ANKLE AND PANTALAR FUSION

Kieran T. Mahan, D.P.M.

Ankle fusion has been a useful procedure for over a century. There have been numerous techniques and variations that have been previously described. The procedure can be an exceptionally rewarding one in those instances where there is severe pain and deformity.

Indications

As with all fusion procedures, fusion of the ankle joint, or pantalar is primarily indicated where there is severe pain or deformity. At one time, patients with poliomyelitis and dropfoot were the most common patients to have ankle fusion performed. Because of the success in treatment of polio, the most common indication now is post-traumatic arthrosis of the ankle joint following improper management of ankle fractures. It has been well demonstrated by many authors that a small shift in the lateral malleolus produces an incongruity of the ankle joint which results in progressive deterioration of the joint.

Another indication for ankle fusion is neuromuscular disease. This can include deformity following nerve injury, compartment syndrome, myelodysplasia, or other types of paralytic deformities. In paralytic deformities it is more common to perform pantalar fusion rather than ankle fusion alone. The foot that is both insensitive and paralytic is, however, more difficult to treat because of a higher incidence of nonunion.

Ankle fusion can also be indicated following disruption of either side of the ankle joint. An example of this is seen in avascular necrosis of the talus and in severe tumors of either side of the ankle joint. Rheumatoid arthritis can also be an indication for ankle fusion because of the severe destruction of the joint. These types of patients present other problems because of their associated local problems of osteoporosis vasculitis and mononeuritis multiplex.

Preoperative Evaluation

In selecting patients for ankle fusion, we have learned over the years that it is important to insure that these patients have had a very thorough trial of conservative therapy prior to performing the fusion. Because the procedure is so definitive in nature, the extensive trial of conservative therapy reassures the patient that the physician has done everything possible prior to performing arthrodesis. In particular, it should be emphasized to patients that the procedure will not allow them to walk normally but that it will be reasonable to expect a significant reduction in pain, a decrease in deformity, and an increase in activity. More specifically, some indications that should be documented include daily pain, significant limitation of activity, or the desire to improve gait.

In addition, it is important to evaluate the surrounding joints prior to ankle fusion. This is important for two reasons. First of all, when any one joint is arthrodesed, surrounding joints will be affected by distribution of forces to those surrounding joints. In this particular case, it is critical to evaluate the subtalar, midtarsal, and Lisfranc's joints preoperatively. If there is any significant deterioration of the subtalar joint preoperatively, then the performance of an ankle fusion will result in a sudden increase in both pain and arthrosis of the subtalar joint as the joint becomes increasingly loaded. Second, it is important to evaluate surrounding joints because of the need to understand the proper position for fusion. In a patient with a severe tibial deformity, this must be accommodated for at the ankle joint at the time of fusion.

One way of evaluating these patients preoperatively is to do selective nerve blocks to determine where the area of most pain is in the foot. This helps to determine whether or not arthrosis in the subtalar or midtarsal areas is symptomatic in character.

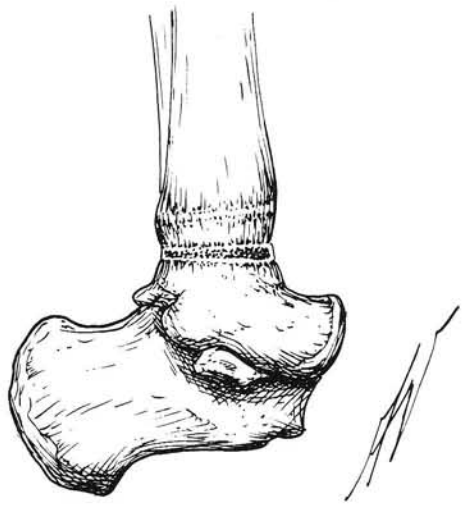

Fig. 1. Chuinard-type distraction-compression fusion with bone graft. Note preservation of distal tibial epiphyseal plate.

Because the ankle joint is usually fused at a right angle to the leg, compensation for heel height usually comes from plantar flexion of the midtarsal and tarsometatarsal joints. Therefore, available range of motion of these joints preoperatively is viewed as a positive indicator for success.

Techniques for Fusion

There are a number of different techniques which have been described in the literature. These can be broken down into several categories:

1. The simplest technique involves denuding the articular cartilage of the talus and tibial surfaces, with or without the use of bone grafts (Fig. 1).
2. Anterior arthrodesis with use of an inlay bone graft across the ankle joint (Figs. 2, 3).
3. Dowel or Trephine technique for arthrodesis.
4. Compression arthrodesis with internal or external fixation.
5. Cartilage denuding, combined with malleolar osteotomies (Fig. 4, 5).
6. Other miscellaneous techniques.

