CHAPTER 14

CALLUS DISTRACTION TECHNIQUES IN MID AND REARFOOT RECONSTRUCTION

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Over the past several years, the technique of callus distraction has been modified to address many complex foot and ankle deformities. Several new modifications have been designed to address pathology about the mid- and rearfoot. In particular, the use of callus distraction in the treatment of flexible pes planus and forefoot adductus deformities will be discussed.

FLEXIBLE PES PLANUS

An alternate method of performing the Evans calcaneal osteotomy for flexible pes planus deformities has been previously described.[1] This method uses the traditional Evans calcaneal osteotomy to treat the transverse plane component of the deformity. In contrast to the traditional technique, postoperative callus distraction is used instead of a graft to achieve the desired lateral column lengthening.

Advantages to the above modification include the ability to achieve a greater and more exact amount of correction. With the traditional method, correction is often limited by the size of the graft available, and by the confines and flexibility of the calcaneocuboid joint. In addition, the technique of callus distraction affords a more predictable form of bone healing. The occasional delayed union or nonunion seen with the standard grafting technique has not been observed in approximately 20 cases treated with the newer alternative.

The callus distraction method also carries with it a higher degree of patient acceptance. When an allograft is used, the surgeon must take into consideration the possibility of disease transmission (primarily AIDS and Hepatitis). Although the actual possibility of transmission is extremely rare, the general public is still very apprehensive about the possibility of disease transmission. Since no guarantees can be made, many patients will refuse the procedure. While an autogenous graft alleviates the risk of disease transmission, it requires a second surgery. Therefore, callus distraction affords many advantages.

Procedure

A linear incision is made along the lateral calcaneal body and calcaneocuboid joint (Fig. 1). The sural nerve and peroneal tendons need to be identified and avoided. As the superficial fascia is separated from the deep fascia, the distal-lateral aspect of the calcaneus and cuboid should be fully exposed. It may also be necessary to reflect the extensor digitorum brevis muscle at its origin to aid in visualization.

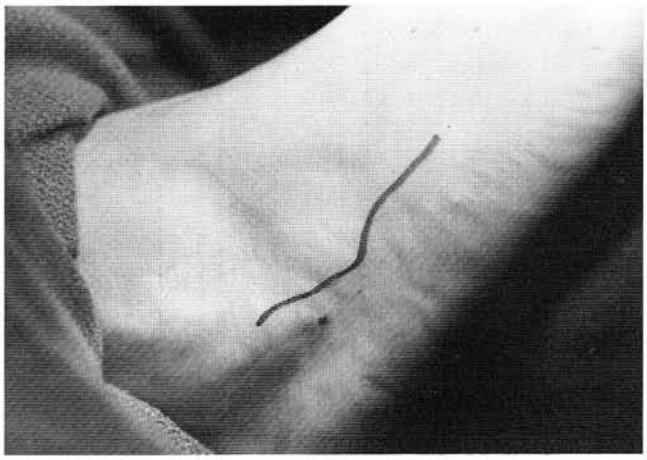

Fig. 1. Dorsolateral incision overlying the calcaneus and cuboid.

After the calcaneal wall is adequately exposed, the pins for the external fixator are inserted (Fig. 2). A total of four pins (2.5-mm or 3.0-mm) are used. Two pins are placed both proximal and distal to the osteotomy. Distally, one pin will lie in the calcaneus and the second will cross the calcaneocuboid joint and enter the cuboid. The osteotomy is then cut from lateral to medial in the standard fashion (Fig. 3). Either power or hand instrumentation may be used, depending on the surgeon's preference. Closure is then performed in anatomic layers before attaching the external frame (Fig. 4).

