CHAPTER **18**

DOUBLE ARTHRODESIS THROUGH A MEDIAL APPROACH FOR END-STAGE ADULT ACQUIRED FLATFOOT

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INTRODUCTION

Triple arthrodesis has traditionally been the procedure of choice for end-stage adult acquired flatfoot. The results have been universally good with relatively high patient satisfaction. Furthermore, triple arthrodesis has proven to be a dependable and predictable procedure. Nonetheless, complications have been reported following triple arthrodesis in certain groups of patients. These complications include an increased risk of degeneration in surrounding joints, inadequate realignment when severe transverse plane deformity exists, increased risk of a residual supinatus/varus deformity in patients with severe peritalar subluxation, and lateral wound problems in patients with a combination of severe valgus deformity and deficient lateral skin (1-6). Additionally, the calcaneocuboid joint (CCJ) may require bone grafting following realignment of a severe deformity (7).

Selective arthrodesis of the talonavicular joint (TNJ) and subtalar joint (STJ) through a single medial approach has been developed as an alternative surgical option to help avoid or diminish the incidence of complications sometimes encountered with triple arthrodesis (8-17). Indications for this procedure include end-stage adult acquired flatfoot (stage III or IV) when deformity is usually severe and nonreducible. The authors especially prefer this procedure with severe transverse plane deformity, where an anterioposterior radiograph demonstrates severe subluxation or dislocation of the TNJ. This procedure is also ideal in those patients with a combination of severe deformity and deficient lateral skin that might predispose them to lateral wound dehiscence following realignment . We often choose this approach as an alternative to triple arthrodesis in high-risk patients, including those patients with diabetes mellitus, rheumatoid arthritis, long-term steroid use, and the elderly.

TECHNIQUE

The procedure is performed through a medial incision beginning just posterior to the medial malleolus and extending to the medial cuneiform. We sometimes carry the incision further distal if a naviculocuneiform or first tarsometatarsal arthrodesis is part of the reconstruction. A full-thickness incision is made just dorsal to the posterior tibial tendon. The tendon is inspected and if severe tendinosis is noted, the entire tendon is evacuated. If however, the tendon appears to be viable and healthy, the tendon is preserved. A complete release of all periarticular structures about the TNJ and STJ, including the interosseous and bifurcate ligaments, is essential. This permits adequate intra-articular visualization for cartilage debridement and joint preparation. Additionally, thorough release of contracted soft tissue structures allows easier reduction of the deformity. However, caution should be exercised during proximal dissection about the malleolus with care taken to avoid excess transection of the anterior portion of the deltoid ligament. Overzealous transaction of the anterior portion of deltoid ligament might predispose the ankle to valgus deformity, especially if hindfoot realignment is not adequate. Furthermore, we typically identify the flexor hallucis longus tendon and sometimes, the flexor digitorum longus tendon, and protect them throughout the case. A combination of lamina spreaders and pin distractors can then be utilized to provide access to the STJ.

Sharp, curved osteotomes and currettes are used to debride the cartilage. Angled currettes are ideal for debriding cartilage from the posterior facet. After the distractors have been present for a period of time and the cartilage has been debrided from the posterior facet, the posterior-lateral joint capsule is visible (Figure 1). The authors carefully release this structure. All debris is then evacuated from the STJ prior to joint preparation. This includes soft tissue

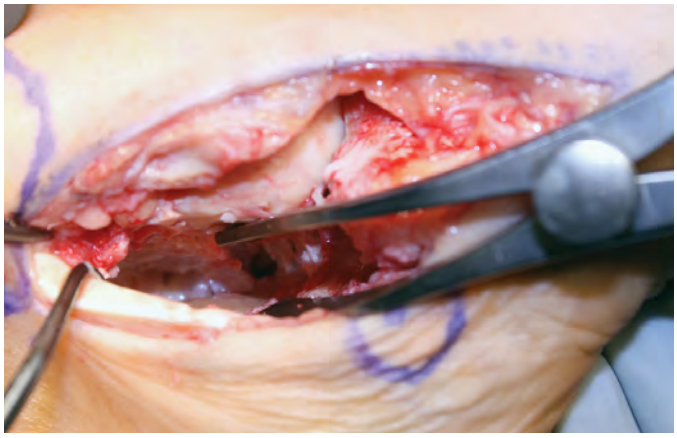

Figure 1. Intraoperative inspection of the subtalar joint following debridement of the cartilage. The lateral capsule can be visualized.

structures distal to the articular surfaces, as we will prepare this area for arthrodesis to extend the fusion mass into the extraarticular area.

