CHAPTER 41

TALO-NAVICULAR ARTHRODESIS FOR ADULT FLATFOOT DEFORMITY

Steven R. Carter, D.P.M.
John A. Ruch, D.P.M.

The purpose of this article is to discuss the use of the talo-navicular arthrodesis as a surgical option for the flexible adult flatfoot deformity. The various types of symptoms encountered in the flexible flatfoot and the reasons why they occur will also be addressed.

Many symptomatic flatfoot deformities are acquired during adulthood and are commonly associated with pathology of the tibialis posterior (TP) tendon. It is currently felt by a number of authors that early symptoms of tendinitis and inflammation of tibialis posterior are due to an abnormal amount of pronation, as seen in the flexible flatfoot which puts excessive strain on the medial soft tissue structures around the ankle. This occurs as the forefoot abducts and the rearfoot falls into valgus. As time progresses, the TP tendon can become attenuated, weakened, dysfunctional, and may even undergo partial or total rupture. It is the loss of strength of the tibialis posterior tendon that then allows the foot to assume an even more exaggerated flatfoot position. Furthermore, a foot that is maintained in this position for a long period of time may eventually lose its flexibility and result in a fixed rigid deformity. Therefore, the flatfoot should be thought of as the primary event which puts strain on the TP tendon causing it to become painful and weakened as a secondary event. Dysfunction of the tendon then leads to an even more severe deformity. However, there are certainly instances where rupture of the TP tendon may be the primary event (such as a laceration of the tendon) that leads to the development of a flatfoot deformity. The reader is encouraged to review the article by Banks and McGlamry that fully discuss this topic.

The diagnosis of tibialis posterior tendon pathology is made by visual inspection as well as physical examination findings. The utilization of a special study such as MRI is also a useful adjunct, but in most instances is not mandatory in making the diagnosis. Early in the condition, there may be a significant amount of pain and inflammation along the course of the tendon. Later, as the tendon loses its strength, loss of the medial longitudinal arch and abduction of the forefoot with the "too many toes sign" may be observed. The heel may also be in a position of valgus. Asking the patient to rise upon the ball of the foot will demonstrate the lack of inversion of the heel. This is referred to as a negative "single heel rise" test. Finally, the examiner should perform manual muscle testing to grade the strength of the TP muscle/tendon complex. The foot should be placed into a position of plantarflexion and inversion. With normal strength of the tendon, the examiner should not be able to "break" this position against the patient's forced resistance.

REASONS FOR SYMPTOMATOLOGY IN FLATFEET

It is important to understand that not all flatfeet (adult or juvenile) have TP dysfunction as a component of the deformity, nor are all flatfeet painful in the same anatomic locations. Commonly, there will be several locations on the foot that are symptomatic. Because of these multiple areas of complaints, the patient may be misdiagnosed as merely having "generalized foot pain," with the true reason for the patient's symptoms remaining undiagnosed. Therefore, it is important for the examiner to have a high index of suspicion *looking for* discomfort in certain specific areas of the foot, rather than using a *looking at* approach.

The examiner must be able to make a determination as to what anatomic abnormalities are causing the patient's symptoms. This concept is especially pertinent to the thought process behind the use of various surgical procedures for symptomatic flatfeet. The first step is to determine what specific areas of the foot are painful. Common areas of discomfort include the medial arch, sinus tarsi, subtalar joint, course of the tibialis

posterior tendon, and the midtarsal joint. Each of these symptoms, when present normally occur due to a specific reason.

Joint Malposition

A majority of the symptoms encountered in these patients are due at least in part to some degree of joint malposition. This is normally seen as pronation of the subtalar joint which causes the anterior edge of the lateral talar process to impact the floor of the sinus tarsi. This is a common reason for chronic pain in the lateral rearfoot. The examiner should therefore palpate along the lateral aspect of the posterior facet of the subtalar joint and the sinus tarsi, checking for discomfort in these areas.

Clinically, the components of the deformity may include collapse of the medial longitudinal arch, abduction of the forefoot at the midtarsal joint, and valgus position of the heel. Radiographically, "sag" may be noted anywhere along the medial column, to include the first metatarsal-cuneiform, navicular-cuneiform, or talo-navicular joints. Abduction occurring at the midtarsal joint is seen on the anterior-posterior view of the foot as lateral subluxation of the navicular on the talus, and increase in the calcaneo-cuboid abduction angle. Again, because the talus is locked within the ankle mortise, it is the foot that is moving away from the talus. This is termed peri-talar subluxation.

