CHAPTER 19

BONE GRAFT FROM THE DISTAL MEDIAL TIBIA IN FOOT AND ANKLE SURGERY

Tanya J. Singleton, DPM
J. M. Schuberth, DPM

INTRODUCTION

Autogenous bone graft remains the standard for use in foot and ankle surgery because of the osteogenic, osteoinductive, and osteoconductive properties with no risk of disease transmission or rejection. Both the iliac crest and proximal tibia are well-studied autogenous sources of bone graft; however these sites may require a second surgeon, additional surgical preparation, and time, which add to the cost of the overall procedure. Furthermore, there is a small but finite morbidity associated with these procedures.

The distal tibia is a viable and proximate source of autogenous bone graft for foot and ankle surgery, but it is less well studied than the aforementioned sites (1-6). In 1995, Danziger et al reported on 40 distal tibial bone grafts used in 41 arthrodesis procedures in the foot and ankle (1). They reported 100% union rate and zero complications. O'Malley and Conti reported a series of 100 cases of distal tibia bone graft used in foot and ankle arthrodesis (2). They had 13 cases of erythema, 3 nonunions, and 1 tibia stress fracture. Saltrick et al reported on 16 cases of harvesting distal tibia cortico-cancellous bone grafts (3). More recently Chou et al reported 4 distal tibia stress fractures out of a series of 100 distal tibial bone grafts. All cases healed with proper immobilization and they continue to advocate the use of distal tibial bone graft for use in foot and ankle surgery (4).

The volume of bone available in the distal tibia for harvest is sufficient for a significant proportion of all foot and ankle cases. The specific technique should be tailored to the needs of the patient. Usually, this is determined by the required volume for each isolated case. The senior author has found success with distal tibial bone grafting for a wide variety of indications from subtle defects requiring small amounts of cancellous bone to large interfaces requiring cortico-cancellous constructs. The universal surgical approach is simple and yet provides the versatility needed to address a wide array of conditions that require modest amounts of bone graft.

SURGICAL TECHNIQUE

A medial midline incision approximately 3-5 cm in length is made directly over the medial malleolus (Figure 1A). The greater saphenous vein and the saphenous nerve are mobilized with the anterior skin flap (Figure 1B). The distal tibia periosteum is exposed and sharply incised in line with the incision. It is then elevated both anteriorly and posteriorly approximately 1 cm in both directions.

When sparse amounts of cancellous bone are needed (less than 3 cc), a large curette is simply plunged through the medial distal tibial cortex into the substance of the metaphyseal bone. Through this defect, several milliliters

Figure 1A. Intraoperative photo of right ankle showing the incision line over the medial malleolus.

Figure 1B. Surgical exposure to the periosteum. The saphenous neurovascular bundle has been mobilized with the anterior skin flap.

of cancellous bone could be obtained. If more cancellous bone is required, 4 holes are created with a 2-0 mm drill in a rectangular orientation with the longer sides in line with the incision (Figure 1C). The corners of the cortical window are rounded by virtue of the drill to decrease the impact of stress risers. The distal extent of the rectangular cortical window is approximately 2 cm proximal to the distal tibia plafond to allow such that damage to the articular surface is avoided, and yet provide the greatest volume of cancellous bone. A cortical window is created by connecting the holes with an osteotome or power instrumentation. The excursion of the instruments should not violate the corners that are transcribed by the drill holes, yet should be deep enough to penetrate through the distal tibial cortices.

This cortical window is either removed temporarily and stored in lactated ringers or hinged on the posterior side. The cancellous bone attached to the window is harvested and additional cancellous bone is obtained through curettage of the distal tibia through the window created. A 20 cc syringe with a 16-gauge needle is used to aspirate the blood marrow mixture and added to the harvested graft to create a slurry of biologic material. After adequate bone is procured, the cortical window is replaced.

When a cortico-cancellous graft is needed, the small osteotome or saw is used to fashion a wedge of material by plunging the instruments deep into the cancellous substance. One or 2 osteotomes are utilized to tease out the resultant cortico-cancellous graft (Figures 1D, 1E). It is placed in lactated ringer's solution until implantation. If necessary, a large curved curette is used to harvest additional cancellous bone, excavating the distal tibia both proximally, distally, and laterally. A 10-cc syringe is then used to harvest the marrow-heme liquid and combined with the cancellous graft (Figure 1F).

