CHAPTER **41**

TREPHINE ARTHRODESIS OF THE FOOT AND ANKLE

Alan S. Banks, DPM

In most instances when performing an arthrodesis of the lower extremity some change in the position or alignment of the part is required in addition to the fusion itself. Realignment of the part is often facilitated totally or in part by the means of joint resection that is undertaken. However, there are circumstances where joints are fused, but the alignment of the foot is suitable preoperatively. The problem is not the position of the foot or ankle, but arthrosis, pain, or instability. In these circumstances the surgeon may find that trephine arthrodesis is a simple technique which affords fusion, but with a lesser degree of tissue disruption. A number of joints within the foot are well suited to this technique and successful results have been reported when trephine fusion is performed in almost any joint of the foot and ankle. This author has found that midfoot fusions are the easiest anatomic site for the application of this technique, although trephine or dowel fusion is not necessarily confined to this area.

HISTORICAL REVIEW

Surprising to many, trephine arthrodesis has been used successfully by a variety of other surgeons for years. Successful fusion has been reported in the midfoot, subtalar joint, talonavicular joint, with triple arthrodesis, and with ankle arthrodesis. Some surgeons have simply created the trephine and rotated the internal segment 90 degrees without supplemental graft. This leaves the cartilage of the joint surface intact and within the confines of the segment through which one hopes to achieve fusion. This segment may not possess a tight "fit" as the bone is compressed slightly by the trephine instrument itself. This approach is not recommended by the author because bone grafting provides a complete bone segment that will incorporate with later fusion without cartilage elements. Furthermore, the recipient site can be filled with sufficient bone to ensure good apposition between the graft-host interface.

When graft has been used most other authors have exclusively employed bone from the iliac crest. However, this form of fusion works well with bone harvested from the calcaneus or with freeze-dried allogenic bone. A number of surgeons have not employed any type of fixation, but some authors have noted that fixation does enhance the success of the surgery in patients undergoing arthrodesis of the talonavicular joint. As a whole, nonunion rates have been low when fixation has been used, regardless of whether or not the trephine is replaced with graft.

Surgical Approach

In many cases where trephine fusion is performed, full exposure of the joint is not required. Preservation of the joint ligaments may provide an additional level of stability, although this is not necessary to achieve good results. When performing an arthrodesis of one of the midfoot joints the author will generally identify the joint with a small puncture through the exposed ligaments, preserving the remainder of the joint structures. At this stage a cylindrical segment is removed from the joint encompassing both the proximal and distal segments of bone on either side of the joint. The cylinder needs to be sufficiently large so as to provide a good surface area for healing of the graft and to adequately stabilize the joint once fusion is complete. In some instances, removing two smaller cylinders of bone may prove as effective as using one large cylindrical resection.

Once the bone has been removed, the defect is filled with graft. The author has used freeze-dried bone graft with success for most of the patients undergoing the procedure. This is a distinct difference from the experiences of earlier surgeons who have exclusively used autogenous bone. If a single joint is to undergo fusion, then bone graft may be harvested from the calcaneus. If additional autogenous material is deemed to be needed, then one may consider the distal tibia as an alternative site. Larger amounts of bone may be available from the iliac crest, but once again, most of these concerns have been eliminated with the availability of allogenic bone. The rate of fusion at this institution has been good with allogenic material.

The defect may be filled with segments of cancellous bone chips that are packed into the site. However, the author has found that the procedure works easily and efficiently when using graduated size trephines. Hand trephines of this nature are available from K-Medic, and have been termed "plug cutters". These come in sizes that are well suited to this type of procedure. Furthermore, the trephines are constructed of a very thin metal to reduce

the amount of bone displacement with use. In addition, power trephines are also available, and may be a good choice when surgery is performed in the ankle or subtalar area, or when iliac crest bone will serve as the donor graft.

The cylinder of bone is resected from the joint and the bone graft is then cut with the next larger size trephine. This has been designed to provide for a good tight fit of the graft in the recipient site. If using bone chips, one would like for the recipient site to become slightly expanded by the graft material so that once the fixation is applied a greater degree of compression will be exerted across the arthrodesis site. The graft is packed firmly with a mallet and the trocar of the trephine device prior to the insertion of the fixation.

