. One year after surgery, the patients were generally doing well, with most (90%) of the 198 patients who had met the inclusion criteria experiencing little or mild pain and having few restrictions in functional activities. The patients had significant improvement in function at one year as compared with six months after surgery. Younger age, male gender, the absence of diabetes, and fewer comorbidities were predictive of a better functional recovery at one year following ankle fracture surgery.

Thomas et al. documented arthroscopic findings in a study of fifty patients who had chronic pain after an ankle fracture<sup>2</sup>. The most common findings were synovitis, arthrofibrosis, chondral injuries, loose bodies, and spurs, with synovitis and chondral damage being more frequent. Synovitis and arthrofibrosis were most frequently found in the anterolateral aspect of the joint. Also, the higher the lateral malleolar frac-

ture was in relation to the syndesmosis, the higher was the occurrence of talar chondral damage.

Haraguchi et al. used preoperative computed tomographic scans to evaluate the pathoanatomy of posterior malleolar fractures<sup>3</sup>. The authors determined that the fracture lines associated with posterior malleolar fractures are highly variable. A large fragment extending to the medial malleolus was noted in association with almost 20% of the posterior malleolar fractures in the study, and some fragments involved almost the entire medial malleolus. The authors concluded that, because of the great variation in fracture configuration, the preoperative use of computed tomography might be helpful for conducting basic research on this condition and for determining appropriate surgical approaches.

Internal fixation of osteoporotic, unstable, displaced ankle fractures is technically demanding and may fail secondary to unreliable bone purchase of the hardware. Panchbhavi et al., in a retrospective review, compared patients who had been managed with standard AO/ASIF fracture fixation with those who had been managed with a hook plate and syndesmotic screws<sup>4</sup>. The results demonstrated that all patients who had three-cortex syndesmotic screw fixation had fracture union without hardware failure or complications. In the standard fixation group, two patients had wound breakdown and one had a valgus malunion with screw pullout. The AOFAS and Olerud-Molander scores also were better in the hook plate and syndesmotic screw group. The authors concluded that this technique can provide stable fixation of osteoporotic ankle fractures in elderly patients, leading to union with good clinical scores.

Harris et al. performed a retrospective review of the clinical and radiographic results and functional outcomes after operative treatment of tibial plafond fractures that had been treated with internal or external fixation<sup>5</sup>. Seventy-nine fractures in seventy-six patients were evaluated clinically and radiographically at an average of twenty-six months. Only thirty-three patients completed outcome questionnaires at a mean of ninety-eight months. The authors found that OTA

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type-C3 fractures were more likely to be treated with external fixation and to be associated with the development of post-traumatic arthritis and worse functional outcomes.

### Calcaneal and Talar Fractures

The current standard of care for displaced intra-articular calcaneal fractures is surgical stabilization. McGarvey et al. described the results of treatment of these fractures with use of indirect reduction with Ilizarov external fixation<sup>6</sup>. The authors reported favorable results, especially in the treatment of open fractures requiring soft-tissue reconstruction.

Redfern et al. used a cadaver model to perform a biomechanical comparison of standard and locking calcaneal plates<sup>7</sup>. Their results indicated that there was no significant biomechanical advantage of a locking plate as compared with a non-locking plate.

The L-shaped lateral approach to the calcaneus has been the workhorse for open reduction and internal fixation of these fractures. However, there is significant potential morbidity associated with this approach. Wiley et al. described their experience with the use of a "smile"-shaped lateral incision<sup>8</sup>. The sural nerve is at risk with this approach, and six of seventy-three patients complained of pain or numbness in the sural nerve distribution. However, no symptomatic neuromas were noted. Reflex sympathetic dystrophy (complex regional pain syndrome) also occurred in three patients but was successfully treated with sympathetic blocks. Overall, the authors believed that this approach provided improved exposure of the sinus tarsi and the posterior facet without increased morbidity.

With regard to treatment algorithms for open calcaneal fractures, Thornton et al. retrospectively reviewed the treatment of thirty-one open intra-articular fractures at their institution<sup>9</sup>. They concluded that the treatment of open calcaneal fractures and the risk of complications both depend on the size and position of the traumatic wound. Lateral wounds are rare. Medial wounds measuring <4 cm can be treated with open reduction and standard internal fixation if the wound can be closed and remain stable without the need for antibiotics. Fractures with wounds measuring >4 cm or unstable wounds should be reduced and held in alignment with percutaneous wire fixation.