A tricortical iliac crest allograft is sculpted fashioned to fit

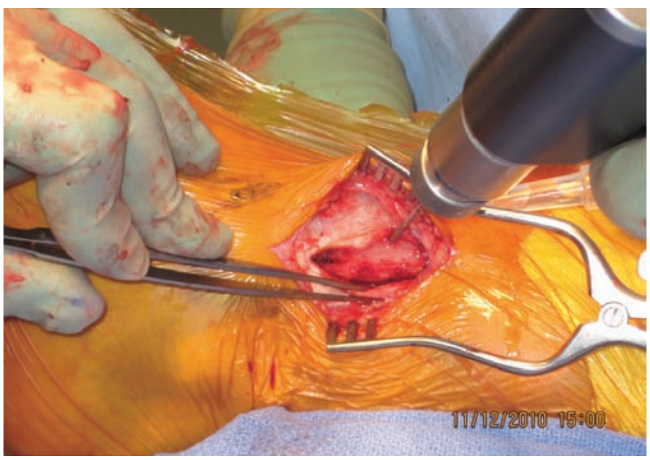

Figure 1C. The proximal anterior drill hole has been made after reflection of the periosteum.

Figure 1D. An osteotome is used to tease out the cortico-cancellous graft.

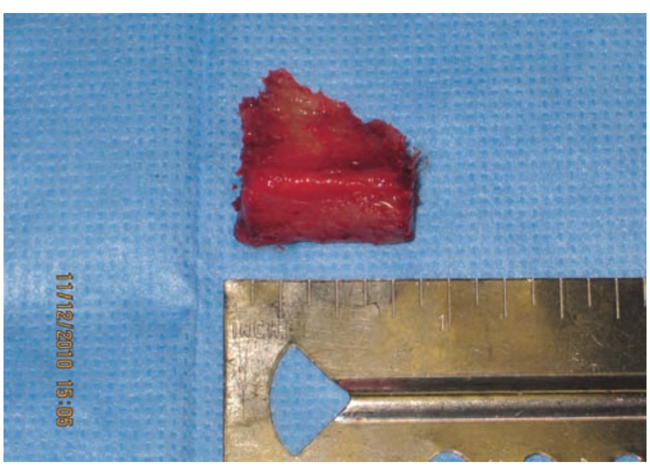

Figure 1E. The resultant graft. Note the size is approximately 2 cm long x 1 cm thick.

Figiure 1F. The resultant defect after additional cancellous bone has been obtained.

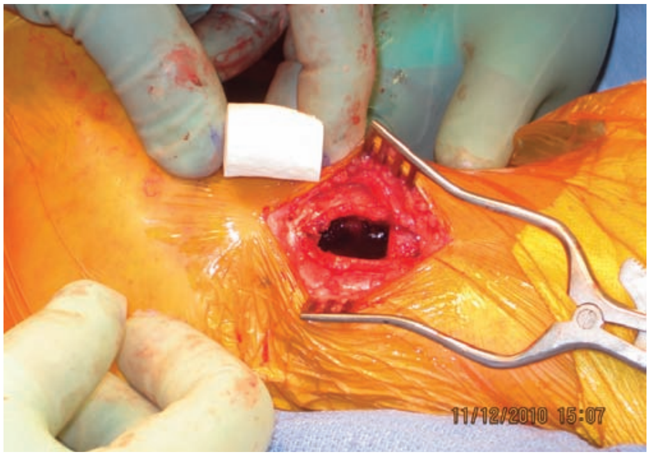

Figure 1G. The tricortical allograft is being sized and trimmed to fill the host defect.

Figure 1H. The allograft has been tamped into place.

Figure 1I. Closure of the periosteum.

Figure 1J. Final closure

the harvest site and press fit into the defect (Figures 1G, 1H). It is oriented such that the superior cortex of the iliac crest allograft replaces the medial distal tibial cortex. Following graft harvest by any of the methods described above, the periosteum is closed primarily and the subcutaneous tissues and the skin closed in layers (Figures 1I, 1J).

Where possible, the recipient site should be adequately prepared and stabilized prior to initiating the bone graft harvest. In most instances the harvested bone graft is back-filled into the recipient defect after bony stabilization. The larger cortico-cancellous grafts were used to fill large interfaces such as distraction arthrodesis. These sites were fixated following graft placement and then augmented with the additional cancellous graft. Where only cancellous bone was needed, the recipient site was fixated primarily and then backfilled with the cancellous bone graft.

CASE EXAMPLE

A 31-year-old woman presented 2 years after sustaining a left calcaneal fracture and lumbar spine fracture that were treated nonoperatively. She complained of pain with ambulation located in the subtalar joint area, anterior ankle, and lateral aspect of the calcaneus.