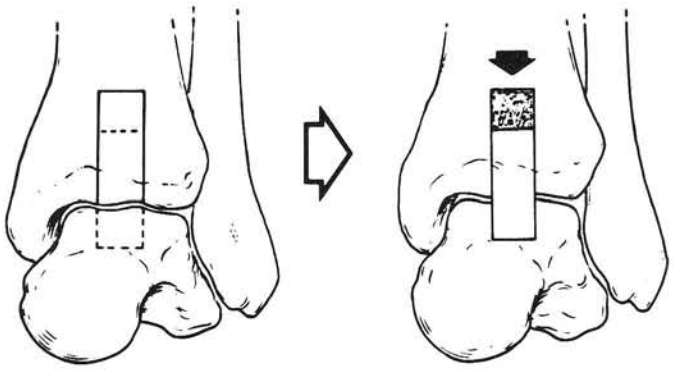

Fig. 2. Sliding inlay graft from tibia as described by Soren (1968) for ankle fusion.

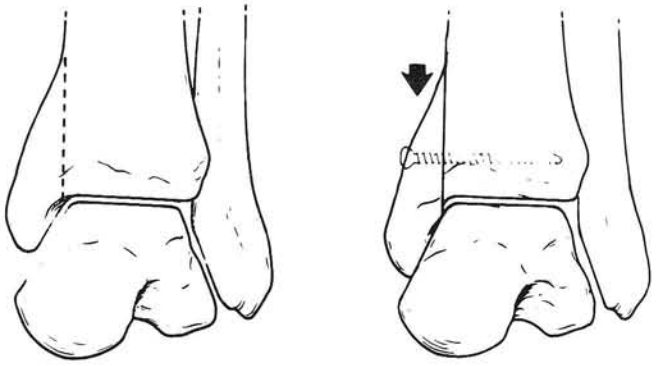

Fig. 4. Glissan's technique (1949) for fusion included medial malleolar osteotomy for exposure of joint and for use as onlay graft.

Obviously, a wide variety of procedures have been described with innumerable variations of each procedure. It can safely be said that currently, compression arthrodesis with or without the use of bone graft is most commonly indicated. It can also be stated that the transverse anterior approach once advocated by Charnley is no longer performed because of trauma to the neurovascular bundle.

Specific surgical approaches have ranged from the Charnley transverse anterior incision which violated the anterior neurovascular bundle, to medial or lateral approaches. The lateral approach is combined with a fibular osteotomy which then provides excellent exposure to all areas of the ankle with the exception of the medial malleolus. It is important for the experienced surgeon to be familiar with the variety of different procedures available,

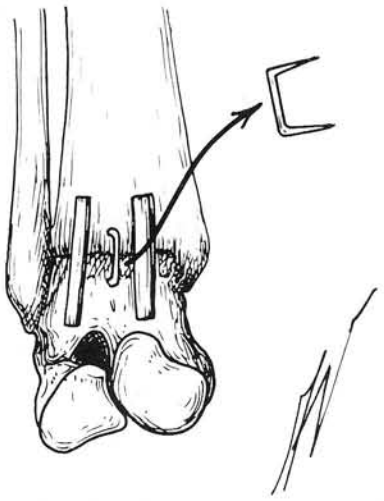

Fig. 3. Modified Gallie fusion with joint resection, inlay grafts, and staple fixation, as described by Kennedy.

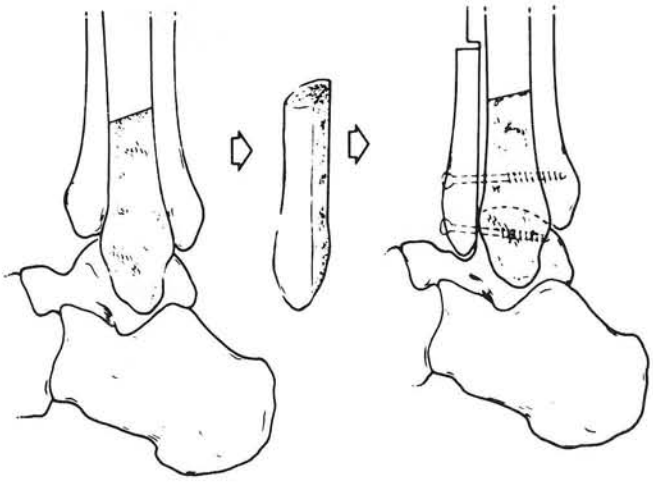

Fig. 5. Bi-hemi-malleolar onlay grafts as described by Wilson (1969) for ankle fusion.

because in any given patient a particular procedure may have a significant advantage in terms of exposure available. Frequently, these patients may have some disorder of the overlying skin which may prohibit an approach from one region or another.

Internal Fixation Technique

The technique of internal fixation for ankle fusions has evolved at The Podiatry Institute over many years with contributions from many surgeons. Periodic retrospective studies have assisted in the modifications to procedures. We are currently involved with updating the retrospective study. There are several advantages to internal fixation which include patient acceptance, resistance to rotary stress, and the avoidance of pintract infections.