Lauder et al., in a study that compared the interobserver and intraobserver reliability of the Sanders and Crosby-Fitzgibbons classification systems for calcaneal fractures, concluded that neither system demonstrated excellent interobserver or intraobserver reliability<sup>10</sup>.

Charlson et al. utilized a cadaver model to compare plate and screw fixation with screw fixation alone for comminuted talar neck fractures<sup>11</sup>. The fractures were fixed with either two solid 4.0-mm partially threaded cancellous screws inserted from posterior to anterior just lateral to the posterior process of the talus or with a four-hole 2.0-mm miniature fragment plate contoured to the lateral surface of the talar

neck and secured with 2.7-mm screws. A 2.7-mm fully threaded cortical screw was placed medially with use of a lag technique. The results demonstrated that posterior-to-anterior screw fixation was associated with a significantly higher load to failure than plate fixation was. The authors concluded that plate fixation may offer substantial advantages in terms of the ability to control the anatomic alignment of comminuted talar neck fractures but that it does not provide any biomechanical advantage as compared with axial screw fixation. Also, the fixation strength of both methods was an order of magnitude lower than that found in previous studies of noncomminuted talar fractures.

### Ankle Instability

Uchiyama et al. used a cadaver model to assess ankle stability after harvesting the fibula for bone graft<sup>12</sup>. They found that the whole fibula, including the head, was essential for the stability of the ankle joint complex and that the distal part of the fibula is responsible for stabilizing the ankle mortise during external rotation and inversion. This was evidenced by increased angular motion after different lengths of fibular resection. The authors recommended fixation of the syndesmosis or bracing to prevent ankle joint instability with rotation of the talus in the mortise, especially when the distal part of the fibula is shortened by  $\geq 6$  cm.

### Ankle Arthrodesis

Arthrodesis remains the gold standard for the surgical treatment of severe ankle arthritis. Thomas et al. reported that, in the intermediate term following an arthrodesis for the treatment of end-stage ankle arthritis, pain is reliably relieved and there is good patient satisfaction<sup>13</sup>. However, there were substantial differences between patients and the normal population with regard to hindfoot function and gait. Specifically, gait analysis demonstrated significant differences between the two groups with regard to cadence and stride length. In addition, there was significantly decreased sagittal, coronal, and transverse range of motion of the hindfoot and midfoot during the stance and swing phases of gait in the arthrodesis group.

Combined ankle and subtalar (tibiotalar) arthrodesis is a procedure that can be used successfully to treat disabling ankle and subtalar joint arthropathy and is a reasonable salvage alternative to amputation for the treatment of nonbraceable Charcot arthropathy and degenerative or rheumatoid arthritis. Bennett et al. tested the stability and micromotion of four arthrodesis techniques biomechanically<sup>14</sup>. They found that the three crossed 6.5-mm cancellous screw technique provided the greatest stability with respect to micromotion while the addition of a tibiotalar staple to a locked intramedullary rod conferred stability nearly equal to that of the crossed cancellous screw fixation. They noted that the locked intramedullary rod technique and the two crossed cancellous screw technique allowed significant micromotion at the arthrodesis sites, which was a full order of magnitude

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greater than that associated with the three crossed cancellous screw technique and the staple-augmented intramedullary rod technique.

Pinzur and Noonan described their experience with the use of a retrograde femoral nail to achieve ankle fusion in nine patients with Charcot arthropathy<sup>15</sup>. Fusion was evident radiographically in all nine patients at an average of 10.5 weeks. None of the patients had development of a stress fracture or evidence of stress concentration at the proximal metaphyseal tip of the nail. There was one wound infection, which resolved after débridement and antibiotic therapy, and one postoperative hematoma, which resolved without surgery. At an average of thirty-two months of follow-up, all patients were able to walk with use of commercially available therapeutic footwear. None of the patients had development of a new foot ulcer, an infection, or a new episode of Charcot arthropathy. The authors concluded that the use of a retrograde femoral nail for ankle arthrodesis in patients with Charcot arthropathy appears to decrease the risk of stress fracture in comparison with the use of shorter nails without increasing the risk of other complications.