There is also frontal plane malposition that may occur between the forefoot and the rearfoot, presenting as forefoot supinatus. It occurs secondary to the foot being maintained over an extended amount of time in a position of rearfoot valgus with the forefoot parallel to the ground. Therefore, when the rearfoot is placed into a neutral position, the forefoot supinatus becomes evident.

Tibialis Posterior Tendon Dysfunction

As proposed by Cozen, and later supported by Banks and McGlamry, most cases of TP dysfunction are caused by a pronating flatfoot that places excessive tension and strain on the posterior tibial tendon. Common examination findings include edema, calor, and pain upon palpation along the course of the posterior tibial tendon. Later in the disease course, the tendon may progressively become weak and attenuated due to the excessive strain. Over a period of time, after the tendon becomes chronically stretched and assumes a lengthened position there actually may be less inflammation (edema, calor, and tendon pain) than earlier in the disease course. This is because there is less tension on the tendon in this over-lengthened position.

Arthritis

Arthritic degeneration of the rearfoot is a common late stage condition, that may occur as a result of severe posterior tibial tendon dysfunction and long-standing joint malposition (Fig. 1). This usually produces chronic rearfoot pain which is very difficult to manage and is often a disabling condition. When patients have chronic pain in the rearfoot, a common physical examination finding is peroneal spasm. This is an attempt by the body to splint the foot and limit the painful motion in the subtalar complex.

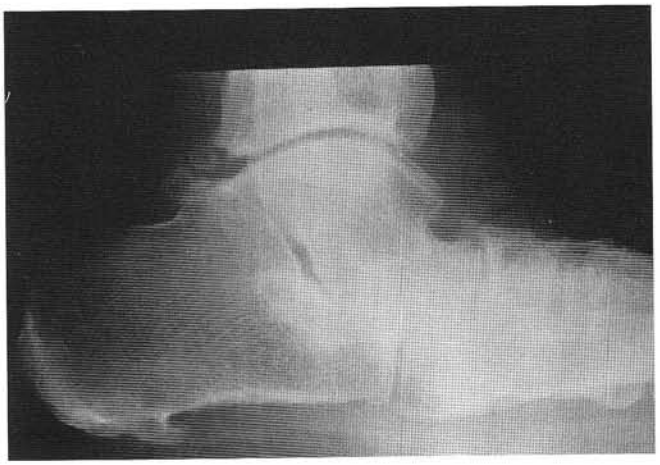

Figure 1. Lateral x-ray of a patient with advanced arthritis in the subtalar and midtarsal joints from long-standing TP dysfunction.

TREATMENT OPTIONS FOR ADULT FLATFOOT DEFORMITY

It should be stressed that the surgical management of patients with painful flatfeet should only be considered after a sufficient period of conservative treatment has proven unsuccessful. Treatment modalities may include the use of supportive walking shoes, orthotics, NSAIDs, sinus tarsi injections, lace-up canvas ankle brace, removable walking cast, or a below-knee non-weight bearing cast. However, the injection of corticosteroids into the vicinity of the tibialis posterior tendon should be used only sparringly, and with caution.

TP Tendinitis

There are primarily two categories of soft tissue surgical procedures that deal with pathology of the posterior tibial tendon. The first category involves debridement of the hypertrophic posterior tibial tendon, as well as the surrounding synovial tendon sheath. This has been referred to as a tenovaginectomy. By virtue of having removed the synovial sheath, the tendon is less able to react and become inflamed. The second category involves various tendon transfer procedures that attempt to recreate the strength of tibialis posterior. The most well known procedure in this category is transferring the flexor digitorum longus tendon and performing a side-to-side anastomosis to the TP tendon. Various authors have written articles about this procedure, and for the most part have generally reported favorable results. However, one important limitation of these procedures is the inability to change the position of the foot. Therefore, even if some strength of the TP tendon is regained, no change in the structural position of the foot can be expected. The implication is that if the patient's symptoms are in part due to joint malposition, an isolated FDL transfer can not be expected to resolve those symptoms.

