CHAPTER **4**

PROXIMAL TIBIAL BONE GRAFT HARVEST

Justin Fleming, DPM

INTRODUCTION

The need for cancellous bone grafting is quite apparent in foot and ankle reconstruction. Despite all of the expanding technology in the field of orthobiologics, no commercially available bone graft or bioengineered graft substitutes have been proven to be superior or equal to autologous bone. Potential donor sites for graft harvest include the iliac crest, fibula, distal tibia, and calcaneus. These sites often yield inadequate quantities and are associated with donor site morbidity such as pain and secondary fracture. The author will illustrate the previously described surgical technique of bone graft harvest from the proximal tibial metaphysis and provide the authors' experience with this technique.[1,2]

INDICATIONS

The primary need for cancellous bone graft in foot and ankle reconstruction is to augment arthrodesis in addition to filling bony voids. Autologous bone is the gold standard in bone grafting and "optimizes" the environment for healing by providing both osteoconductive and osteogenic properties. Although platlet gels, bone marrow aspirates, and other technologies (BMP) have reduced the need for autologous bone, their cost is substantial and no comparison long term studies are currently available. The author began to utilize this technique when hospital administration would no longer allow for the use of orthobiologics and implantable bone stimulation because of their financial drawbacks. Specifically, the author finds the most frequent procedures performed in conjunction with proximal tibial bone graft harvest are arthrodesis procedures involving the ankle and subtalar joint in cases of post-traumatic arthritis. These injuries often leave large avascular cystic changes in the talus and more commonly in the distal tibia which require grafting (Figure 1). In addition, those cases of revisional fusions or high risk fusions (smokers, open fractures) and extended midfoot fusions (i.e., neuroarthropathy) may benefit or require supplement grafting. Contraindications include those patients with an open physis, total knee arthroplasty, or prior anterior cruciate ligament reconstruction. The graft harvested in this region in not intended to be structural in nature.

Figure 1A. Subtotal AVN of the distal tibia with cystic change secondary to post-traumatic arthritis. Sagittal plane image through prior region of AVN following bone grafting and tibio-talo-calcaneal arthrodesis.

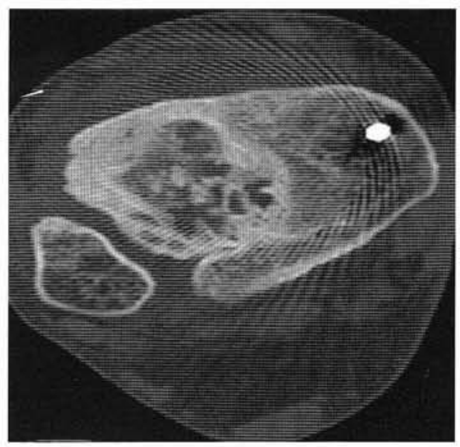

Figure 1B.

Figure 1C.

CHAPTER **4**

PROXIMAL TIBIAL BONE GRAFT HARVEST

Justin Fleming, DPM

INTRODUCTION

The need for cancellous bone grafting is quite apparent in foot and ankle reconstruction. Despite all of the expanding technology in the field of orthobiologics, no commercially available bone graft or bioengineered graft substitutes have been proven to be superior or equal to autologous bone. Potential donor sites for graft harvest include the iliac crest, fibula, distal tibia, and calcaneus. These sites often yield inadequate quantities and are associated with donor site morbidity such as pain and secondary fracture. The author will illustrate the previously described surgical technique of bone graft harvest from the proximal tibial metaphysis and provide the authors' experience with this technique.[1,2]

Figure 1A. Subtotal AVN of the distal tibia with cystic change secondary to post-traumatic arthritis. Sagittal plane image through prior region of AVN following bone grafting and tibio-talo-calcaneal arthrodesis.