Suh et al. reported on their experience with nine patients who were managed with a dorsal modified calcaneal plate to achieve an extensive midfoot fusion<sup>16</sup>. The authors reported high fusion rates and a high level of patient satisfaction and concluded that this technique is viable for the surgical treatment of extensive midfoot arthropathy.

Bennett et al. investigated the use of a lag screw and a dorsal plate for fixation at the site of a first metatarsophalangeal joint arthrodesis<sup>17</sup>. Because of a 13% rate of nonunion and hardware failure, the authors recommended not using this implant for this particular procedure.

Cohen et al. reported similar results in a study in which screw fixation was compared with H-locking plate fixation for first metatarsocuneiform joint arthrodesis<sup>18</sup>. The authors found that screw fixation created a stiffer construct than the H-locking plate did. This was thought to be due to the mechanical design of the implants. Screws allowed for compression across the metatarsocuneiform joint; however, the plate relied on a fixed-angle design with no compression.

### Osteochondral Lesions of the Talus

Various options are available for the operative treatment of symptomatic osteochondral lesions of the talus. The treatment of choice will depend on the size, type, and location of the lesion. Débridement with drilling is a standard method of treatment for unstable lesions. Becher and Thermann, in a study of thirty patients who were managed with arthroscopic débridement and microfracture, reported that 83% of their patients had a good to excellent result<sup>19</sup>. The age of the patient was not shown to be a limiting factor.

Elias et al., in an observational study of osteochondral lesions of the talus that were treated nonoperatively, noted that these lesions do not invariably progress over the short

term without operative intervention<sup>20</sup>. Also, on magnetic resonance imaging, bone cysts and bone marrow edema may not be reliable signs of lesion severity or progression of degenerative change because some resolve spontaneously.

One of the options for the surgical treatment of large osteochondral lesions of the talus is autogenous osteochondral transplantation. Marymont et al. studied cadaver ankles and matched knees to evaluate the morphology of cored femoral osteochondral grafts<sup>21</sup>. On the basis of radiographic evaluation of graft contour and fit, the authors concluded that the superolateral aspect of the femur was the optimal location from which to harvest a cored osteochondral graft for any medial talar lesion.

Finally, in the study by Baums et al., autologous cultured chondrocyte transplantation was performed in twelve patients with a focal deep cartilage lesion of the talus<sup>22</sup>. The mean size of the lesion was 2.3 cm<sup>2</sup>. Subchondral bone defects were treated with an autogenous distal tibial cancellous bone graft. All of the patients were followed prospectively, and the mean duration of follow-up was sixty-three months. Every patient had improvement from the preoperative status, and patients who had been involved in competitive sports were able to return to their full activity level.

### Arthritis

Arthritis and other inflammatory or degenerative joint conditions are among the leading causes of disability in adults in the United States. A review of Musculoskeletal Functional Assessment forms completed by patients with the diagnosis of end-stage ankle arthrosis demonstrated severe functional limitations when compared with the general population<sup>23</sup>.

Salk et al. performed a randomized, double-blind, saline solution-controlled trial of intra-articular injection of sodium hyaluronate for the treatment of osteoarthritis of the ankle<sup>24</sup>. Both groups had significant improvement in the ankle osteoarthritis score at six months. However, more of the patients in the hyaluronate group had >30 points of improvement on the ankle osteoarthritis score as compared with the baseline value.