Flexible Flatfoot

The symptomatic flexible flatfoot with malposition pain offers several surgical treatment options depending on the areas of discomfort and the structures involved. Flexibility implies that the foot can be manually reduced into a corrected position. The previously mentioned tendon transfers have been used to treat this type of deformity, but because no structural changes of the foot are produced, other procedures are becoming more popular. Most of these procedures involve some type of arthrodesis technique. Although the triple arthrodesis has been the traditional surgical procedure for the adult flatfoot deformity, less aggressive single joint arthrodesis procedures are gaining popularity. These include the subtalar fusion, calcaneo-cuboid distraction arthrodesis, and the talo-navicular arthrodesis. The latter procedure will be discussed in detail. A significant number of patients with flatfeet also have an associated equinus, and may also need to be surgically addressed.

Rigid/Arthritic foot

There are certain patients with severe TP dysfunction, or a rigid deformity which need a triple arthrodesis for optimal outcome. Degenerative changes in the joints of the rearfoot, or severe nonreducible forefoot varus (Fig. 2) also constitute conditions which would necessitate fusion of all three rearfoot joints to afford proper correction.

Figure 2. Severe forefoot varus.

ISOLATED TALO-NAVICULAR ARTHRODESIS

Rationale

A single joint arthrodesis procedure such as the talo-navicular fusion is indicated for patients with symptomatic flatfeet which are still flexible and have no arthritic degenerative changes in the subtalar joint. The talo-navicular joint arthrodesis offers an effective surgical option for the above category of patients by virtue of its ability to: 1) improve and maintain position of the foot, 2) limit excessive subtalar joint pronation, and 3) remove the strain from the tibialis posterior tendon. Some authors have reported that after fusion of the talo-navicular joint, up to 80% of subtalar joint motion is blocked. Furthermore, the subtalar and

midtarsal joints function as a unit; therefore, as the transverse component of the pronatory deformity is improved by relocating the midtarsal joint, the sagittal plane component is also improved by altering the position of the talus on the calcaneus.

Isolated talo-navicular arthrodesis was originally reported in the literature for the management of arthrosis of this joint in patients with rheumatoid arthritis. It was previously known that the talo-navicular joint is commonly the first of the rearfoot joints to become affected by this condition. Several studies have evaluated patients with rheumatoid arthritis that presented with degeneration of the talo-navicular joint. Many of these patients were found to eventually have developed degeneration and collapse of the subtalar joint. However, if fusion of the talo-navicular joint was performed early in the disease course, many patients never developed arthritis of the subtalar joint. The conclusion was that because fusion of the TNJ improved the position of the foot and limited pathologic subtalar motion, hindfoot arthritis was inhibited.

Surgical Technique

The first step in this procedure is the accurate identification of the critical anatomic landmarks. The structures to be identified include the course of tibialis anterior, tuberosity of the navicular, medial malleolus, and course of the tibialis posterior tendon. A linear skin incision is placed across the mid-body of the navicular starting at the tip of the medial malleolus, and extending distally to the level of the first metatarsal-cuneiform joint (Fig. 3). Dissection is carried through the subcutaneous tissue, retracting the saphenous vein superiorly until the deep fascia is visualized (Fig. 4). A longitudinal deep fascial/capsular incision is made across the talo-navicular joint in line with the skin incision. The soft tissue is then reflected from the dorsal as well as the plantar aspect of the joint, making sure to adequately release the dorsal talo-navicular ligament. The joint can then be opened with a lamina spreader (Fig. 5). The adjacent articular surfaces of the talo-navicular joint are resected using hand instrumentation (osteotome/mallet, curette) in order to maintain the congruity of the joint. Emphasis is placed on maintaining the normal "ball and socket" configuration of this joint (Figs. 6, 7). This allows the flexible but malpositioned foot to be placed in the desired corrected position prior to fixation (Figs. 8, 9). Temporary fixation is achieved using two .062" K-wires, and an intra-operative x-ray is taken (Figs. 10, 11). The pins are then replaced with two 4.0 mm partially-threaded cancellous screws (Figs. 12, 13). Note the change in alignment at the talo-navicular joint after the foot is repositioned and fixation is placed across the joint. Sequential layered soft tissue closure is then performed. Figures 14 and 15 show a close-up of the repositioned talo-navicular joint.