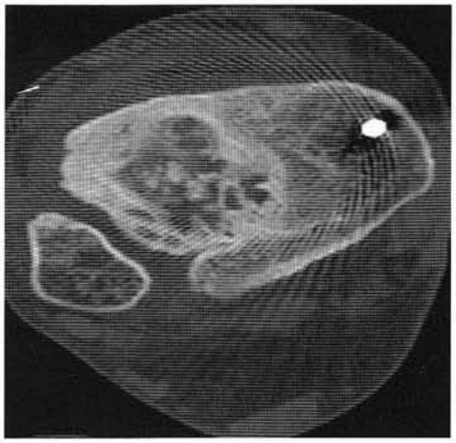

Figure 1B.

Figure 1C.

INDICATIONS

The primary need for cancellous bone graft in foot and ankle reconstruction is to augment arthrodesis in addition to filling bony voids. Autologous bone is the gold standard in bone grafting and "optimizes" the environment for healing by providing both osteoconductive and osteogenic properties. Although platlet gels, bone marrow aspirates, and other technologies (BMP) have reduced the need for autologous bone, their cost is substantial and no comparison long term studies are currently available. The author began to utilize this technique when hospital administration would no longer allow for the use of orthobiologics and implantable bone stimulation because of their financial drawbacks. Specifically, the author finds the most frequent procedures performed in conjunction with proximal tibial bone graft harvest are arthrodesis procedures involving the ankle and subtalar joint in cases of post-traumatic arthritis. These injuries often leave large avascular cystic changes in the talus and more commonly in the distal tibia which require grafting (Figure 1). In addition, those cases of revisional fusions or high risk fusions (smokers, open fractures) and extended midfoot fusions (i.e., neuroarthropathy) may benefit or require supplement grafting. Contraindications include those patients with an open physis, total knee arthroplasty, or prior anterior cruciate ligament reconstruction. The graft harvested in this region in not intended to be structural in nature.

SURGICAL TECHNIQUE

Prior to surgery, a complete radiographic analysis of the proximal tibia and knee should be obtained in addition to the studies appropriate for the index procedure. Pre-existing clinical or radiographic abnormalities in the region of harvest should be evaluated by an orthopedic surgeon or another source of bone should be identified.

The proximal tibia can usually be accessed with the patient in any position (supine, prone, lateral decubitus, etc.) and the procedure can be carried out with or without tourniquet control. If tourniquet time is not available, retraction of the soft tissues generally provides adequate hemostasis much like dissection on the plantar foot.

If the patient is obese and the typical subcutaneous landmarks are not readily palpable, fluoroscopy may be utilized and is encouraged to avoid violation of the knee joint or entrance into the diaphyseal region of the tibia. The incision is created over the lateral flare of the tibial plateau. Gerdy's tubercle, the tibial tubercle and the anterior tibial crest serve as landmarks for incision placement (Figure 2).

A 4-5cm oblique incision over the anterior compartment begins just inferior to the Gerdy's tubercle and terminates slightly distal to the inferior pole of the tibial tubercle.[2] The lateral flare of the tibia is usually palpable and is helpful in gaining orientation. There are no named neurovascular structures in this region and dissection can be carried sharply to the crural fascia overlying the anterior musculature. This fascia is incised just lateral to the tibial crest allowing adequate repair of this structure upon closure (Figure 3).

The tibialis anterior muscle belly is bluntly elevated off the lateral tibia leaving the periosteum intact. This will serve as a hinge for the cortical window. The tip of the Homann retractor is placed on the posterior aspect of the tibia and serves as the primary source of retraction. A 1.5 cm by 1 cm oval shaped cortical window is then created in the lateral metaphysis of the tibia[2] (Figure 4). A 2.0 mm drill is used to outline the window and the drill holes are connected with an osteotome. The long axis of the cortical defect is made parallel to the long axis of the tibia. The cortex is then rotated posteriorly on a periosteal hinge and graft procurement can begin. Various curved curettes are necessary to reach the medial and lateral flares of the plateau. Following graft harvest, the cortical window is returned to its position. Repair of the periosteum is not necessary. The metaphyseal defect may be filled with allograft as the surgeon desires although this is not critical. Gel foam may be placed in the access hole to decrease the incidence of hematoma. The fascia is then closed with 2-0 vicryl.