Arthrodesis and prosthetic replacement are the most common options considered for the treatment of end-stage ankle arthritis. However, the use of fresh osteochondral allograft has also been described, and Meehan et al. reported on their experience with this technique in a study of eleven patients<sup>25</sup>. A bipolar replacement was used in nine ankles, and a unipolar replacement was used in two (on the tibial side in one ankle and on the talar side in the other). After a minimum duration of follow-up of twenty-four months, six of the eleven ankles were deemed to have a successful result. The average AOFAS score improved from 55 preoperatively to 73 postoperatively. The pain, gait, and walking surface scores were all significantly improved. The ankle range of motion was  $\geq 30^\circ$  in these six ankles. Seven of the eleven patients had eleven additional surgical procedures, including five talofibular joint

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débridements, three repeat allograft placements, two hardware removals, and one conversion to a prosthetic ankle replacement. The complications included one intraoperative fibular fracture and one superficial wound infection. Follow-up radiographs revealed moderate or severe joint degeneration in six ankles; however, this finding did not necessarily correlate with a poor outcome. Poor results tended to occur in ankles with a graft-host size mismatch or graft thickness of <7 mm. Despite the high rate of complications and additional procedures, the authors stated that fresh osteochondral transplantation for tibiotalar joint arthritis is a promising alternative to arthrodesis and prosthetic replacement.

### Hallux Valgus

The chevron bunionectomy is frequently performed for the treatment of symptomatic hallux valgus. Osteonecrosis of the metatarsal head is a documented complication of the procedure. Some authors have reported an increased prevalence of osteonecrosis when chevron osteotomy is combined with adductor tenotomy. Kuhn et al. prospectively measured intraoperative blood flow to the metatarsal head during various stages of hallux valgus correction surgery in twenty patients<sup>26</sup>. They found that the greatest insult was during a medial capsulotomy, which caused a 45% decrease in blood flow. The lateral release and adductor tenotomy caused a 13% decrease, and the chevron osteotomy caused a 13% decrease, totaling a 71% decrease overall from the baseline. There was no evidence of osteonecrosis at three months, and all patients had radiographic evidence of union without recurrence or overcorrection. The authors concluded that an adductor tenotomy and lateral release can be completed safely with a chevron bunionectomy because disruption of blood flow to the metatarsal head is not complete.

Decreased range of motion of the first metatarsophalangeal joint is commonly noted following the surgical correction of hallux valgus, and it can negatively affect patient satisfaction. Jones et al., using a cadaver model, demonstrated a 22° loss of dorsiflexion after corrective surgery consisting of a distal soft-tissue reconstruction and a proximal metatarsal osteotomy<sup>27</sup>.

Coughlin et al., in a study of twenty-one feet in sixteen patients, presented the results of primary metatarsophalangeal joint arthrodesis for the treatment of moderate to severe hallux valgus<sup>28</sup>. The average duration of follow-up was eight years. Good to excellent results were obtained in all patients. There were three nonunions, only one of which was symptomatic and required surgical treatment.

Varner et al. performed a cadaver study in which screw fixation was compared with plate fixation of crescentic osteotomies for the correction of hallux valgus deformities<sup>29</sup>. The authors found that plate fixation required a much higher load to failure than did fixation with a single 4.0-mm cancellous screw. The mode of failure of screw fixation was fracture through the cortical bone. The authors also concluded that

screw fixation was much more dependent on bone quality than was plate fixation.

Good results have been described in association with the use of a distal metatarsal osteotomy for the surgical treatment of hallux valgus. Giannini et al. presented the clinical results of the first 1000 consecutive hallux valgus corrections that they performed with use of a SERI (Simple Effective Rapid Inexpensive) osteotomy<sup>30</sup>. In that study, 1000 feet in 631 patients underwent a distal metatarsal osteotomy through a 1-cm medial incision at the metatarsal neck. The osteotomy site was stabilized with a 2-mm Kirschner wire. The inclusion criteria were a deformity of <40° and an intermetatarsal angle of ≤18°. The average duration of follow-up was sixty months. All of the osteotomy sites healed, with delayed union being noted in twenty-five feet. Mild stiffness was noted in thirty-one feet. There was significant correction of the hallux valgus and intermetatarsal angles. The mean AOFAS score improved from 48 preoperatively to 89 postoperatively.

### Hallux Rigidus

Arthrodesis is the current standard treatment for end-stage hallux rigidus. Gibson and Thomson performed a prospective, randomized trial in which arthrodesis was compared with first metatarsophalangeal total joint arthroplasty<sup>31</sup>. The results demonstrated that total joint arthroplasty cost twice as much, was associated with lower patient satisfaction, provided poor gain in motion, and had a much higher failure rate secondary to implant loosening.