Any form of fixation may be employed, but the author prefers the use of staples when feasible. The staple can typically span the confines of the joint and graft without impinging upon either of these two structures. The Uniclip staple devices work very well in the midfoot and allow the surgeon to add another element of compression across the surgical site.

One technical point should be mentioned at this stage. Ideally, one should attempt to avoid resecting the trephine through the opposite cortex of bone. Leaving the opposite cortex intact provides a defined closed space to receive the bone graft. If the trephine penetrates through the opposite cortex then the graft will tend to extrude once it is inserted.

Specific Applications

The author has found the trephine technique to be very effective in LisFranc arthrodesis. These joints are smaller, and particularly in the central rays, good stability is afforded by the adjacent articulations. Easy access is achieved through a dorsal approach for the bone removal and for staple fixation. In addition, this is an area where fusion is frequently required, yet without requisite repositioning of the metatarsals. The first metatarsal can be approached through either a dorsal or medial incision.

Another indication for trephine arthrodesis is when a patient is undergoing multiple joint fusions. In some individuals, both a naviculocuneiform and first metatarsocuneiform joint fusion may be required to address arthrosis or provide medial column stability. Once joint resection has been performed, this may result in a fair degree of shortening of the medial column if graft material is not employed. An alternative is to perform a trephine arthrodesis at one or both of these joints to maintain greater length to the medial column. This is particularly helpful if the first metatarsal is short preoperatively.

Trephine arthrodesis has also been described for use in rearfoot stabilization. However, in rearfoot fusions joint positioning and realignment is more frequently required than not. Therefore, use of this technique may be more limited in this anatomic area. Interestingly, the Gallie subtalar joint fusion was originally described as a block resection from the posterior facet with graft replacement, similar to a dowel fusion. The author has found this technique useful in several specific situations. The first would be in a patient where an ankle and subtalar arthrodesis is required. In this circumstance the ankle dissection proceeds as is usual, but the dissection around the subtalar joint can be significantly reduced when trephine fusion is performed at this level. Correction of deformity can be achieved at the ankle, and dissection through the sinus tarsi can be minimized to preserve some of the blood supply to the talus. The cylindrical removal of bone is performed from the lateral process of the talus medially and slightly posterior through the posterior facet of the subtalar joint.

Trephine fusion may also be employed in patients with subtalar joint coalitions. In this circumstance the resection of the osseous bridge may prove a somewhat arduous task. This can be completely avoided by performing a dowel fusion. The author has also used trephine fusion in one patient for an ankle arthrodesis. This has been described by other authors as well, notably in patients with rheumatoid arthritis.

Disadvantages

Perhaps the only disadvantage of trephine arthrodesis is the difficulty in assessing the status of the fusion following surgery. As the confines of the joint margins are largely preserved, the typical signs of arthrodesis, bridging across the fusion site, are more difficult to assess. Therefore, the surgeon may allow the patient to begin the initial weight bearing in many instances without definitive radiographic evidence of fusion. Fortunately, nonunion has not been an issue in the patients where this techinque has been employed thus far.

Figure 1. Preoperative radiograph of a patient with degenerative arthrosis.

Figure 2. Preoperative lateral view of a patient with degenerative arthrosis.

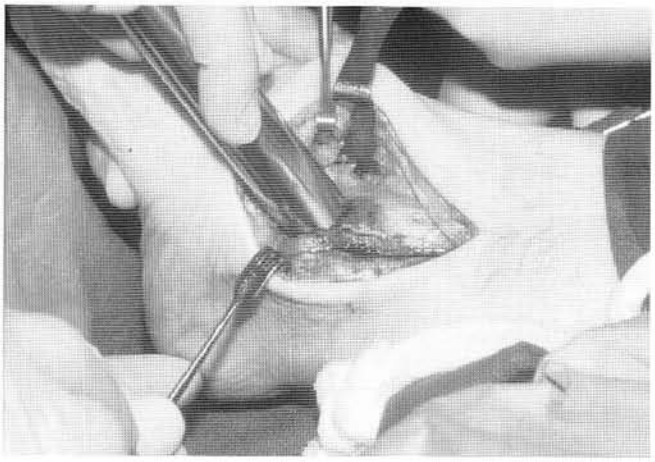

Figure 3. Use of the large "plug cutter" to create the deficit in the tibiotalar articulation.