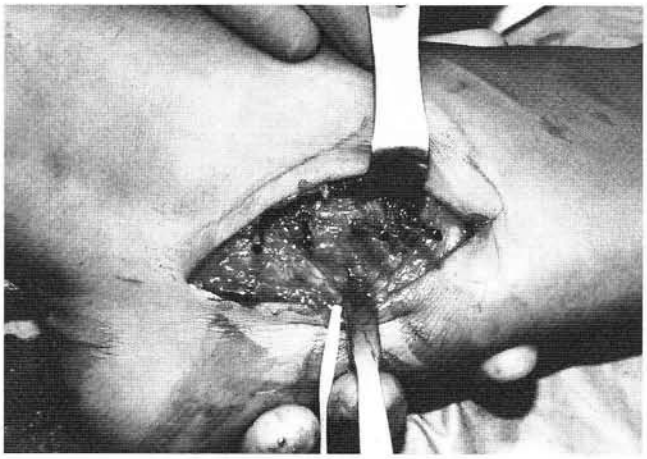

Fig. 2. Pin placement prior to cutting the osteotomy.

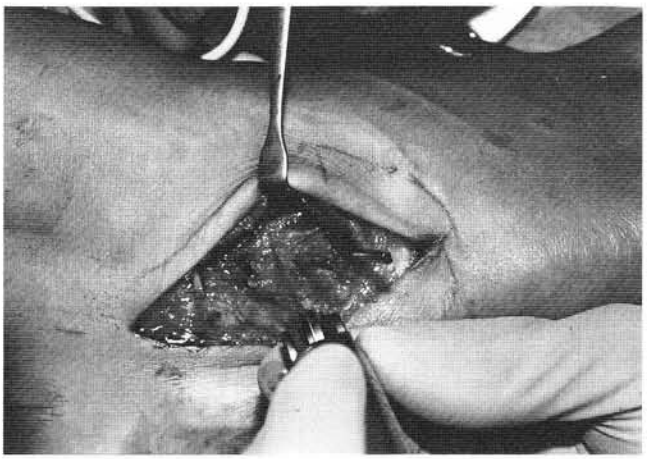

Fig. 3. Traditional Evans osteotomy design.

Fig. 4. Following final closure, the external frame is attached to the pins.

A 5-7 day postoperative latency period must expire before beginning the distraction process. During this time, the patient is kept non-weight-bearing with cast protection. Once the distraction process is started, it is continued on a regular schedule of five 1/4 turns daily, until the desired correction is obtained. This particular distraction cycle allows for the most efficient bone formation and remodeling that is practically possible. The accompanying hexagonal wrench allows for an accurate turning sequence.

Radiographs are taken every 10-14 days to monitor healing. The distraction rate described will result in approximately 1 mm of lengthening each day. The average amount of correction for this deformity is typically 1-1.5 cm. However, smaller or larger amounts can easily be achieved with this method.

Once the preferred amount of correction has been obtained, the external frame is left in place for 2 to 3 weeks to allow for bone remodeling. During this time, the patient is kept non-weight bearing with cast protection. If desired, physical therapy can be instituted during this two-week observation period. Once x-rays reveal adequate osseous remodeling, the external frame is removed (Fig. 5). Frame removal is performed in the office, and does not require anesthesia. Subsequently, a slow and deliberate return to normal weight bearing is initiated.

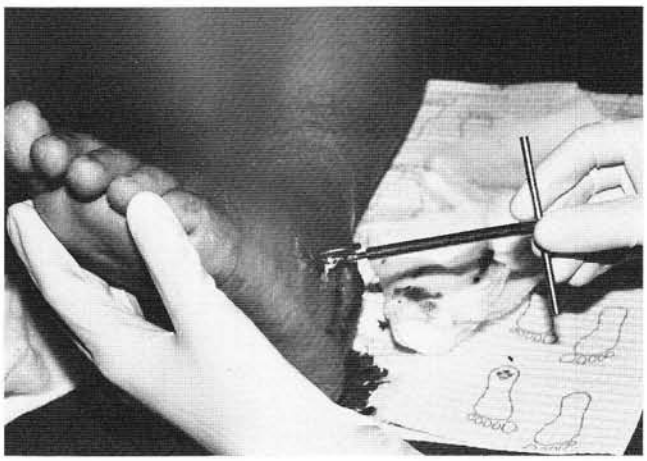

Figure 5. Removal of the frame is a simple and painless office procedure.