Queler et al. presented the follow-up results for patients who had been managed with a capsular interposition arthroplasty for the treatment of hallux rigidus<sup>32</sup>. This procedure maintains the motion of the first metatarsophalangeal joint while resurfacing the joint surface with the extensor hood, capsule, and extensor digitorum brevis. Eleven patients with an average age of fifty-nine years underwent the procedure. Preoperatively, the average AOFAS score was 51 points, with an average score of 15 points for pain. At an average of twenty-two months postoperatively, the average AOFAS score was 80 points, with an average score of 30 points for pain. Nine of the eleven patients stated that they would have the procedure again.

### Lesser Toe Problems

The Weil metatarsal osteotomy is used to treat painful metatarsalgia in the central rays. In one study, plantar pressures were measured in cadaver feet after a second metatarsal Weil osteotomy was performed<sup>33</sup>. There were significant decreases in pressure beneath the second metatarsal head, with a 36% decrease in neutral and a 65% decrease during heel rise. There also were significant decreases beneath the third metatarsal in both neutral (39%) and during heel rise (37%) and beneath the fourth metatarsal in neutral (28%). A significant increase in pressure occurred beneath the first metatarsal in neutral (23%). No significant pressure changes occurred under the

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fifth metatarsal head in either position.

Myerson and Jung evaluated the results of flexor digitorum longus transfer to the dorsum of the proximal phalanx for the treatment of instability of the second metatarsophalangeal joint<sup>34</sup>. There was a high rate of complications, including crossover deformity, persistent medial deviation of the toe, vertical subluxation, and joint contracture, and fourteen of fifty-nine patients were dissatisfied with the outcome.

### Posterior Tibial Tendon Dysfunction

The flexor digitorum longus tendon is commonly used for reconstruction in patients who have posterior tibial tendon dysfunction. Rosenfeld et al. reported their findings after flexor digitorum longus tendon transfer and medial displacement osteotomy of the calcaneus for the treatment of stage-II posterior tibial tendon dysfunction<sup>35</sup>. They found that the flexor digitorum longus muscle hypertrophied significantly and the posterior tibialis muscle atrophied. They also observed that when the posterior tibial tendon was excised, the entire muscle belly underwent fatty infiltration.

Cooper et al. found that fluoroscopic local anesthetic tendon sheath injections were more sensitive than magnetic resonance imaging for the diagnosis of stage-I posterior tibial tendon synovitis<sup>36</sup>. In their study, seventeen patients underwent tendon sheath Marcaine (bupivacaine) injection and magnetic resonance imaging. Fifteen of the seventeen patients had a positive magnetic resonance imaging scan, whereas all seventeen patients had a positive tendon sheath injection.

Alvarez et al. reported the results of a nonoperative treatment protocol in a study of forty-seven consecutive patients with stage-I and II posterior tibial tendon dysfunction<sup>37</sup>. The rehabilitation protocol included the use of a short, articulated ankle-foot orthosis or a foot orthosis, aggressive plantar flexion activities, and an aggressive high-repetition home-exercise program that included gastrocnemius-soleus tendon stretching. Isokinetic evaluations were done before and after therapy to compare inversion, eversion, plantar flexion, and dorsiflexion strength in the involved and uninvolved extremities. The criteria for successful rehabilitation were no more than a 10% strength deficit, the ability to perform fifty single-support heel rises with minimal or no pain, the ability to walk 100 ft (30.5 m) on the toes with minimal or no pain, and the ability to tolerate 200 repetitions of the home exercises for each muscle group. After a median of ten physical therapy visits over a period of four months, thirty-nine patients (83%) had successful subjective and functional outcomes and forty-one (87%) were satisfied. Five patients required surgery after the failure of nonoperative treatment. The authors concluded that many patients with stage-I and II posterior tibial tendon dysfunction can be managed nonoperatively with an orthosis and structured exercises.

### Achilles Tendon

The epidemiology and outcomes of Achilles tendon ruptures

among National Football League players in the United States was analyzed by Parekh et al.<sup>38</sup>. The authors found that 31% of the players who sustained an Achilles tendon rupture did not return to play in the National Football League, and, on the average, players had >50% reduction in their power ratings.

