CHAPTER **56**

MID-SHAFT FIBULA AUTOGRAFT FOR ELECTIVE FOOT SURGERY

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HISTORIC BACKGROUND

Although the use of bone graft materials has been documented since the 1600s, the procurement of fibular autograft has only been popularized within the last 30 years. The majority of the literature documents this type of graft in the form of a free vascularized autograft used as a corticocancellous strut for large segmental bone defects in the extremities.[1-4] Even though a few articles have documented the use of nonvascularized fibular transplant for tumor reconstruction in long bones, there are no documented cases of the use of nonvascularized mid-shaft fibular autografts in elective surgical procedures in the foot.[1,5]

Despite the recent popularity and accepted use of allograft bone, autogenous grafts retain their advantage of biologic and immunologic superiority.[6] Additionally, cortico-cancellous grafts, such as those taken from the fibula, combine the structural integrity of cortical bone with the osteogenic properties of cancellous bone.[6] The cited disadvantages of autografts include donor site morbidity and the need for a second surgical procedure. Postoperative complications using the extensive free vascularized fibular grafts have included a few cases of transient superficial peroneal nerve palsy, flexor hallucis longus contracture, and knee or ankle instability. However, of the few studies reporting the use of the less involved non-vascularized fibular autograft, no complications have been seen at the donor site.

Complete osseous regeneration of the fibula, independent of the resected length, in children is well-documented. Research on the bone regeneration of donor areas has concluded that osseous regeneration is more rapid and more intense in young patients. Psillakis et al. analyzed the regeneration of the rib or iliac crest in 26 bone grafts in patients ranging in age from 8 to 64 and concluded that children always regenerate completely and patients over 30 never do.[7] Likewise, a recent article authored by Bettin et al analyzed 53 patients where average fibular graft harvest length was 12 (range 4-28) cm long. Their conclusions mirrored that of Psillakis et al, stating that patient age is the only proven predictor of donor site regeneration of the fibula, irregardless of the harvested graft length. They noted regeneration was particularly successful when patients were less than 15 years old at the time of surgery.[1]

Availability of suitable bone graft materials also influences the decision-making process regarding elective, reconstructive foot surgery. In many countries, lyophilized bone allograft may not be readily available, especially in socialized systems of medicine. There are also regional differences regarding the acceptability of using human graft implants in elective surgery. For these reasons, an autograft may be the preferred choice of bone graft materials.

CASE SELECTION

All of the cases presented in the update presentation used a fibula autograft for reconstructive surgery of pediatric flatfoot deformities, and the common procedure was a lateral lengthening osteotomy of the calcaneus (Evans Calcaneal Osteotomy) with interpositional bone graft.[8] Inclusion criteria were flexible, reducible flatfeet with no involvement of a tarsal coalition. All patients were under the age of 15 years at the time of surgery. Additional procedures include heel cord lengthening (gastrocnemius recession) and medial arch augmentation. Medial arch procedures were either soft tissue or osseous. Soft tissue augmentation was via tibialis anterior transfer-sling (Young's Tenosuspension)[9] and tightening of the tibialis posterior tendon and spring ligament. Bony correction of the medial arch was via medial cuneiform osteotomy with dorsal bone grafting (Cotton Osteotomy).[10] In all cases of Cotton Osteotomy, the bone graft was taken from the same segment of fibular autograft. In all cases the fibula regenerated with complete bone bridging and remodeling, with a medullary canal and cortical margins returning to a normal architectural appearance.

The authors believe that abundant vascularity due to a rich muscular bed, a preserved and intact periosteum, and patient age (active growth phase), accounts for the consistency in complete regeneration of the fibula in this selection of patients. Of note, a common observation in adult patients who sustain a high fibular fracture is that the fracture heals despite significant gapping and angular separation of the fracture ends (Figure 1).

Figure 1. Healed displaced high fibular fracture in a 52-year-old female patient. Note the well-aligned nonunion medial malleolar fracture in the same patient. Fracture location and surrounding vascular bed influence the ability to heal irrespective of patient age.

SURGICAL TECHNIQUE

Following the delivery of anesthesia, the patient is positioned supine on the operating table. A high calf tourniquet is placed on the leg over abundant padding. Following draping and preparation of the surgical field, a lateral incision is made in the middle one-third of the leg, at least ten centimeters superior to the ankle joint. The incision is centered on the lateral bisection of the fibula, except in cases where a gastrocnemius recession is being performed through the same incision, in which case the incision is made more posterior, along the posterior margin of the fibula. Superficial and deep fascia are sectioned longitudinally. Blunt dissection through the lateral compartment musculature is then performed, aided by deep retractors. Once the fibula is reached, a periosteal elevator is used to score and reflect the periosteum (Figure 2A). A Sagittal saw is used to transversely divide the fibula, removing a two to three centimeter length of bone (Figure 2B). Deep repair of the periosteum is performed, followed by deep fascia, superficial fascia, and skin. The autograft is held in reserve in sterile saline.

