CALCANEAL BONE GRAFTS

Kieran T. Mahan, DPM

INTRODUCTION

Bone grafts are used for a variety of purposes including replacement of osseous defects, lengthening procedures, and stimulation of non-unions. There are a variety of bone graft materials that can be chosen, but the most common materials are either freeze-dried allogeneic bone or autogenous bone. Freeze-dried allogeneic bone has the advantage of being readily available and has proven to be very useful in Evans calcaneal osteotomies as well as other calcaneal osteotomies. Freeze-dried bone contains no living tissue. It has bone morphogenetic protein, but does not provide any new living cells. Good results have been experienced with the use of freeze-dried allogeneic bone, with a major advantage being the fact that it does not require a donor site surgery.

Many types of surgical procedures require autogenous bone. In those situations, there are a variety of sources from which bone can be procured, including the iliac crest, the greater trochanter, the tibial metaphyseal regions, and the fibula. Each of these donor sites has specific advantages and disadvantages, however, most of these sites have a risk of significant morbidity. Iliac crest grafts provide a very good source of cortico-cancellous bone. Nonetheless there are a fair number of complications that can occur with this procedure. One study showed that 10% of the patients having an iliac crest graft still have pain in the donor site one year later. Other complications including pain, nerve entrapment and hematoma can occur. In foot surgery, many of the uses for autogenous bone require only relatively small amounts of bone. This paper will describe the use of the calcaneus bone as an alternative site for procuring autogenous bone grafts.

TECHNIQUE

The calcaneal bone graft can best be procured from the lateral side of the heel. Although the medial side of the heel is accessible as well, it is better to avoid that approach because of the presence of the tarsal canal and the medial calcaneal nerves. Resultant tarsal tunnel syndrome following a medial approach to the heel is possible. The lateral approach has its own disadvantages, primarily the possibility of entrapment of the sural nerve. The relevant anatomy also includes the small saphenous vein which is located adjacent to the peroneal tendons in the lateral calcaneal artery.

Trephine Plug

Two types of bone, a trephine plug, or a segmental graft can be procured from the calcaneus. The trephine plug is the simpler of the two techniques and requires only a 1-2 cm incision on the lateral side of the heel. The incision is planned so that the trephine plug will be taken in the body of the calcaneus, centrally located between the posterior edge of the posterior facet and the anterior edge of the insertion of the tendo achilles. Blunt dissection is used to get down onto the periosteum, which can either be left in place as a good source of new bone, or freed with a periosteal elevator. A hand trephine is then used to penetrate the calcaneus for approximately 1-2 cm. The trephine is rocked back and forth to loosen the far side of the trephine plug. The plug is then removed and a tamp is used to remove the bone plug from the trephine. Additional plugs can be procured through the same cortical entrance, supplying additional cancellous bone. Care must be taken to avoid penetration of the posterior facet or disruption of the insertion of the tendo achilles. It is also extremely important to avoid violation of the

plantar cortex of the calcaneus as this will produce a significant stress riser and likely, a fracture of the calcaneus. This approach can provide excellent cancellous bone in small quantities.

Segmental Bone Graft

The other technique available is the more open approach for a segmental bone graft. This technique requires a 4 to 6 cm incision extending approximately 1-2 cm above the superior margin of the body of the calcaneus and then extending distally along the lateral side of the calcaneus. Blunt dissection is used to carry the dissection down onto the periosteum. The sural nerve may be identified and carefully retracted.

A sharp incision is made on the lateral side of the calcaneus and a freer elevator is used to separate off the periosteum. The shape of the desired graft, approximately 1 to 1½ cm wide and 1 to 2 cm long is outlined with a marking pencil. The graft can be procured in either a proximal to distal orientation or a lateral to medial orientation, depending upon the desired shape. The corners should usually be radiused with a small K-wire. This step is particularly important if hand instrumentation is being used. A power saw is used to make the major cuts, and a small curved osteotome is used to pry the graft out of the calcaneus. Since the far wall of the graft cannot be reached with the sagittal saw, the curved osteotome is used to pry the graft away from the calcaneus. Additional bone can then be procured with a trephine or with a small hand osteotome.

The segmental type graft provides excellent cortico-cancellous bone. The author has used this technique for a slot graft in an ankle fusion, non-union repair, digital bone grafting, brachymetatarsia repair and packing of defects after removal of implants or bone cysts.

Following procurement of the graft, hemostasis is managed with a drain, bone wax, or an application of a freeze-dried bone graft. Freeze-dried bone graft is usually not necessary following removal of the autogenous calcaneal bone, unless a very large segment is removed. In that case, the freeze-dried graft helps to improve the consolidation of the donor site. Because the donor site is weakened for a period of time, the patient should remain non-weight bearing in a cast for six to twelve weeks depending upon the size of the bone graft removed.

Possible complications of calcaneal bone grafts include hematoma, fracture at the donor site, entrapment of the sural nerve, fracture of the medial cortical wall of the calcaneus, infection and peroneal tendonitis. The author has only encountered a case of brief peroneal tendonitis resulting from postoperative edema.

CONCLUSION

When evaluating the possible use of this technique for a patient, the potential complication of a calcaneal fracture with propagation into the subtalar joint must be considered. The possibility of this complication should be judiciously weighed against other options such as the use of freeze-dried bone or the use of other donor sites.

The author has experienced excellent results with the use of calcaneal bone grafts. This type of graft has proven to be most useful for small defects requiring autogenous bone.