Martin et al., in a study of nineteen patients, evaluated the functional outcome associated with a flexor hallucis longus tendon transfer and complete excision of a diseased Achilles tendon for the treatment of chronic Achilles tendinosis<sup>39</sup>. The AOFAS ankle-hindfoot scores and SF-36 scores were excellent for all patients. All patients had weakness of approximately 30% on testing of ankle plantar flexion strength. They also had a significant decrease in ankle plantar flexion range of motion. However, no patient had limitation in the activities of daily living.

Hufner et al. discussed the results of functional nonoperative treatment of Achilles tendon ruptures<sup>40</sup>. The indications for nonoperative treatment were a distance of  $\leq 10$  mm between the tendon ends when the ankle was in a neutral position and complete apposition of the tendon ends with the ankle in 20° of plantar flexion as assessed with ultrasonography. The treatment protocol included a repeat ultrasound examination performed by an experienced individual two to five days after the initial study to confirm the indications for nonoperative treatment, the use of a 3-cm heel lift for eight weeks, and then the use of a 1-cm heel lift for another three months. Good or excellent results were obtained in ninety-two of 125 patients who met the treatment criteria.

Numerous operative approaches have been described for the treatment of insertional calcific Achilles tendinosis. Johnson et al. evaluated twenty-two patients who underwent a central tendon-splitting approach for the treatment of this disease entity<sup>41</sup>. After an average duration of follow-up of thirty-four months, there was significant improvement in terms of pain and function in the AOFAS ankle-hindfoot score. The authors concluded that this surgical approach can yield good relief of pain with improved function and the ability to work without a painful postoperative scar.

### Diabetes and Peripheral Neuropathy

A total-contact cast is highly effective for the treatment of plantar ulcerations in patients with diabetic neuropathy. Guyton reviewed the iatrogenic complications associated with total contact casting<sup>42</sup>. In that series, 398 total contact casts were used for the management of seventy patients over a twenty-eight-month period. Complications (new ulcers) occurred in association with twenty-two casts. The complications included six pretibial ulcers, six midfoot ulcers, four forefoot or toe ulcers, five hindfoot ulcers, and one malleolar ulcer. No preexisting ulcer was made worse. These findings corresponded with an overall complication rate of 5.53% per cast. Overall, 30% of the patients experienced one complication during the course of treatment. With one exception, all new ulcers healed with simple modalities within three weeks, often

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with continued total contact casting. In one case, the cast caused a proximal interphalangeal ulceration that exposed the joint and eventually necessitated toe amputation. The rate of permanent sequelae resulting from cast-related injuries was therefore 0.25%. Guyton concluded that a frequently changed total contact cast is a safe modality for the offloading and immobilization of the neuropathic foot, albeit with an expected constant rate of minor, reversible complications. Patients should be informed of these potential complications and risks before cast application.

Leibner et al. studied the unloading mechanism of total-contact casts<sup>43</sup>. They found that peak pressure and force on the plantar aspect of the foot increased by 53% and 31%, respectively, during walking, when the proximal (above-the-ankle) portion of the cast was removed. They surmised that the mechanism appears to be a critical unloading function of the proximal portion of the cast, presumably due to reduction in ankle motion.

Goodridge et al. examined the quality of life of adults with healed and unhealed diabetic foot ulcers<sup>44</sup>. Short Form-12 (SF-12) and Cardiff Wound Impact Scale (CWIS) scores were obtained for each patient in this cross-sectional study. Both groups had lower mean SF-12 physical summary component scores than the published scores for diabetic and hypertensive individuals without ulcers. Also, patients with unhealed ulcers had a significantly lower SF-12 score and the CWIS responses demonstrated a negative impact on the average Well-being Component Score. The authors concluded that individuals with diabetic foot ulcers experience a profound compromise of physical quality of life, which is worse in those with unhealed ulcers.

The initial treatment of Eichenholtz stage-I Charcot arthropathy of the foot generally is total contact cast application and sometimes non-weight-bearing. Pinzur et al. reviewed the results for nine patients who were managed with total contact casting and weight-bearing for the treatment of acute stage-I Charcot arthropathy of the foot<sup>45</sup>. The casts were changed every fourteen days. On the average, the patients required nine weeks of cast treatment before they could be transitioned to commercially available depth-inlay shoes and custom accommodative foot orthoses. Only one subject had development of a superficial ulcer, which resolved with footwear modification. All nine patients were able to wear commercially available depth-inlay shoes and custom accommodative foot orthoses.