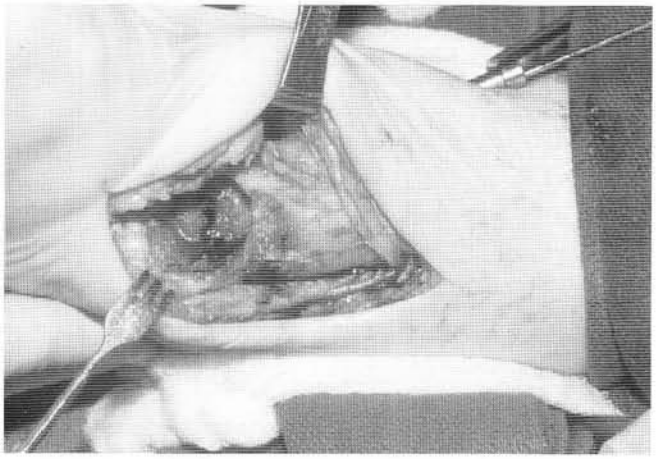

Figure 4. Completed resection of bone.

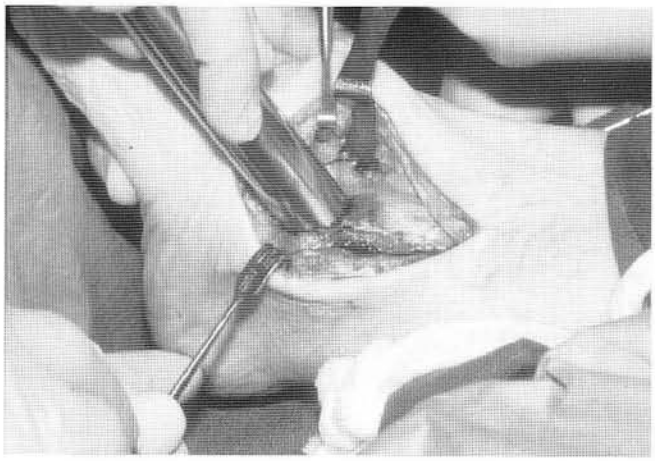

Figure 5. Allogenic bone graft from the calcaneal tuber is ideal for use in trephine fusion. This is available from LifeLink Tissue Bank, Tampa, FL.

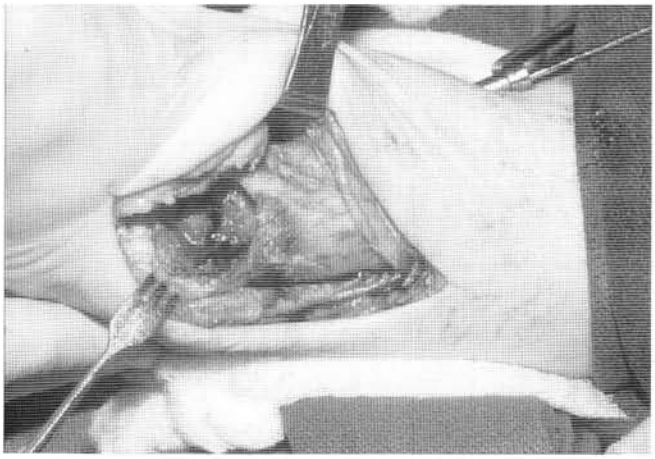

Figure 6. The next largest size trephine is used to obtain the "plug" for the recipient site.