Case History

An 11-year-old male patient was evaluated for a second opinion regarding a previously diagnosed "flatfoot" condition. Prior treatment included an extensive trial of physical therapy, nonsteroidal anti-inflammatory medications, and custom made orthotics. Although obtaining early subjective relief of pain with these measures, the condition progressively worsened with regard to increased pain and degree of deformity.

When questioned, the patient complained of intermittent pain throughout the medial arch and lateral sinus tarsi region. The pain intensified with physical activity, especially athletics. He was a competitive basketball player, and felt that his playing ability was being affected as the pain became significant within 30 minutes of activity. Objective findings revealed a classic flexible pes planus deformity with both frontal and transverse plane components. There was no evidence of rigidity or crepitus with subtalar motion. Stance examination revealed significant forefoot abduction, heel valgus, and collapse of the medial arch. The Heubsher maneuver was positive indicating a flexible nature to the deformity. There was also a moderate degree of gastrosoleal equinus deformity present.

Radiographic examination demonstrated significant pathologic changes in the transverse plane (Figs. 6A, 6B). Increased talocalcaneal, talonavicular, and calcaneocuboid joint angles were observed. Pathologic frontal plane changes were also present, but to a much lesser degree.

Figure 6A. Dorsoplantar radiograph demonstrating significant transverse plane abnormalities of the talocalcaneal, talonavicular, and calcaneocuboid joints.

Figure 6B. Lateral radiograph demonstrating mild breeching of the naviculocuneiform joint.

Operative procedures included a medial arch soft tissue reconstruction, Achilles tendon lengthening, and the modified Evans calcaneal osteotomy with callus distraction. Following the first dressing change at postoperative day 5, the distraction process was commenced (Fig. 7). After approximately three weeks of distraction, x-rays revealed a significant amount of lateral column lengthening and deformity correction (Fig. 8). The external fixator was left in place for approximately three additional weeks before unprotected weight bearing was initiated. At this time, follow-up x-rays confirmed adequate remodeling at the osteotomy site (Fig. 9). The patient is now approximately 6 months post-

Figure 7. Following frame and pin placement, calcaneal osteotomy, and a 5 day latency period, distraction was initiated.

Figure 8. Significant correction was obtained following three weeks of callus distraction.

Figure 9. At six weeks postoperative, the osteotomy distraction gap was well remodeled.

operative, and has returned to full activity including competitive basketball. He is essentially asymptomatic, however there is a slight residual painless limp secondary to the Achilles tendon lengthening. This is expected to resolve uneventfully over the next 6 months.

FOREFOOT ADDUCTUS (METATARSUS ADDUCTUS)

Another clinical condition which has recently been challenged with the modified callus distraction technique is the congenital forefoot or metatarsus adductus deformity. The surgical correction of this deformity presents much more controversy than the pes planus deformity already discussed. There are authorities in both the podiatric and orthopedic communities that regard this condition as one primarily of radiographic significance, with no real clinical consequences. This debate is beyond the scope and intent of this paper. There are times, however, where this deformity is clinically significant. When symptoms arise, they are either directly related to the in-toe deformity itself (tripping over the feet), or are a result of secondary compensatory changes occurring at the subtalar and midtarsal joints.

It is not uncommon to have conservative treatment fail in this type of patient, thereby necessitating surgical intervention. Crescentic osteotomies, described by Berman and Gartland, have been the standard in both the podiatric and orthopedic professions. More recently, Lepird described an obliquely-oriented osteotomy which also allows for rotation and transposition of the metatarsals (Figs. 10A, 10B). The advantage of this technique is the ability to accommodate rigid internal screw fixation.