### Total Ankle Arthroplasty

Since the introduction of the newer generation of total ankle prostheses for the treatment of ankle arthritis, surgeons have been evaluating their intermediate-term results and refining their techniques. With a substantial learning curve, experienced surgeons are better able to define clinical pearls and pitfalls.

Horton et al. reviewed the records of eighty patients who underwent a Scandinavian Total Ankle Replacement

(STAR)<sup>46</sup>. The implant survival rate was 78% at 8.3 years. Fifteen patients had to have a second procedure, such as exchange of the polyethylene mobile bearing, osteotomy, ligament reconstruction, or irrigation and débridement. In addition, four patients had a categorical failure that required revision or removal of the metallic prosthetic components. Two of these four patients had a revision to fusion because of aseptic loosening. The fusions were performed at an average of 2.8 years after implantation. The third patient underwent revision to a different prosthesis because of chronic unresolved pain of unclear etiology. The fourth patient had revision of the talar component because of aseptic loosening.

Haddad et al. performed a meta-analysis and systematic review of total ankle arthroplasty and ankle arthrodesis<sup>47</sup>. They noted that the mean AOFAS ankle-hindfoot score was 78.6 for patients managed with total ankle arthroplasty and 76.3 for those managed with arthrodesis. Overall, 30% of the patients who had been managed with total ankle arthroplasty had an excellent result; 32%, a good result; 14%, a fair result; and 24%, a poor result. In the arthrodesis group, the corresponding numbers were 31%, 37%, 19%, and 13%, respectively. The five and ten-year survival rates were 79% and 77%, respectively. The revision rate following total ankle arthroplasty was 6%, with the primary reason for revision being loosening or subluxation. The revision rate following ankle arthrodesis was 9%, with the main reason for revision being nonunion. Below-the-knee amputation was necessary in 1% of the patients who had been managed with total ankle arthroplasty, compared with 5% of patients who had been managed with ankle arthrodesis. On the basis of these findings, the authors concluded that total ankle arthroplasty and ankle arthrodesis appear equivalent. Prospective direct comparison studies are needed to strengthen this conclusion.

Doets et al. performed a prospective observational study of the results of total ankle arthroplasty with two mobile-bearing designs<sup>48</sup>. The preoperative diagnosis in all of the patients was inflammatory arthritis. The mean overall survival rate at eight years was 84%. A significantly increased failure rate was encountered in ankles with a preoperative deformity in the frontal plane and in ankles in which an undersized tibial component had been implanted. The most common mode of failure requiring revision was aseptic loosening, which occurred after fifteen of the ninety-three ankle replacements.

### Evidence-Based Orthopaedics

The editorial staff of *The Journal* reviewed a large number of recently published research studies related to the musculoskeletal system that received a Level of Evidence grade of I. Over 100 medical journals were reviewed to identify these articles, which all have high-quality study design. In addition to articles published previously in this journal or cited already in this Update, five additional level-I articles were identified that were relevant to foot and ankle surgery. A list of those titles is appended to this review after the standard bibliography. We

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have provided a brief commentary about each of the articles to help to guide your further reading, in an evidence-based fashion, in this subspecialty area.

### Upcoming Educational Events

The Sports Injuries of the Foot and Ankle course will be held on May 3 through 5, 2007, in Oak Brook, Illinois. The AOFAS Twenty-third Annual Summer Meeting will be held on July 12 through 15, 2007, in Toronto, Ontario, Canada. The Arthroscopy Association of North America and AOFAS Foot and Ankle Arthroscopy Course will be held September 8 and 9, 2007, in Rosemont, Illinois. The AOFAS Complete Foot Care Course will be held September 13 through 15, 2007, in Las Vegas, Nevada. The AOFAS Complications in Foot and Ankle Surgery course will be held October 26 and 27, 2007, in New Orleans, Louisiana.