REPRESENTATIVE CASE PRESENTATION

An eleven year-old female patient had a four-year history of painful bilateral flexible flatfoot deformity. She was treated with orthotics and physical therapy prior to surgery. Allograft materials were not available for surgery. The surgical procedures included Evans calcaneal osteotomy with fibular autograft, Cotton cuneiform osteotomy with fibula autograft, and distal gastrocnemius recession via Vulpius-Stoffel Tenotomy.[11] The fibula autograft was harvested first, followed by the gastrocnemius lengthening through the same lateral mid-leg incision, the Evans osteotomy, and finally the Cotton osteotomy. Both bone grafts were obtained from the fibula autograft (Figures 3A- 5C).

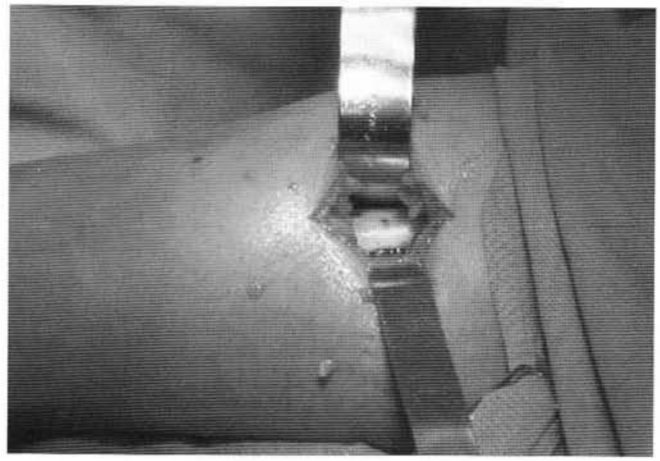

Figure 2A. Fibula autograft exposure.

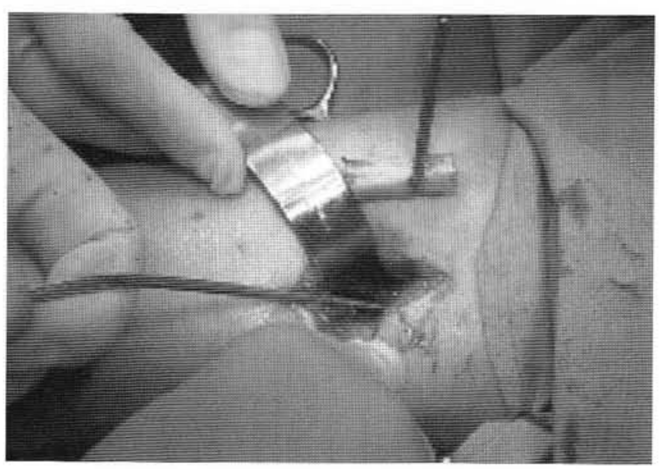

Figure 2B. Harvest.

Figure 3A. Preoperative DP radiograph.

Figure 3B. Postoperative DP radiograph.

Figure 4A. Preoperative lateral radiograph.

Figure 4B. Postoperative lateral radiograph.

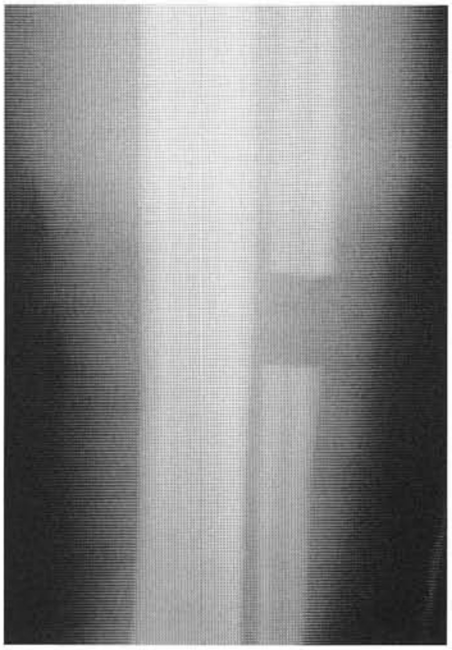

Figure 5A. Immediate postoperative radiograph of fibula donor site.

Figure 5B. Regenerating fibula donor site.

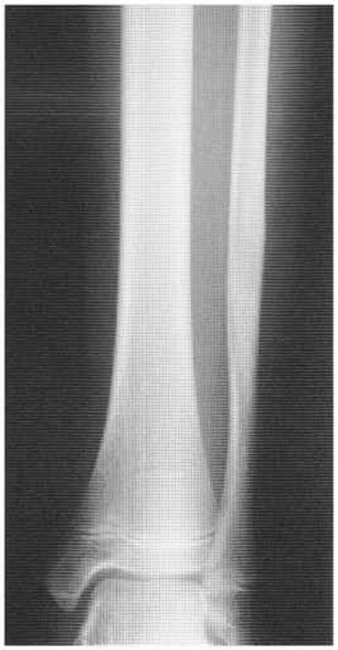

Figure 5C. Complete regeneration of the fibula.

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