Ganley was the first to place the emphasis of correction at the more proximal tarsometatarsal articulation. He proposed simultaneous cuboid and medial cuneiform osteotomies to correct the forefoot adductus condition. These thoughts were also supported by Chang and McGlamry.[2] They pro-

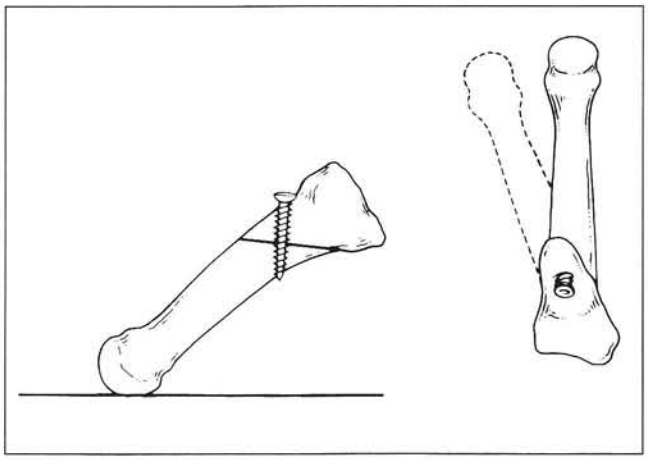

Figure 10A. Illustration of the central metatarsal osteotomy of the Lepird procedure.

Figure 10B. Radiographic appearance of the Lepird procedure.

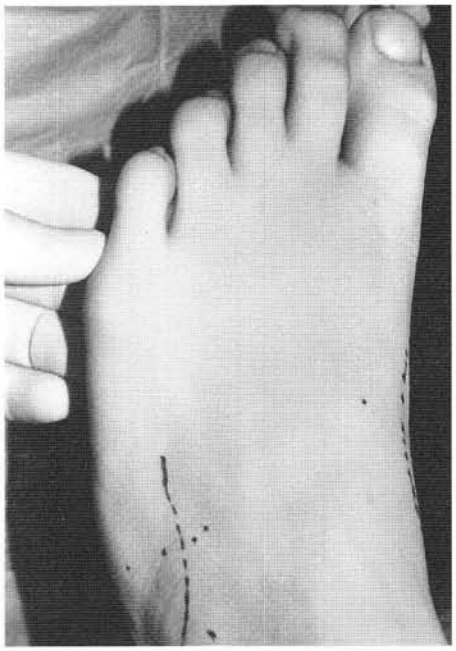

Figure 11A. Lateral incision over the calcaneocuboid region.

posed a closing wedge osteotomy of the cuboid, along with an opening wedge osteotomy of the medial cuneiform.

The modification presented herein was designed to improve the results at the level of the medial cuneiform, and closely resembles the procedures described by Ganley, and Chang and McGlamry. In the technique, grafting at the level of the medial cuneiform can be self-limiting in terms of the amount of obtainable correction. In contrast, the callus distraction method allows for a much more predictable correction, and has the potential for a greater degree of correction.

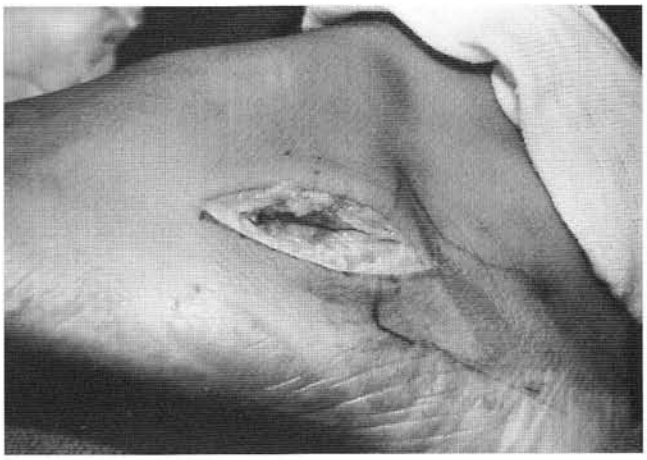

Figure 11B. Dissection identifying the deep fascia and extensor digitorum brevis muscle.

Procedure

The lateral cuboid osteotomy is performed first through a dorsolateral incision placed over the cuboid. An aggressive closing wedge osteotomy is performed with the base directed laterally and the apex directed medially. As the hinge is weakened, the osteotomy is closed and stabilized with staple fixation (Figs. 11A-11E).

Figure 11C. Closure of the osteotomy with staple fixation.

Figure 11D. Lateral oblique radiograph following cuboid osteotomy.