### Evidence-Based Articles Related to Foot and Ankle Surgery

Costa ML, MacMillan K, Halliday D, Chester R, Shepstone L, Robinson AH, Donell ST. Randomised controlled trials of immediate weight-bearing mobilisation for rupture of the tendo Achillis. *J Bone Joint Surg Br.* 2006;88:69-77.

This report describes two independent, randomized controlled trials that assessed the potential benefit of immediate weight-bearing after rupture of the Achilles tendon. One trial was performed after operative treatment of Achilles tendon ruptures, and the other was performed after nonoperative treatment. The results of the two trials demonstrated that patients who were managed operatively had an improved functional outcome when made weight-bearing immediately postoperatively in a functional brace, as opposed to those who were kept non-weight-bearing in a cast. The patients who were managed nonoperatively did not appear to gain any functional benefit from early weight-bearing, but they also were noted not to experience a higher complication rate. The importance of this study is that it is the first to compare casting and non-weight-bearing with immediate loading of a ruptured Achilles tendon protected by an off-the-shelf orthosis. This study also provides excellent evidence that immediate weight-bearing is safe and potentially beneficial for operatively managed patients. More experience with this method of operative repair and immediate weight-bearing hopefully will confirm this study result.

Tom WL, Peng DH, Allaei A, Hsu D, Hata TR. The effect of short-contact topical tretinoin therapy for foot ulcers in patients with diabetes. *Arch Dermatol.* 2005;141:1373-7.

This randomized, double-blind, placebo-controlled trial evaluated the efficacy and safety of short-contact application of topical tretinoin for the treatment of diabetic foot ulcers. The results demonstrated that tretinoin therapy was well tolerated and that it improved the healing of ulcers in pa-

tients with diabetes who did not have evidence of peripheral arterial disease or infection. This appears to be a promising method of resolving diabetic foot ulcers.

Armstrong DG, Lavery LA; Diabetic Foot Study Consortium. Negative pressure wound therapy after partial diabetic foot amputation: a multicentre, randomised controlled trial. *Lancet.* 2005;366:1704-10.

Patients with adequate perfusion and open wounds after partial foot amputation at or distal to the transmetatarsal level were randomized to either wet-to-dry dressing changes or wound vacuum-assisted closure therapy. The wounds were treated until healing or for 112 days of active treatment. The study demonstrated that negative pressure wound therapy does appear to improve wound-healing rates in this setting; however, the overall healing rates in this study were low (56% in the wound vacuum-assisted closure group, compared with 39% in the wet-to-dry dressing group). This study reinforces the improved wound-healing associated with vacuum-assisted closure that has been noted previously on the basis of anecdotal experience.

Costa ML, Shepstone L, Donell ST, Thomas TL. Shock wave therapy for chronic Achilles tendon pain: a randomized placebo-controlled trial. *Clin Orthop Relat Res.* 2005;440:199-204.

This randomized, double-blind, placebo-controlled trial demonstrated no difference in pain relief between the shock wave therapy group and the control group. Two patients in the treatment group sustained an Achilles tendon rupture. These results provide no support for the use of shock wave therapy for the treatment of chronic Achilles tendon pain. This study joins others in demonstrating a lack of success in association with the use of shock wave therapy for the treatment of chronic inflammatory problems of the foot and ankle. A final definitive conclusion regarding the effectiveness of shock wave therapy has yet to be reached.

Mologne TS, Lundeen JM, Clapper ME, O'Brien TJ. Early screw fixation versus casting in the treatment of acute Jones fractures. *Am J Sports Med.* 2005;33:970-5.

In this controlled trial, eighteen patients were randomized to cast treatment and nineteen were randomized to screw fixation of an acute fracture at the base of the fifth metatarsal. The time to union and the time to return to sport in the screw fixation group were half of those in the casting group. In addition, there was a 44% rate of failure of cast treatment. This study provides strong evidence for the treatment of acute Jones fractures with intramedullary screw fixation.

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## WHAT'S NEW IN FOOT AND ANKLE SURGERY

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- 12.** Uchiyama E, Suzuki D, Kura H, Yamashita T, Murakami G. Distal fibular length needed for ankle stability. *Foot Ankle Int.* 2006;27:185-9.
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