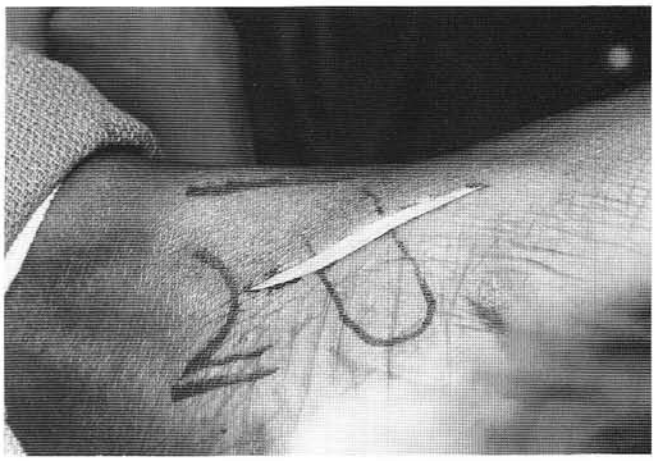

Figure 3. Skin incision is placed across the medial aspect of the talo-navicular joint.

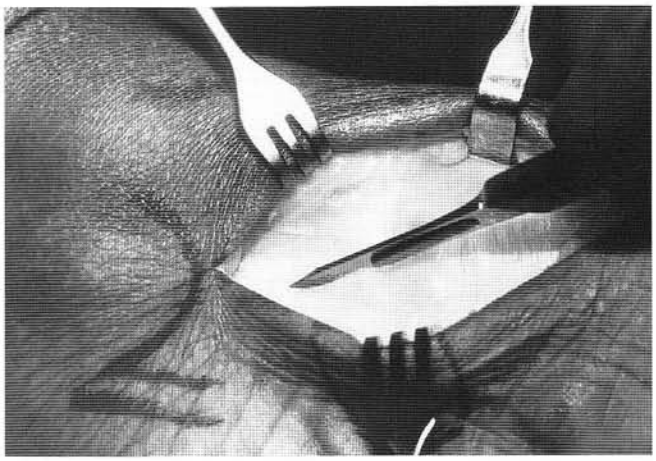

Figure 4. Deep fascial/capsular incision in line with the skin incision.

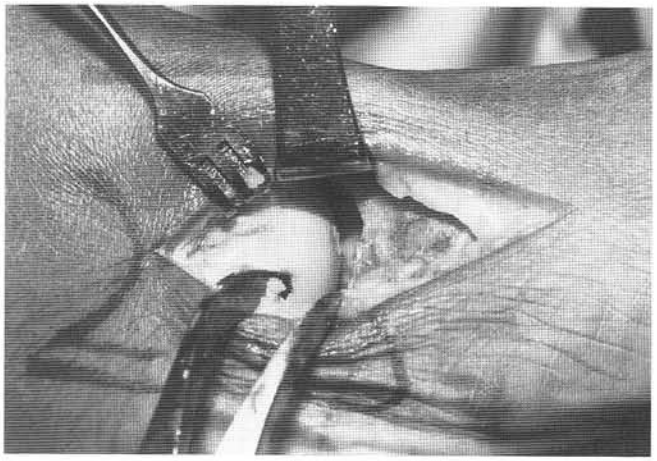

Figure 5. Lamina spreader distracting the talo-navicular joint. The cartilage on the head of the talus is evident.

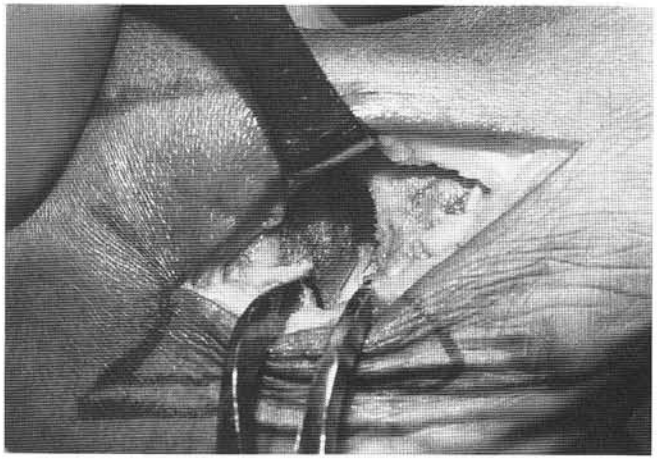

Figure 6. The articular surface on the head of the talus has been resected.