The TNJ is then distracted for cartilage debridement and joint preparation in the same manner. Following lavage of both joints, the subchondral plates are fenestrated and weakened with a 2.5 mm drill and then methodically broken with a small osteotome (Figure 2). We often augment these sites with demineralized bone matrix gel.

The STJ is reduced into a neutral position and the TNJ is then realigned and provisionally fixated with guide pins from a 4.5 mm cannulated screw system. This maneuver is performed under image intensification checking anteriorposterior, lateral, and axial images. We typically deliver the first screw medial, from the navicular tuberosity, to support realignment. The second screw is delivered percutaneously along the most lateral aspect of the TNJ. A third screw is sometimes delivered centrally. It is important to have even compression across the entire TNJ. The STJ is then fixated with two large-diameter cannulated screws delivered from inferior to superior (Figure 3).

We then perform a valgus stress test of the ankle under image intensification and proceed to repair the deltoid ligament if valgus is found. The wound is then closed in standard fashion over a closed suction drain. Patients are placed into a non-weightbearing short-leg cast for 6 to 8 weeks followed by a fracture boot for an additional 3 to 4 weeks. Postoperative decisions are based on serial radiographs and clinical findings such as edema and warmth.

ANCILLARY PROCEDURES

There are a number of ancillary procedures that are sometimes necessary in order to obtain a stable, plantigrade foot. Posterior muscle group lengthening either in the form of an Achilles tendon lengthening or gastrocnemius recession is invariably required in stage III adult acquired flatfoot. The authors utilize gastrocnemius recession in

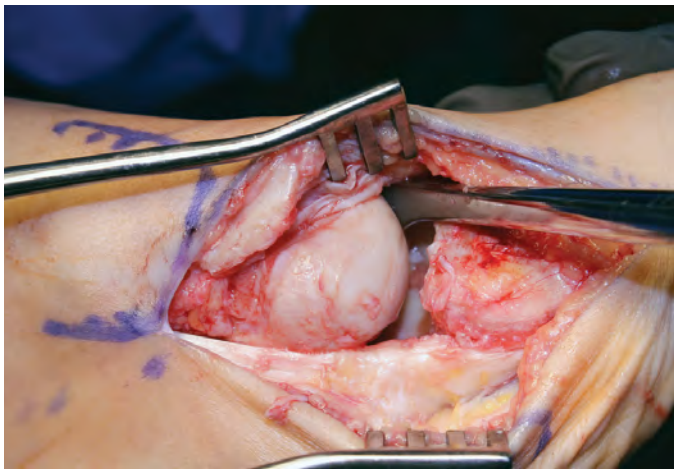

Figure 2A. Exposure of the talonavicular joint.

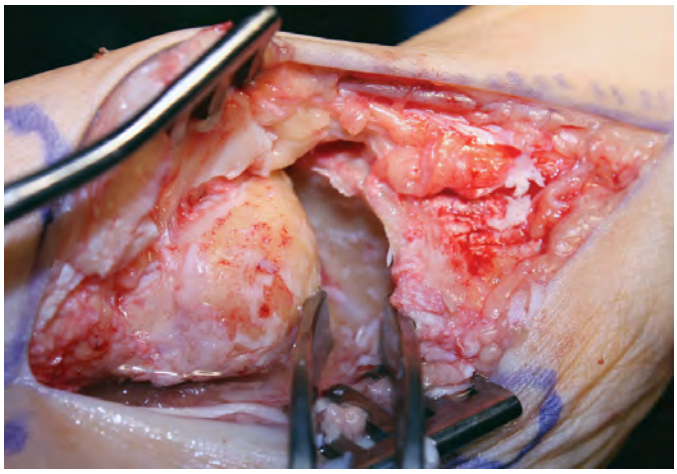

Figure 2B. Following debridement of articular cartilage.

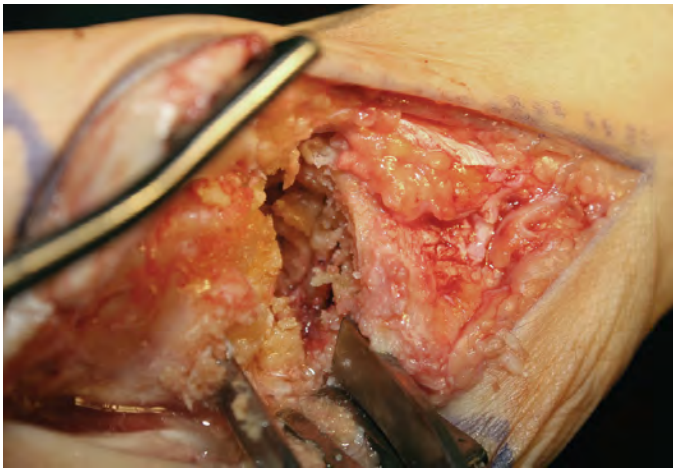

Figure 2C. Preparation of subchondral plates.