The technique utilizes internal fixation and a lateral approach (Fig. 6). The incision is placed over the lateral aspect of the fibula and curved anteriorly over the lateral surface of the talus. Dissection is carried down to the periosteum overlying the fibula and then subperiostial dissection is carried out across the anterior aspect of the ankle. The fibula is then osteotomized transversely and reflected. The distal attachments of the fibula such as the calcaneofibular ligament are generally left intact. The articular cartilage is then resected from the tibia and the talus. The articular cartilage of the talus is removed first with power instrumentation after visualizing the ankle and the desired position of fusion. The cartilage of the tibial plafond is then removed by a combination of power and hand instrumentation.

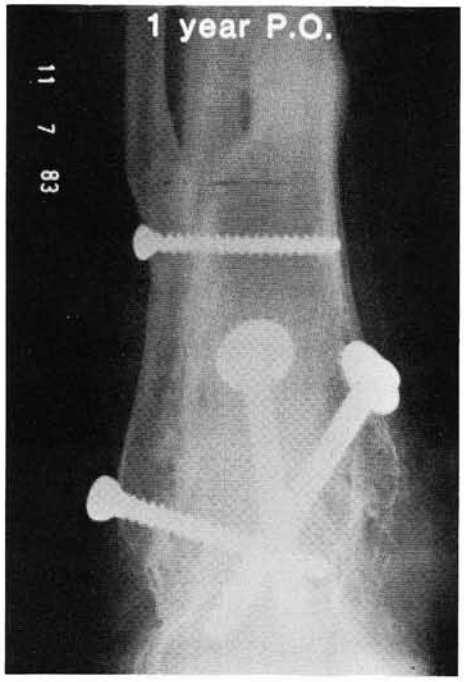

Fig. 6. AP view of ankle fusion one year postoperative. Note use of washers.

Additional wedging may then be necessary as well as removal of cartilage off of the medial side of the fibula and lateral side of the medial malleolus. The removal of medial malleolar cartilage is done through an ancillary medial incision. Once the ankle appears to be in the desired position of the fusion, it is temporarily stabilized with pins and an intraoperative x-ray is taken. If the position is satisfactory, the ankle joint is fixated with two crossing 6.5 mm cancellous screws.

It is critical to note the role of the intraoperative x-ray in ankle fusion. Because of the definitive nature of the procedure and the very small tolerance for error, the position of the ankle joint must be confirmed by intraoperative radiographs prior to permanent fixation. An additional technique which has proven useful is to perform the drill holes for the crossing lag screws prior to the intraoperative x-ray. The drill bit can be left in one of the holes and the depth gauge left in the other. This technique allows visualization of where the final screws will be positioned and may cause the surgeon to modify the angulation of the screws somewhat. This is particularly helpful in checking the depth of the holes to insure that the subtalar joint has not been violated. An accessory medial incision is usually required for insertion of the medial screw as well as access to the medial malleolus. The fibula is generally utilized as a bone graft and fixated to the tibia with a 4.5 mm cortical screw. In our experience, the osteotomized fibula need not be repaired.

The concept behind the crossing position of the two heavy screws is to cancel out any theoretical shift caused by the oblique angulation of the screws. The medial screw begins above the medial malleolus and is positioned to angle in an anterior direction. The lateral screw begins on the anterolateral aspect of the tibia and is positioned to angulate in a posterior direction. There are other acceptable variations for screw placement.

Once permanent fixation is accomplished, additional intraoperative x-rays are performed to confirm proper position. At this time, layered closure is accomplished over closed suction drainage. A compression cast is then used for three to four days prior to application of a fiberglass cast. The procedure is generally performed under thigh tourniquet hemostasis but the tourniquet is released prior to closure.

External Fixation Technique

Although the use of the internal fixation technique has proven very successful in our hands, the most common technique involves utilization of external fixation devices. There are several devices available for achieving external compression fixation. The use of external fixation is perfectly acceptable. Generally, external fixators are utilized for six to ten weeks followed by another month of casting.

Fixators are then generally removed under either heavy sedation or more commonly, general anesthesia. As with all pin sites meticulous care is critical in order to prevent pin tract infections. External fixator devices have been demonstrated to generate significant static interfragmentary compression. With use of external fixation devices, the compression can be adjusted during the postoperative period.

It is important to recognize that fixation is only one element of any procedure. The technique that is utilized in any given situation will depend on the surgeon's skill, the requirements of the particular operation, and the patient's psychological and physical makeup. Many patients find external fixators to be unacceptable, particularly the larger devices. Internal fixation on the other hand is more easily tolerated by patients because they do not have to see the hardware. In addition, although external fixators are capable of producing a great deal of interfragmentary compression, they do lack rotary stability, as has been demonstrated by Scranton. Consequently, they are not superior to internal fixation techniques on the basis of fixation properties.