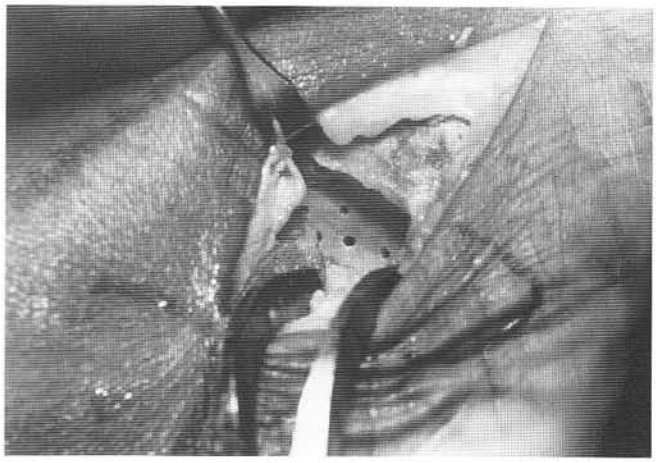

Figure 7. The cartilage on the cup of the navicular has been resected and several small subchondral drill holes have been made.

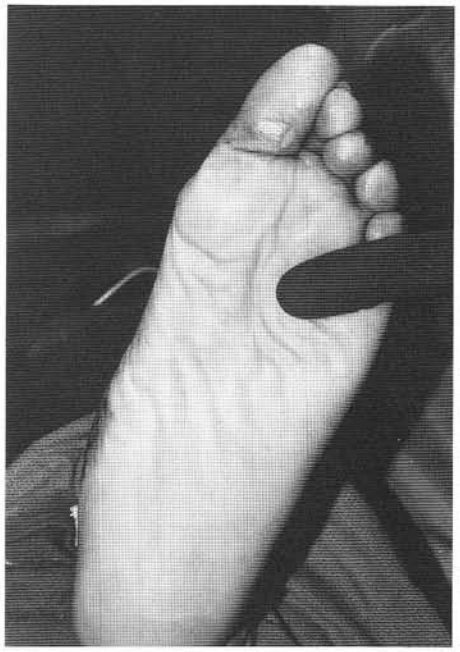

Figure 8. Plantar view of the foot in its abducted malposition.

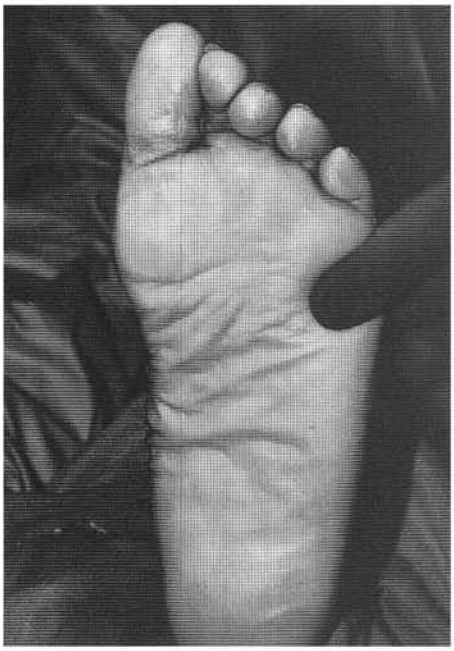

Figure 9. Plantar view of the foot after the foot is manually reduced.

Figure 11. Intra-operative x-ray demonstrating the position of the temporary fixation pins.