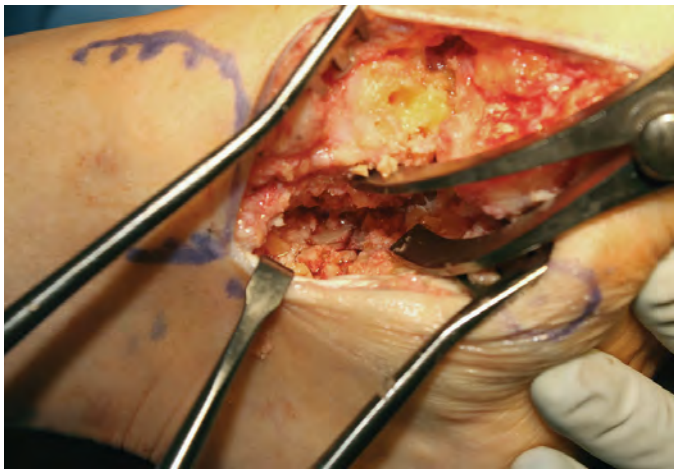

Figure 2D. Preparation of subchondral plates.

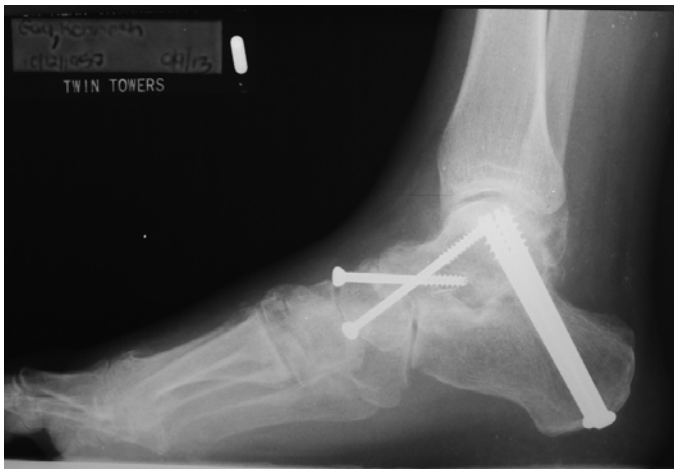

Figure 3A. Lateral radiograph showing standard fixation.

Figure 3B. Anterioposterior radiograph demonstrating standard fixation construct.

Figure 3C. Three screw construct for the talonavicular joint.

Figure 3D. Three screw construct.

the majority of cases. However, following realignment of a severe deformity, an Achilles tendon lengthening may be necessary to obtain adequate length and restore sagittal plane position.

Medial displacement osteotomy of the calcaneus can be used as an adjunct procedure to address ankle valgus or medial soft tissue attenuation. Resnick et al have shown that a triple arthrodesis in combination with a medial displacement osteotomy of the calcaneus will reduce deltoid ligament forces by 56%. Song et al have also suggested that medializing the calcaneus following triple arthrodesis would protect the deltoid complex (18, 19) (Figure 4).

The authors will consider medial column stabilization either in the form of naviculocuneiform arthrodesis or first tarsometatarsal arthrodesis, when medial column instability is identified following triple arthrodesis for stage III adult acquired flatfoot. Insufficiency of the medial column can result in a functional varus. Failure to address medial column instability can result in a lateral column overload when patients begin weightbearing (Figure 5).

Harvesting of regional bone graft and/or bone marrow aspirate is a part of virtually every hindfoot arthrodesis. Cancellous bone is often harvested from the calcaneus utilizing 6 to 8 mm trephines through small lateral incisions. Bone marrow aspirate is obtained from the calcaneus prior to tourniquet inflation. The cancellous bone is packed into arthrodesis sites. The extra-articular areas along the under surface of the talus and the dorsal surface of the calcaneus are decorticated. The bone marrow aspirate is mixed with bioactive glass and then packed into this extra-articular area (Figure 6).