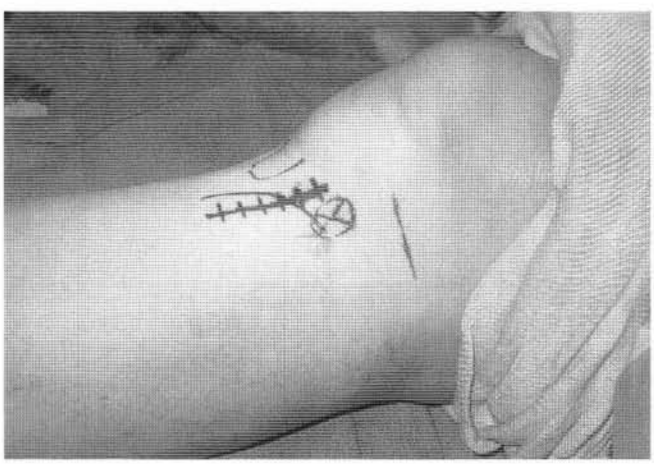

Figure 2A Typical landmarks for incision placement for graft harvest include Gerdy's tubercle (circle), the tibial tubercle and anterior tibial crest and the lateral flare of the tibial plateau. The incision is drawn with a hatched line.

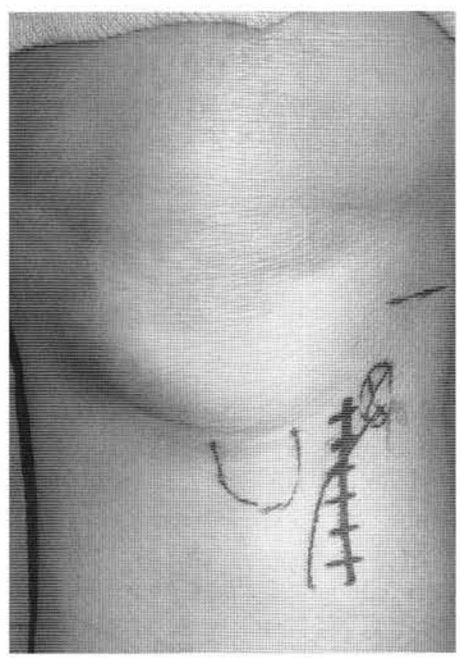

Figure 2B. Typical landmarks.

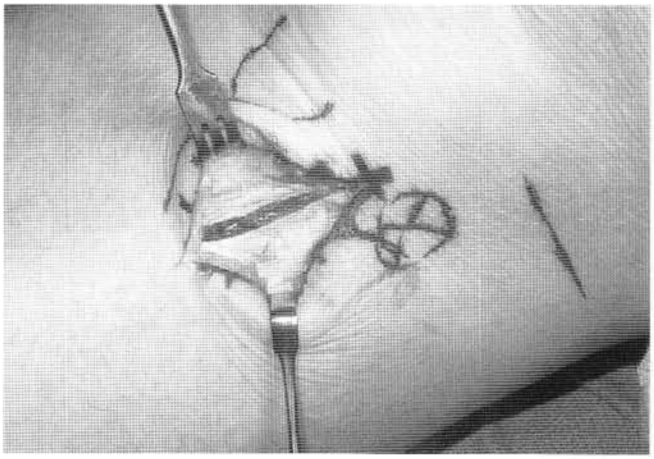

Figure 3. Fascial incision overlying the anterior compartment.

