CHAPTER 4

ANKLE AND PANTALAR ARTHRODESIS: A Review of Forty-Two Cases and the Podiatry Institute Technique for Internal Fixation

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There are a wide variety of ankle fusion techniques available. Most of these have in common the removal of articular cartilage between the talus and the tibia, and some form of stabilization is employed. Although artificial joint implants have been described for the ankle, arthrodesis remains the primary procedure for severe joint destruction of the talotibial articulation.

Arthrodesis of the ankle is primarily indicated in patients with severe pain or deformity. Commonly, this occurs from either post-traumatic arthrosis, or a variety of neurological conditions. Post-traumatic joint destruction occurs following failure to adequately reduce a malleolar or a pilon-type fracture. In particular, shortening of the fibula and lateral shifting of the talus can result in a loss of talotibial congruency that can lead to post-traumatic arthritis. Neurological conditions are also common indications for ankle fusion. Even today, patients can be seen with post-polio conditions that require fusion in order to achieve stable ambulation. Other neuromuscular conditions that may necessitate an ankle fusion include severe deformities associated with Charcot-Marie-Tooth disease, nerve injury, deformity and paralysis following compartment syndrome, and the insensate neuropathic foot. Inflammatory arthritides can also result in severe pain or deformity, requiring arthrodesis.

The indications for an ankle or pantalar arthrodesis are severe pain, severe instability of a joint, or very severe deformity. In practice, this means that the procedure is performed on patients who have daily pain, significant limitation of activity, the desire to function free of braces, or the desire to reduce the need for specialized shoes.

PREOPERATIVE EVALUATION

A variety of techniques can be used in order to evaluate these patients preoperatively. A radiologic assessment should be performed on the joints to be fused, as well as surrounding joints, in order to determine whether or not they will be able to sustain the increased load following arthrodesis of the ankle joint. In addition, it is important to determine the alignment proximally and distally of contiguous joints. Super-structural assessment is critical in order to determine hip, knee, tibial, mid-foot, and forefoot positions, as well as the rearfoot. A comprehensive gait analysis should be performed prior to surgery as well as vascular and neurologic assessments. Successful fusion requires both significant vascularity and adequate sensation, as it has been shown that there is an increased risk of nonunion in neuropathic patients.

SURGICAL APPROACHES

There are a variety of incisional approaches that have been described for ankle fusion. Charnley described a transverse anterior approach with a skin-to-bone incision that incised the neurovascular bundle as well as the extensor tendon apparatus. This approach provided very direct and clear visualization of the anterior aspect of the ankle joint, but at a significant functional cost. The approach that will be described here is the lateral trans-malleolar approach. This generally involves a primary incision over the fibula with reflection of the distal aspect of the fibula. An ancillary medial incision is used for fixation placement and debridement of the interval between the medial malleolus and the medial aspect of the talus. Numerous other surgical approaches have been described, including a longitudinal anterior incision, a posterior incision, and an anterior bi-malleolar approach. However, the lateral approach provides excellent visibility and is most commonly used with this technique.

SURGICAL TECHNIQUES

A large number of techniques have been described for creating tibiotalar fusion. The anterior bone graft is the most common procedure described in the literature. This is described as a sliding bone graft from the tibia across the talotibial interface. It is usually combined with joint resection. Others have described malleolar osteotomies in conjunction with joint resection, utilizing the malleolus as a fixation graft across the joint. Subtotal joint fusions have been described, and of course Charnley described compression arthrodesis. He initially described it as having two primary purposes: to eliminate all shearing strains, and to eliminate any gap between the talotibial surface. Until approximately ten years ago, external fixation was the most common technique for ankle arthrodesis. A variety of internal fixation techniques have now been described. Morgan et al. (1985) described a technique of crossing 6.5-mm screws into the talus, one from the medial malleolus and one from the lateral malleolus. Other internal fixation techniques that have been described include the pediatric angled blade plate, T-plate fixation, and a variety of internal screw fixation configurations.

Regardless of the technique utilized, one can see that Glissan's four requirements for a successful fusion apply: complete removal of all cartilage, fibrous tissue, and any other material that may prevent intimate contact; accurate and close-fitting of the fusion surfaces; optimal position of the ankle joint; and maintenance of the bone position in an undisturbed fashion until the fusion is complete. Most recently, two new techniques have been described for ankle fusion. The use of the Ilizarov method has been described for revisional ankle fusions, septic ankle fusions, or those with significant bone loss. Arthroscopic ankle fusion has been described which combines the use of cannulated screw internal fixation.