Figure 4. Addition of medial displacement osteotomy of the calcaneus.

Figure 5A. Radiograph demonstrating the addition of naviculocuneiform osteotomy to address medial column instability.

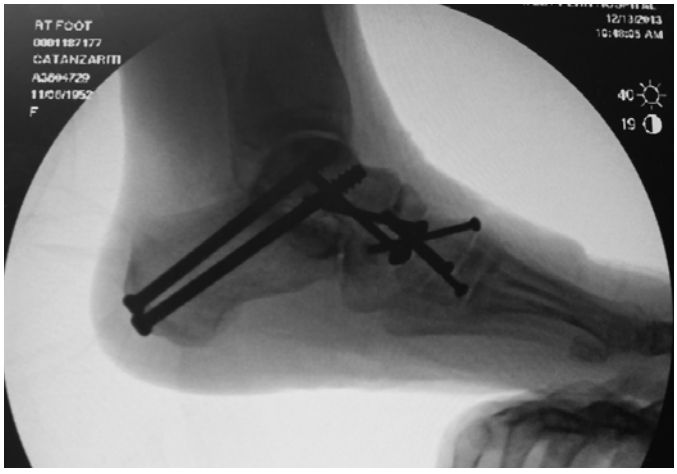

Figure 5B. Addition of naviculocuneiform osteotomy.

Figure 5C. Addition of naviculocuneiform osteotomy.

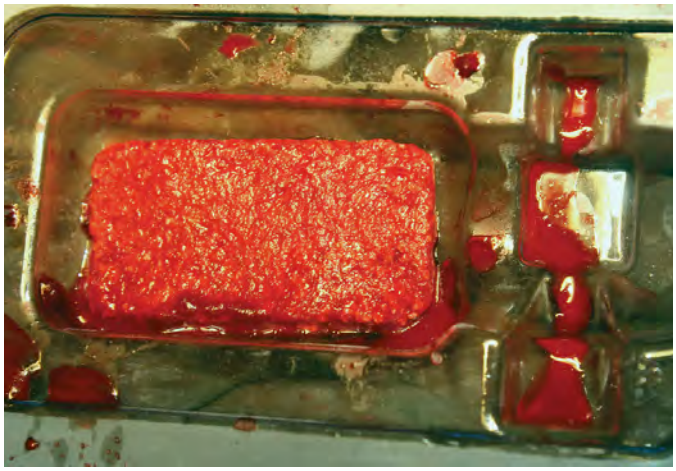

Figure 6A. Bone marrow aspirate combined with bioactive glass is packed into the extrarticular sites to enhance arthrodesis and increase the fusion mass.

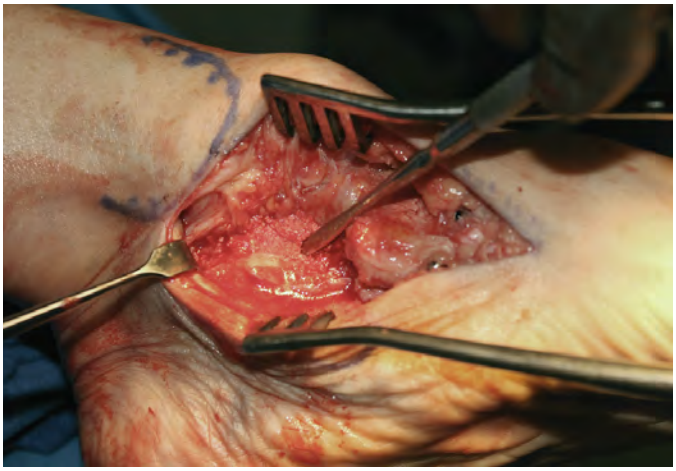

Figure 6B. Bone marrow aspirate is packed into the site.

Transfer of the peroneus brevis to the peroneus longest tendon is performed when the deformity is rather severe. Severe contracture of the peroneus brevis tendon can sometimes make it difficult to obtain complete realignment. As an alternative, the authors sometime transect both tendons.

POTENTIAL PROBLEMS

Inadequate realignment of a severe deformity following double arthrodesis through a medial approach can occur. This is always a possibility without the release of severely contracted lateral soft tissue structures. We try to perform an intra-articular release of the lateral STJ capsule when possible. In situations where adequate realignment is not possible following thorough release of soft tissue structures, the authors will consider osseous decompression through the TNJ. A sagittal saw is used to debride the joint until realignment is obtained in both transverse sagittal planes (Figure 7). We also consider a medial displacement osteotomy of the calcaneus as an ancillary procedure if there is residual deformity following provisional fixation of the arthrodesis.