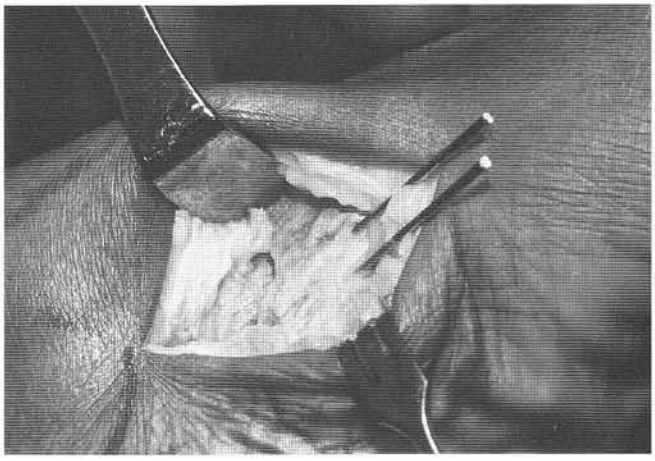

Figure 10. Two temporary fixation pins have been placed across the talo-navicular joint.

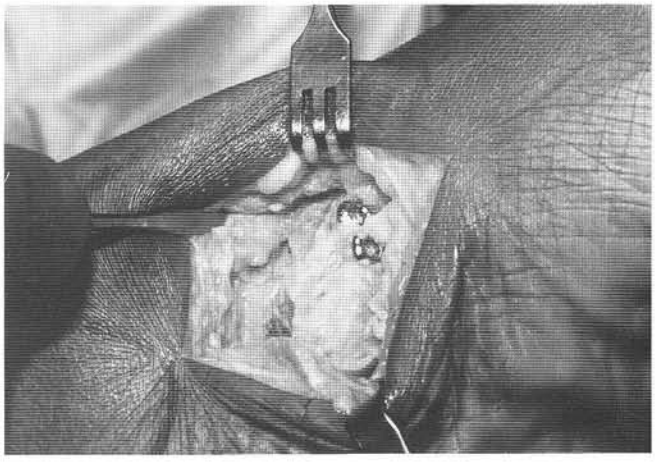

Figure 12. Two 4.0 mm partially-threaded cancellous screws have been placed across the joint.

Figure 13. Lateral x-ray demonstrating position of the 4.0 mm screws.

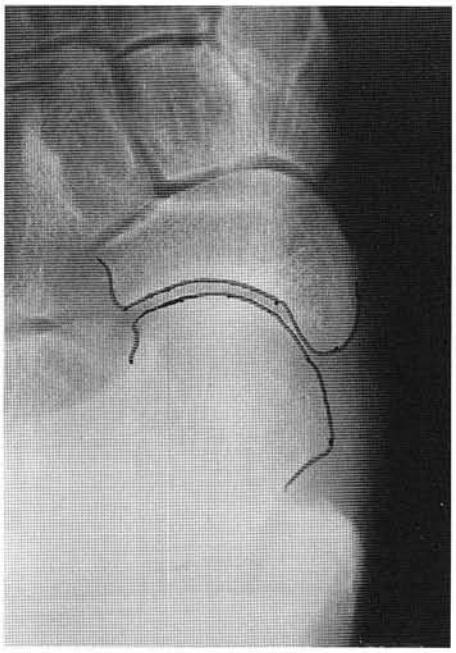

Figure 14. Preoperative AP view of the patient's left foot.

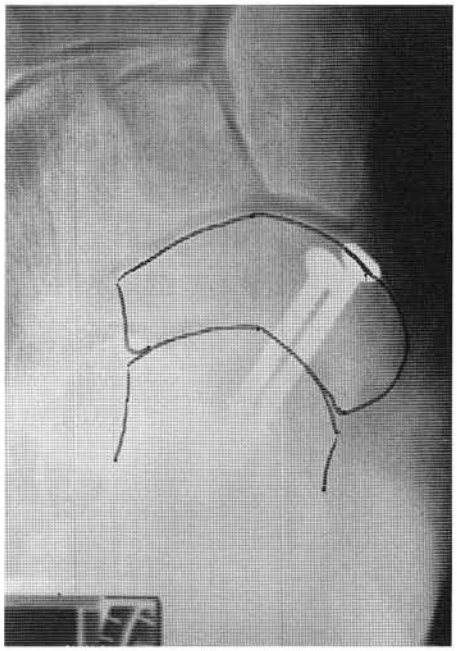

Figure 15. Postoperative AP view of the patient's right foot.