MATERIALS AND METHODS

This study reviewed forty-two patients who had ankle or pantalar arthrodesis surgery between 1985 and 1990. A total of thirteen pantalar arthrodesis surgeries, and twenty-nine ankle fusions were performed. The average follow-up period of time was 7.5 years. Internal screw fixation was used on thirty-five patients, and seven patients had either external fixation or Steinmann pin fixation.

PODIATRY INSTITUTE ANKLE FUSION TECHNIQUE

The standard surgical approach for the Podiatry Institute Technique involves a primary lateral incision and ancillary medial incision. The incision is carried down through the superficial fascia to the level of the deep fascia and periosteum. A deep incision is made and sub-periosteal dissection is carried out across the fibula and over the anterior aspect of the tibia. The ankle joint is exposed through a transfibular approach. A through-and-through transection osteotomy is performed 5–8 centimeters proximal to the ankle joint. A portion of the fibula may be removed proximally. The distal fibula can then be retracted inferiorly or posteriorly, or it can be removed for later re-introduction as an onlay graft. This provides excellent exposure to the ankle joint.

The articular cartilage of the talus and the tibia are then removed in a parallel fashion. Any wedging of bone is done at the level of the tibia. The ankle joint is placed at a right angle. Care is taken not to displace the talus anteriorly on the tibia, because this will create a longer lever arm for the foot. Adequate external rotation must also be insured prior to introduction of temporary fixation.

Temporary fixation can either be accomplished with two large Kirschner wires, or more commonly combined with the use of cannulated screw fixation. The procedure, as originally described, utilized two 6.5-mm cancellous bone screws crossing from the medial and lateral aspects of the tibia into the talus. Great care is taken not to cross the subtalar joint. Intraoperative radiographs or fluroscopic imaging can then be performed to insure adequate bone-to-bone contact and good alignment of the fusion site, as well as the temporary fixation. The final fixation is applied, and again, radiographs can be obtained to confirm alignment and fixation. The fibula can then be applied as an onlay graft, either in total, or as a longitudinal hemi-section. This can be applied to the tibia and the talus with 4.0-mm cannulated screws or with 4.5-mm malleolar screws. Closure is performed over one or two closed-suction drains. Postoperative care consists of an above knee cast

for 4–6 weeks, and an additional period of below-knee casting, usually bringing the total casting time to 3–4 months. If a pantalar arthrodesis is to be performed, then the midtarsal joints can be either fixated with staples, Steinmann pins, or 6.5-mm screws. The subtalar joint is commonly stabilized with a 6.5-mm screw.

RESULTS

The average age of these patients was forty-three years, and there were twenty men and twenty-two women. Twenty procedures were performed on the left and twenty-two on the right extremity. The most common indications for surgery were post-traumatic arthritis and neurological conditions. Most patients had the surgery performed due to severe pain. There were very few soft tissue complications and no postoperative infections. There was an interesting variety of bone complications. Initially, the fibular osteotomy was repaired using one or two screws. This proved to be inadequate, and became a source of pain to some patients. With the fibular osteotomy excluded, the overall nonunion rate was slightly less than 12%, with an ankle fusion nonunion rate of 3 1/2%. Another interesting complication was tibial fractures, which occurred in two patients. In both patients the fracture occurred at full weight bearing; one at six months and the other at three years postoperative. Approximately 50% of the patients responded to a questionnaire. They reported nearly seven years of complaints before their surgery. Overall, 75% of the patients were pleased with the surgery. The average improvement reported by the patients was slightly less than 7 on a scale of 0-10. Fifteen of the twenty patients who responded were either satisfied, or very satisfied with their overall result, and seventeen patients would recommend the procedure to a friend with a similar problem.

DISCUSSION

The results of this study encouraged the Podiatry Institute faculty to change several aspects of this procedure. The fibular osteotomy is no longer directly repaired. The fibula is either screwed directly onto the tibia as an onlay graft, or discarded. This has effectively eliminated the fibula as a source of nonunion or pain. In addition, because of the complication of tibial fractures, the technique has been modified in some instances so that one screw is placed from the lateral process of the talus into the medial aspect of the tibia. This reduces the risk of creating a stress riser in the tibia which is caused by two screws originating in the same plane. In addition, the author has begun utilizing a calcaneal donor bone graft as an inlay graft anteriorly across the talotibial interface. In the author's experience with six cases not reported in this series of fusions, the graft has responded quickly with consolidation. Lastly, the casting technique has been changed. The initial cast is now usually an above-knee cast as opposed to a below-knee cast. The casting time has been increased from 3 months to generally around 4 months. Mechanical testing of a variety of ankle arthrodesis alternatives is currently being performed at the Pennsylvania College of Podiatric Medicine in conjunction with Howard Hillstrom, Ph.D.

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