Nonunion is also a potential problem. Theoretically, the incidence of nonunion might be higher with double versus triple arthrodesis because the entire tri-tarsal complex has not undergone arthrodesis and the construct may be less stiff. The authors have encountered a number of nonunions of the TNJ following double arthrodesis, however we do not have a statistical comparison to triple arthrodesis (Figure 8). One such study is currently underway (personal communication, Glenn Weinraub, DPM). We have changed our fixation construct to include three screws across the TNJ. Additionally, we sometimes supplement screw fixation with a medial locking plate (Figure 9).

Dissection of the anterior portion of the deltoid ligament might predispose the ankle to valgus deformity. The authors have encountered this situation when hindfoot realignment has been inadequate. However, one recent study comparing postoperative radiographs in patients undergoing double and triple arthrodesis, demonstrated a statistically significant difference between the two groups.

Figure 7A. Severe deformity being treated with decompression of the talonavicular joint.

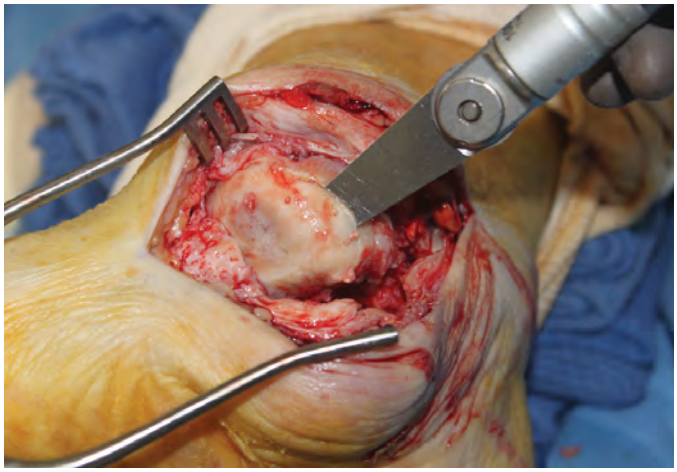

Figure 7B. Severe deformity.

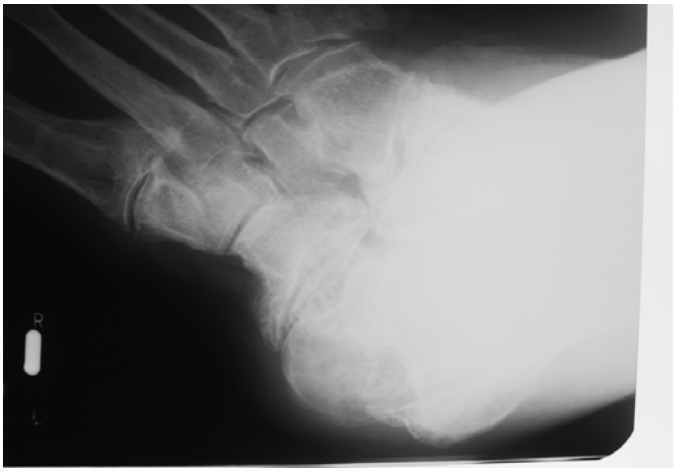

Figure 7C. Preoperative anterioposterior radiograph.

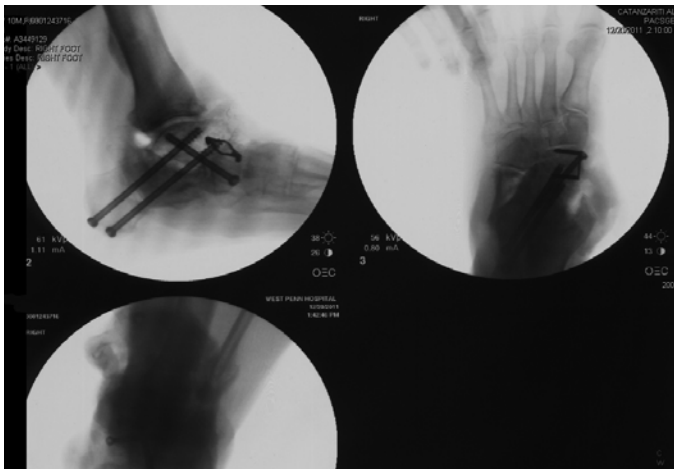

Figure 7D. Intraoperative realignment.

Figure 8A. Anterioposterior preoperative radiograph.