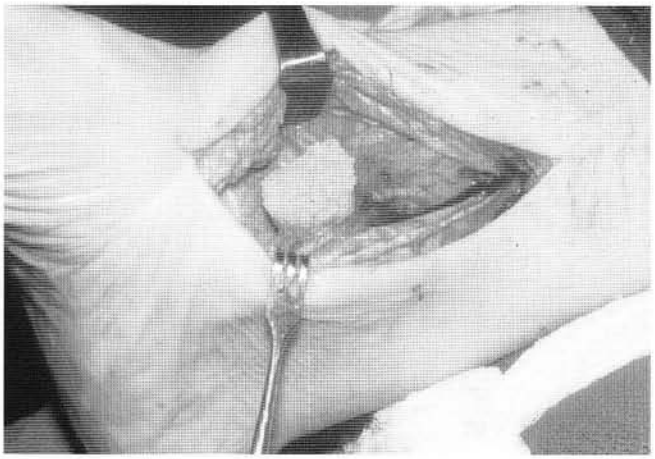

Figure 7. Insertion of the dowel graft. This will be packed into the recipient site with the trocar.

Figure 8. Lateral trephine for the subtalar fusion.

Figure 9. Radiographic appearance after fusion.

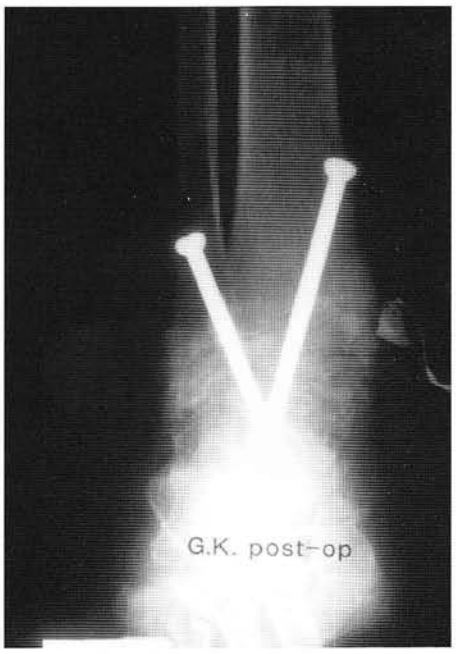

Figure 10. Lateral radiographic view after fusion.

BIBLIOGRAPHY

Belt EA, Maenpaa H, Lehto MU. Outcome of ankle arthrodesis performed by dowel technique in patients with rheumatic disease. *Foot Ankle Int 2001*;22:666-9.

Cracchiolo A 3rd, Pearson S, Kitaoka H, Grace D. Hindfoot arthrodesis in adults utilizing a dowel graft technique. *Clin Orthop* 1990;257:193-203.

Johnson JE, Johnson KA. Dowel arthrodesis for degenerative arthritis of the tarsometatarsal (Lisfranc) joints. *Foot Ankle* 1986;6:243-53.

Ljung P, Kaij J, Knutson K, Pettersson H, Rydholm U. Talonavicular arthrodesis in the rheumatoid foot. *Foot Ankle* 1992;13:313-6.

Park DS, Schram AJ, Stone NM. Isolated lateral tarsometatarsal joint arthrodesis: a case report. *J Foot Ankle Surg* 2000;39:239-43.

Peterson HA. Dowel bone graft technique for triple arthrodesis in talocalcaneal coalition report of a case with 12 year follow up. *Foot Ankle* 1989;9:201-3.

Pirani SP, Tredwell SJ, Beauchamp RD. Extraarticular subtalar arthrodesis: the dowel method. *J Pediatr Orthop* 1990;10:244-7.

Stranks GJ, Cecil T, Jeffery IT. Anterior ankle arthrodesis with cross screw fixation. A dowel graft method used in 20 cases. *J Bone Joint Surg Br* 1994;76:943-6.

Teasdall RD, Johnson KA, Hickman ML. The Rochester bone trephine for small joint arthrodesis in the foot. *Foot Ankle* 1993;14:418-23.

Thoren K, Ljung P, Pettersson H, Rydholm U, Aspenberg P. Comparison of talonavicular dowel arthrodesis utilizing autogenous bone versus defatted bank bone. *Foot Ankle* 1993;14:125-8.