A Novel Technique Utilizing a Fibular Strut Allograft for Reconstructive Midfoot Fusion

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Purpose

Reconstructive midfoot fusion in the setting of avascular necrosis or nonunion requires significant osseous resection and utilization of bone graft to fill the remaining osseous defect. While allograft products negate donor site morbidity associated with autograft harvest, many lack the structural stability or appropriate construct for osseous defects of the midfoot. The purpose of the present study is to describe a novel technique for reconstructive medial column midfoot fusion utilizing a fibular strut allograft.

Literature Review

In 2012, Yu et al. described a screw and plate fixation construct combined with a tricortical autologous iliac crest graft for talonavicular and naviculocuneiform arthrodesis secondary to Müller-Weiss disease.[1] They reported clinical and radiographic evidence of successful fusion in all seven patients at an average of 13 weeks. While no complications related to autograft harvest were encountered in this study, persistent donor site pain has previously been reported.[2] Osseous allografts have been shown to be overall safe while preserving many of the desirable biological properties to promote healing.[3]

The use of a fibular strut allograft has been described in orthopedic literature at other anatomical sites for osseous deficits associated with nonunions, complex fractures and unicameral bone cysts.[4-8] To the author's knowledge, the utilization of a fibular strut allograft for medial column midfoot fusion has not yet been described. The biomechanical and osteoconductive properties of a fibular strut allograft have been demonstrated through its well described use in comminuted humeral neck fractures. This strut has been shown to establish a second column of support when remaining bone is inadequate, increasing the strength of the fixation construct and resisting loss of length or reduction.[9] Further, the stability gained with the fibular allograft has contributed to decreased complications of osteonecrosis of surrounding fracture fragments and has allowed earlier and more aggressive therapy.[9]

Case Study

Three patients with a mean age of 42 years presented with significant pain and disability associated with the affected midfoot. Two patients had previously undergone talonavicular arthrodesis at an outside facility resulting in symptomatic nonunion. A single patient presented with navicular avascular necrosis following untreated midfoot trauma several years prior. Weightbearing radiographs and non-contrast computed tomography (CT) were obtained in all cases which confirmed talonavicular nonunion and navicular avascular necrosis with significant adjacent degenerative changes (Fig. 1). Based on failure of conservative management, patients elected to proceed with reconstructive medial column midfoot fusion.

In all cases, nonviable bone was resected to healthy bleeding margins resulting in a significant osseous defect. A trough was created in the talar neck, navicular, medial cuneiform and first metatarsal to allow the fenestrated rehydrated fibular allograft to be press fit to fill the void (Fig. 2a). This was supplemented with impactable allogenic bone graft product and autogenous bone marrow aspirate. A customized dorsal mesh plate was then placed from talus to first and second tarsal-metatarsal joints to increase construct stability and secure the fibular allograft (Fig. 2b).

Radiographic and clinical evidence of graft incorporation and successful fusion was achieved in all cases (Fig. 3). Patients were able to return to their desired activity level at the latest mean follow-up of 12.2 months and no wound healing or hardware complications were noted.

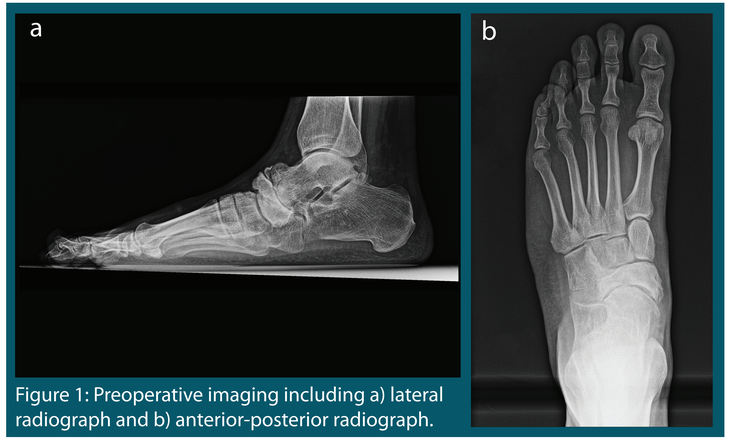

Figure 1: Preoperative imaging including a) lateral radiograph and b) anterior-posterior radiograph.

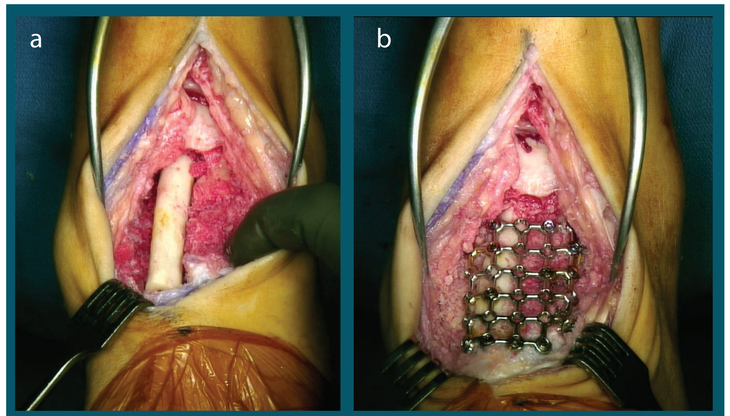

Figure 2: Intraoperative images demonstrating a) fibular strut allograft placement and b) mesh plate fixation over the fibular strut allograft.

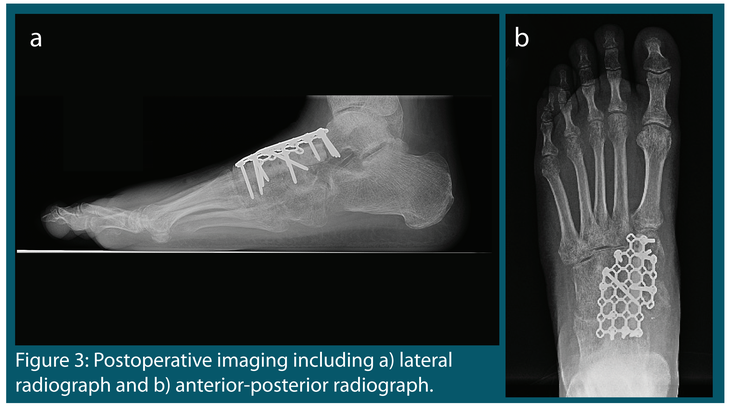

Figure 3: Postoperative imaging including a) lateral radiograph and b) anterior-posterior radiograph.

Analysis & Discussion

Arthrodesis of the midfoot, especially in cases of revision surgery, often proves to be difficult in obtaining a solid construct able to consistently manage the dynamic stresses of the midfoot. Typical fixation methods include various screw configurations, locking plates, compression staples or a combination of these. We have presented a novel technique in midfoot arthrodesis which aims to not only provide a structurally sound midfoot but also potentiates a solid arthrodesis among multiple midfoot joints. The fibular strut provides the necessary osteoconductive properties and the ability to embed this within the talus and along the trough enhances the stability of the midfoot. The use of a mesh plate allows the surgeon to construct a customized plate to contour the osseous alignment in multiple planes, as well as providing a cage-like construct to hold the fibular strut and surrounding bone graft in place.

We have presented three cases using the described technique, one being a primary fusion due to avascular necrosis and post-traumatic arthritis and two being revision surgeries after failed talonavicular fusion. All cases had favorable outcomes with successful union and patients being able to return to full activity. This technique not only provides options for primary arthrodesis, but also for complex revision cases. While the short-term results are promising, long term surveillance will provide additional insight into the efficacy of the above approach to complex midfoot pathology.

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