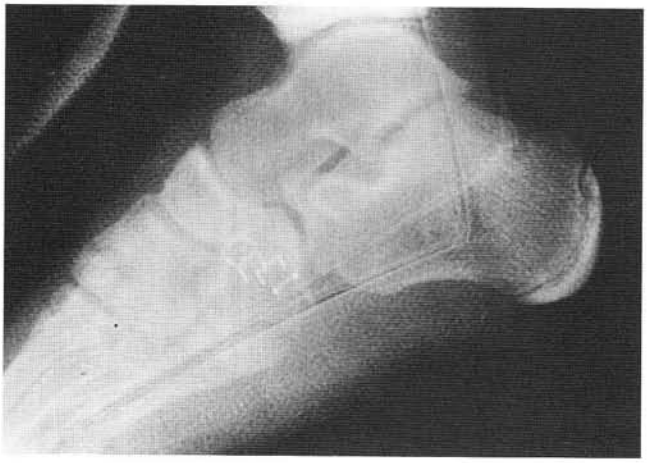

Figure 11E. Lateral radiograph demonstrating staple fixation.

Attention is then directed medially for the remainder of the procedure. A 6 cm incision is made over the superiomedial aspect of the navicular-cuneiform-metatarsal joints. As the dissection is continued, care should be taken to avoid the medial dorsal cutaneous nerve and the dorsalis pedis artery with its lateral perforating branch.

Obtaining adequate exposure to the medial and middle cuneiforms is paramount to executing an accurate osteotomy. Once exposed, a transverse osteotomy is then made from medial to lateral through the mid-body of the two bones. The pins for the external fixator can then be inserted from medial to lateral. Distal to the osteotomy cut, one pin is placed in the cuneiforms and a second pin in the first and second metatarsal bones. The proximal pins are placed in the cuneiforms and occasionally in the navicular (Fig. 12). Following final closure, the external frame is placed over the pins and secured.

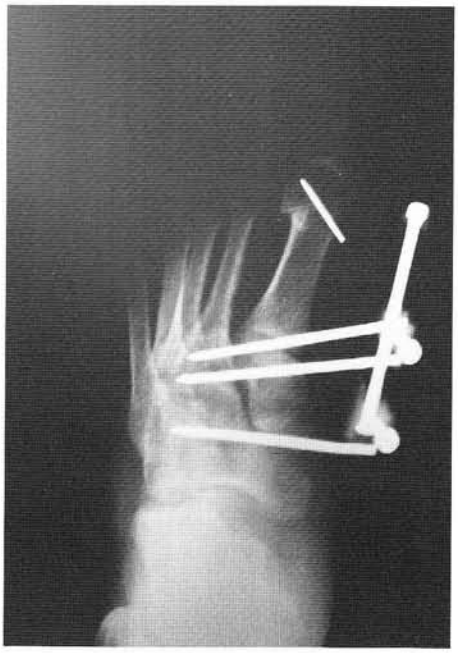

Figure 12. Proper pin placement following medial osteotomy, with two pins distal to, and two pins proximal to the osteotomy.

The patient is kept non-weight bearing with cast protection during the initial postoperative period.

After a 7-day latency period, distraction is started using the same cycle as described earlier for the calcaneal osteotomy. The distraction process is continued until satisfactory correction is observed both clinically and radiographically. Rarely is the process continued longer than 3 weeks. Once the desired correction is obtained, the fixator is kept in place for three additional weeks to allow for bone remodeling. Once the fixator and pins are removed, the patient is slowly returned to weight bearing and normal activity.

Results

The procedure has been performed on four patients at the time of this writing. The early results have been encouraging. Correction has been excellent in all cases, and minimal complications have been encountered. The use of callus distraction is impressive in its ability to address this complex deformity with minimal complications (Figs. 13A, 13B).

Figure 13A. Preoperative dorsoplantar radiograph demonstrating significant forefoot adduction with a positive talo-first metatarsal angle.

Figure 13B. Postoperative dorsoplantar radiograph following correction, demonstrating a negative talo-first metatarsal angle.

REFERENCES

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