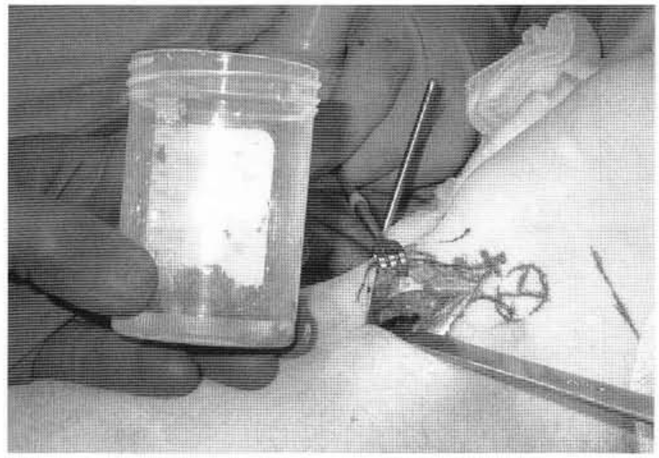

Figure 4. Picture of cortical window in the proximal tibia and cancellous graft. Approximately 20-30 cc of graft material is usually obtained.

POSTOPERATIVE MANAGEMENT

Postoperatively the wound is evaluated within the first week and the patient is encouraged to perform range of motion as tolerated. Weightbearing is dictated by the primary procedure and usually occurs between 6 and 12 weeks, although previous authors' have allowed immediate weightbearing on the extremity without documented fractures occurring through the graft site.[1] Periodic radiographs should be obtained to document healing.

COMPLICATIONS

Possible complications of this technique are similar to other techniques of bone graft harvest. Major complications include fracture, persistant dysthesias, infection, chronic pain, wound breakdown, compartment syndromes and knee instability.[1-4] A medial approach was originally advocated, however transient neuropraxias involving the saphenous nerve were identified and the recommend approach is from the lateral side as described. There are no reports of donor site fracture or intraarticular violation secondary to harvest. The latter is likely due to the thick subchondral plate of the tibial plateau (Figure 5). Minor complications and those reported most commonly (1.3%) include hematoma and incisional parathesias, which resolved prior to weightbearing.[1]

Figure 5. Fluoroscopic image of the area of graft harvest. The cortical access hole is 1 – 2 cm inferior to ideal placement. Notice the curette is unable to advance proximally secondary to the thick overlying subchondral bone plate.

CONCLUSION

While the search for an ideal bone graft substitute continues, autograft remains the best source for osteo-inductive and osteoconductive graft material. The proximal tibia provides sufficient quantity of cancellous graft for reconstructive procedures of the foot and ankle. This region can easily provide 20-30 ml of cancellous bone for the index procedure which is quite significant when compared to other potential graft sites such as the distal tibia or calcaneus. In the author's limited experience of ten cases, the procedure is well tolerated by patients and has a low risk of major complications which have been well documented. The complications that do occur seem to be rare and minor in nature (temporary incisional dysthesias). Although this technique does require additional operating time, it does not require a consulting surgeon as does the iliac crest graft. There is question as to whether or not this should be avoided in the athletic or neuropathic population as there likely is a greater potential for fracture due to high or

Figure 6. Postoperative CT scan demonstrating incomplete reestablishment of trabecular patterns in the proximal tibial metaphysis

unrecognized loads placed on the tibial plateau. Further imaging studies need to be performed documenting the neo-trabeculation which is thought to occur sometime after graft harvest. Figure 6 shows a 9 month postoperative CT scan demonstrating incomplete reestablishment of trabecular patterns in the proximal tibial metaphysis. The patient is asymptomatic and the clinical relevance of this finding is uncertain. Long term studies investigating these questions are necessary.

REFERENCES

1. O'Keefe RM Jr, Riemer BL, Butterfield SL. Harvesting of autogenous cancellous bone graft from the proximal tibial metaphysis. *J Orthop Trauma.* 1991;5:469–74.
2. Thorderson N, Early JS. Harvesting cancellous graft from the proximal tibia *Foot Ankle Surg* 2004;3:206–9.
3. Alt V, Nawab A, Seligson D. Bone grafting from the proximal tibia. *J Trauma* 1999;47:555–7.
4. Geideman WM, Brodsky JW, Early JS. Clinical results of harvesting autogenous cancellous graft from the ipsilateral proximal tibia for use in foot and ankle surgery. Presented at: American Orthopaedic Foot and Ankle Society 19th Annual Summer Meeting; Final Program 19:57; 2003.