The neurovascular examination was normal, but there was a palpable prominence of the calcaneal wall laterally with distal fibular impingement. There was also tenderness to palpation over the anterior ankle joint line and accentuated dorsiflexion. The subtalar joint was stiff, however not in any appreciable varus. Imaging studies revealed a consolidated joint depression calcaneal fracture with widening of the posterior facet and lateral blow out. The talus was imploded within the substance of the calcaneus with anterior ankle joint impingement (Figure 2A).

Figure 2A. Preoperative lateral view showing the flattened calcaneal pitch.

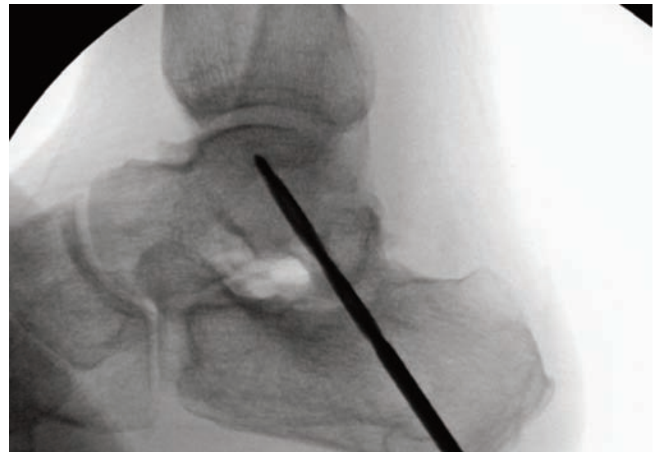

Figure 2B. The cortico-cancellous tibial autograft has been positioned. The drill bit is in place for placement of the first screw.

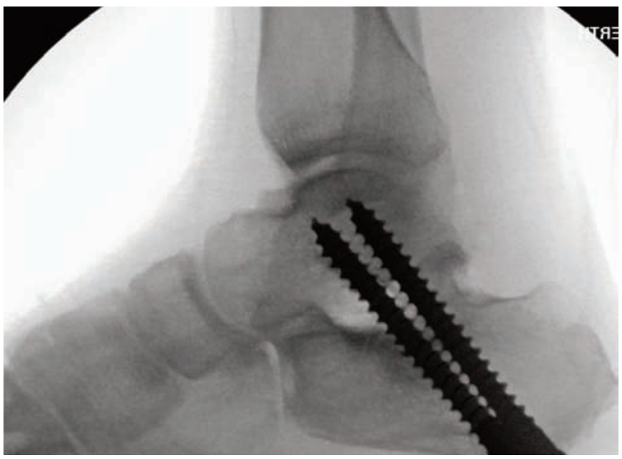

Figure 2C. Both screws have been placed in a non-lagged fashion to support the graft and maintain correction.

Figure 2D. Final consolidation.

A distraction bone block subtalar joint arthrodesis was performed through a lateral approach. Once the subtalar joint was prepared down to raw cancellous bone, the talus and calcaneus were positioned. The cortico-cancellous distal tibial graft was procured and inserted to maintain joint distraction (Figure 2B). The medial cortex of the tibia was oriented posteriorly. Two fully-threaded 6.5 cancellous screws were delivered across the fusion mass, maintaining the corrected position. The remaining void at the fusion site was backfilled using additional distal tibial cancellous graft (Figure 2C).

The patient remained nonweight bearing in a short-leg cast for 6 weeks followed by 2 weeks of nonweight bearing in a removable boot. Bony consolidation and signs of integration of the graft were apparent at 6 weeks. Full weight bearing was allowed at 8 weeks without formal support (Figure 2D).

DISCUSSION

Although the use of autogenous biomaterials has decreased recently due to the wide availability of bone graft substitutes, the true efficacy or measure of equivalence has not been established. Yet, the negotiation of large defects in the foot and ankle has prompted surgeons to utilize such synthetic or allograft materials. Proponents of these materials contend that there is little cost differential, less morbidity, and satisfactory outcomes when using non-autologous bone (7). The technique described herein is expedient and provides an optimal biologic substrate to achieve bony union. Furthermore, there is usually an adequate volume of bone for use in most procedures in the foot. As described, either pure cancellous or cortico-cancellous grafts can be obtained through a standard incision.

While ideal in location, the calcaneus does not provide sufficient volume of bone for most hindfoot applications. Further, the complication rate for the harvest of bone from the distal tibia has been reported to be quite low (1, 2). The ease of the distal tibial bone graft in both surgical time and proximity to the index procedure make it an ideal source for modest quantities of autograft.

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