Figure 8B. Lateral preoperative radiograph.

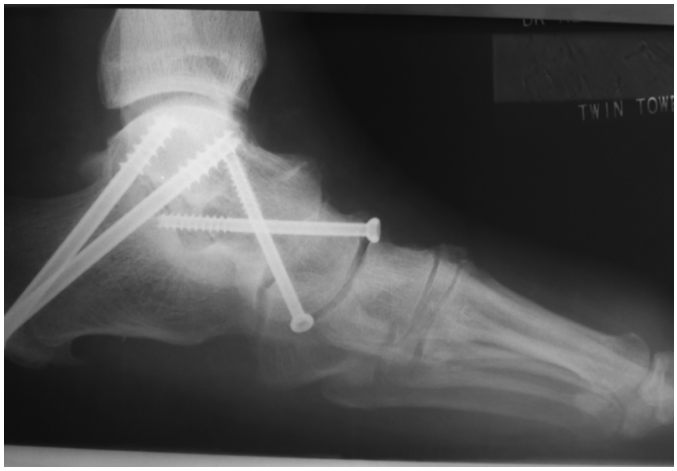

Figure 8C. Postoperative radiograph.

Figure 8D. Postoperative radiograph.

The odds of having an increase in valgus deformity in the triple group was 3.64 times that for patients in the double group (20).

ADVANTAGES

Various advantages have been described for using double arthrodesis relative to triple arthrodesis. These include a significant reduction in lateral wound complications, decreased incidence of nonunion, improved intraoperative visualization, and shorter operative times. The decreased risk of nonunion and shorter operative time is secondary to sparing the CCJ. Transverse plane realignment of a severely abducted foot might be easier if the lateral column is not shortened by CCJ arthrodesis. One study observed distraction of the CCJ may reduce the risk of degenerative joint disease at this site (21). Other studies describe the protective effect of motion remaining at the CCJ following double arthrodesis and the decreased incidence of arthritis on surrounding joints compared to triple arthrodesis (8, 14, 22). Another recent study demonstrated that double arthrodesis through a medial approach was both more efficient and cost-effective than traditional triple arthrodesis. (23).

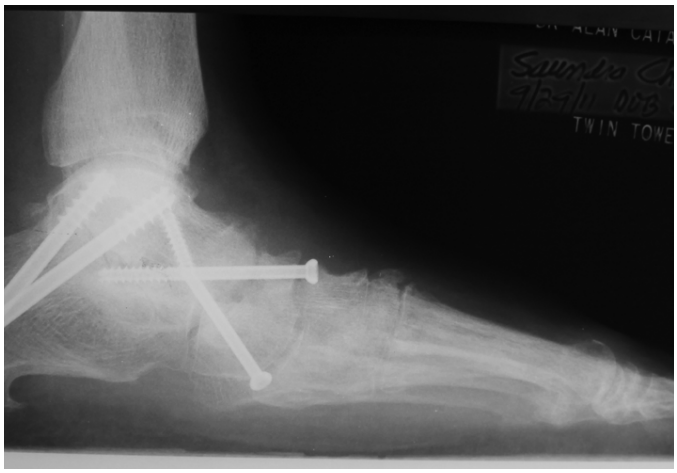

Figure 8E. Nonunion of the talonavicular joint.

Figure 9. Supplemental fixation of talonavicular arthrodesis with locking plate.

SUMMARY

Double arthrodesis through a medial approach is a reasonable alternative to triple arthrodesis, especially when patients are predisposed to lateral wound dehiscence secondary to a severe deformity, deficient lateral skin, or have risk factors that adversely affect their wound healing potential. The majority of research evaluating this procedure has been level IV. A recent review on a series of 18 feet undergoing a single-incision medial approach double arthrodesis for posterior tibial tendon dysfunction reports a union rate of 89% with 2 malunions and 2 valgus ankles. There were no wound complications and satisfaction rate was 78%. However the results were not encouraging enough for the authors to recommend adopting this approach as an alternative to triple arthrodesis (24).

Although we prefer double arthrodesis for stage III and IV adult acquired flatfoot, we continue to employ triple arthrodesis for the most severe, nonreducible deformities. Although radiographic improvement is acceptable and predictable following double arthrodesis, we have found that the clinical appearance is not as good as patients undergoing triple arthrodesis. A prospective, randomized study comparing double to triple arthrodesis for surgical management stage III adult acquired flatfoot would be beneficial. This type of study might help identify which deformities are best treated by either double or triple arthrodesis.

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