Follow-up Care

A combination of above and below knee casting is used for ten to sixteen weeks. Numerous follow-up studies have been performed on the variety of techniques available. These indicate roughly comparable fusion rates.

Pantalar Fusion

The technique for pantalar fusion is similar to that described for the ankle fusion with some additions. The incisional approach is carried distally to the base of the fourth metatarsal. The medial incision now becomes mandatory and extends from the medial malleolus across the medial side of the talus and extends distally to the first cuneiform. The ankle and subtalar joints may be fixed by two long screws traversing both the ankle and subtalar joints or they may be fixed separately.

Pantalar fusion is most often indicated when there is degeneration of the subtalar joint or severe deformity of the rearfoot along with the ankle. The procedure is usually performed in one stage. An interesting variation is that described by Lorthioir and Hunt and Thompson who performed pantalar fusion by temporarily extirpating the talus, denuding it of cartilage and soft tissues and replacing it in position as a free bone graft. This technique has the advantage of creating somewhat less shortening by less bone removal in order to create congruous surfaces. It is also clear that there is somewhat greater stripping of blood supply utilizing this technique although it does not appear to be a problem in the sensitive foot. However, in the insensitive foot, this technique is associated with a higher incidence of nonunion.

Summary

Based on the experience of numerous authors as well as of our own study, several points become obvious. The ankle should be fused in a position 0 to 5 degrees of plantarflexion for both men and women. The ankle should also be fused in a neutral position in the frontal plane. Although there is some controversy in the literature concerning the extent of tarsal hypermobility after ankle fusion, it is probable that some compensation does come from plantar flexion at the mid tarsal and tarsometatarsal joints. It is also clear that a viable subtalar joint and normal contralateral foot and ankle are important determinants for a functional gait cycle postoperatively. In our own study, several things have become clear. We have found that the patients with the highest level of subjective satisfaction postoperatively, were those patients who had the longest degree of conservative care preoperatively. We have also determined that previous efforts to repair the fibular osteotomy are neither successful nor worthwhile. Consequently, the fibular osteotomy is no longer repaired and the fibula is simply secured directly to the tibia and talus as a bone graft. We have found a particularly low incidence of soft tissue problems in our own series. We relate this to the use of proper hemostasis and layered dissection techniques as is used in other areas of foot and ankle reconstructive surgery. In terms of pantalar fusions, two factors are quite important:

1. The knee must be stable.
2. The procedure should be avoided in the insensitive foot wherever possible.

Complications of ankle and pantalar fusion include nonunion, infection, malposition, and delayed wound healing. In our own series, these complications have been significantly less than reported in the literature. However, it is clear that this is a major surgery and that patients must be adequately prepared preoperatively and followed for a substantial period of time postoperatively in order to achieve a successful result.

References

Ahlberg A, Henricson A: Late results of ankle fusion. *Acta Orthop Scand* 52:103-105, 1981.

Horwitz T: The use of the transfibular approach in arthrodesis of the ankle joint. *Am J Surg* 60:550-552, 1942.

Hunt WS, Thompson HA: Pantalar arthrodesis: a one-stage operation. *J Bone Joint Surg* 36A:349-360, 1954.

Jackson A: Tarsal hypermobility after ankle fusion—fact or fiction. *J Bone Joint Surg* 61B:470-473, 1979.

King H, Watkins T, Samuelson K: Analysis of foot position in ankle arthrodesis and its influence on gait. *Foot Ankle* 1:44-49, 1980.

Lorthioir J: Huit ras d'arthrodese du pied avec extirpation temporaire de l'astragala. *Annals Societe Belge Chir* 11:184-187, 1911.

Mahan K: Wound healing in the rheumatoid patient. In McGlamry ED, McGlamry R (eds): *Categoric Foot Rehabilitation, Fourteenth Annual Surgical Seminar.* Atlanta, Doctors Hospital Podiatric Education and Research Institute, 1985, pp 71-73.

Mahan KT: Ankle and pantalar fusion. In McGlamry ED (ed): *Comprehensive Textbook of Foot Surgery,* vol I. Baltimore, Williams & Wilkins, 1987, pp 519-533.

Mahan KT, Yu GV: Ankle and pantalar fusion. In McGlamry ED, McGlamry R (eds): *Comprehensive Conference in Foot Surgery, Thirteenth Annual Surgical Seminar.* Atlanta, Doctors Hospital Podiatric Education and Research Institute, 1984, pp 49-51.

Scranton PE, Fu FH, Brown T: Ankle arthrodesis: a comparative clinical and biomechanical evaluation. *Clin Orthop* 151:234-243, 1980.