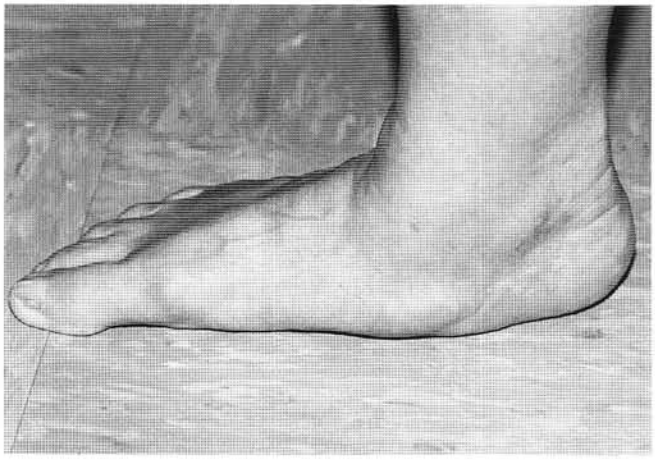

Figure 16. Preoperative appearance of the right foot.

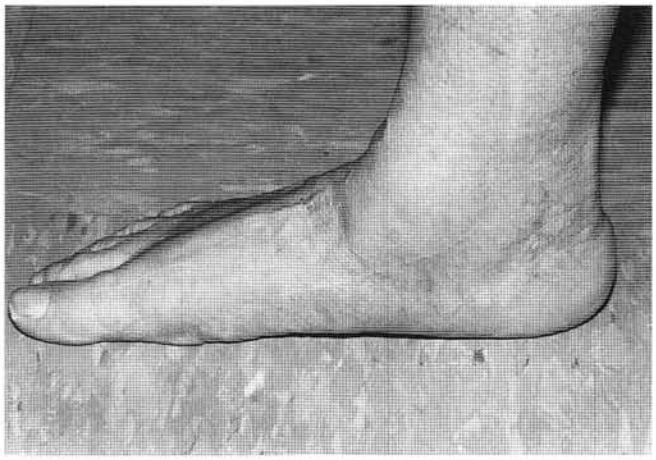

Figure 17. Five month postoperative appearance of the right foot following arthrodesis of the talo-navicular joint.

Postoperative Management

The immediate postoperative management includes 7 to 8 weeks of keeping the patient non-weight bearing in a below-the-knee cast. After the non-weight bearing cast is removed, the patient's foot is maintained in a removable walking cast for an additional 4 weeks. Following the entire casting period, the patient can begin wearing tennis shoes. It is recommended that the patient be maintained in an orthotic device for additional support of the foot. Figures 16 and 17 show a comparison of the preoperative and five month postoperative appearance of a patient's right foot following an isolated fusion of the talo-navicular joint. Note the change in the sagittal plane position of the medial arch.

Complications

The more significant complications associated with single joint arthrodesis procedures such as the isolated talo-navicular fusion include the potential for delayed or non-union, infection, and fusion in poor position. The initial literature discussing this procedure found a very high incidence of

non-union. However, it was concluded that most of these non-unions were secondary to the surgical technique used. The highest rates of non-union were found when freeze-dried allografts were implanted at the arthrodesis site. Most of the procedures were also performed using saw resection and staple fixation. Therefore, the more popular trend today is to use hand instrumentation and internal compression fixation with or without the use of fresh autogenous graft within the arthrodesis site. Another complication of this procedure is inadvertent resection of the wrong joint which has been reported in two different articles.

Another potential complication that has been proposed with isolated fusion of the talo-navicular joint is the development of secondary arthritic changes in the adjacent hindfoot joints. However, most of the studies that discuss this complication were performed on patients with rheumatoid arthritis. The authors admitted that the later arthritic changes may have developed secondary to the natural progression of the rheumatoid arthritis, and not necessarily caused as a result of the fusion. Furthermore, secondary arthritic changes are of course not limited to talo-navicular fusions. The triple arthrodesis has long been associated with the occasional development of secondary ankle arthritis. Although some secondary arthritic changes may be seen on follow-up radiographs, the patient often has no concomitant symptoms.

SUMMARY

The isolated talo-navicular fusion offers an effective surgical option for the symptomatic flexible flatfoot deformity that has failed to respond to conservative therapy. Tibialis posterior tendon dysfunction is often a component of this condition and can be effectively managed with this procedure. Emphasis is placed on the use of hand instrumentation for resection of the joint in order to maintain the congruity of the adjacent joint surfaces.

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