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Case Reports and Series

Double Calcaneal Osteotomy With Percutaneous Steinmann Pin Fixation as Part of Treatment for Flexible Flatfoot Deformity: A Review of Consecutive Cases Highlighting Our Experience With Pin Fixation

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ABSTRACT

Surgical correction of flexible flatfoot deformity and posterior tibial tendon dysfunction has been extensively reported in published studies. When appropriate, calcaneal osteotomies for flatfoot correction have been a favorite of foot and ankle surgeons because of the corrective power achieved without the need to fuse any rearfoot joints. The medial displacement calcaneal osteotomy and Evans calcaneal osteotomy, together termed the *double calcaneal osteotomy*, have been reported several times by various investigators with a wide variety of fixation options. We undertook an institutional review board-approved retrospective review of 9 consecutive patients (11 feet), who had undergone double calcaneal osteotomy with 2 percutaneous Steinmann pin fixation for the correction of flexible flatfoot deformity, with or without posterior tibial tendon dysfunction. All patients had radiographic evidence of bone healing of the posterior calcaneal osteotomy and incorporation of the Evans osteotomy bone graft at 6 weeks and demonstrated clinical healing at 6 weeks. All patients had 2 percutaneous Steinmann pins placed through both osteotomies, and these were removed an average of 6 weeks postoperatively. No patient developed pin site complications. The only complication noted was sural neuritis, which was likely incision related. No patients had delayed union or nonunion, and we did not identify any graft shifting postoperatively. The present retrospective series highlights our experience with 2 percutaneous Steinmann pin fixation, demonstrating equal or better results than many previous published fixation methods for double calcaneal osteotomy. It is cost-effective and minimizes the potential risk of iatrogenic Achilles pathologic features associated with screw fixation.

Surgical correction of flexible flatfoot deformity and posterior tibial tendon dysfunction has been extensively reported in published studies. When appropriate, calcaneal osteotomies for flatfoot correction have long been a favorite of foot and ankle surgeons owing to the corrective power achieved without the need for midfoot or hindfoot joint fusion. Koutsogiannis (1) described a medial displacement posterior calcaneal osteotomy that was intended to bring the weightbearing portion of the heel back under the leg and medialize the ground reactive forces. A wide variety of fixation options have been described for this osteotomy, all of which have had relatively good results (1,3–7). Evans also described a calcaneal osteotomy, but this time in the anterior process of the calcaneus using a bone graft to achieve lateral column lengthening (2). Koutsogiannis (1) did not fixate the grafted osteotomy, which has remained common practice. The combination of the anterior and posterior heel osteotomies is widely known as the double calcaneal osteotomy.

Several investigators have advocated for some form of fixation of the Evans anterior calcaneal osteotomy to prevent graft displacement (3,7–11). Before 2008, we did not routinely use fixation of the Evans anterior calcaneal osteotomy and have traditionally used percutaneous Steinmann pins for the posterior heel osteotomy. As trends have moved toward fixation of the Evans osteotomy, it was a natural progression to simply advance the pins into the anterior calcaneus to achieve stabilization of both osteotomies with 2 pins, thereby preventing rotation of either osteotomy. Pins have been used for decades for fixating the posterior heel osteotomy and advancing these pins across the Evans anterior calcaneal osteotomy serves as insurance against graft displacement and elevation of the anterior calcaneal fragment. Cannulated screw systems offer a variety of options for the

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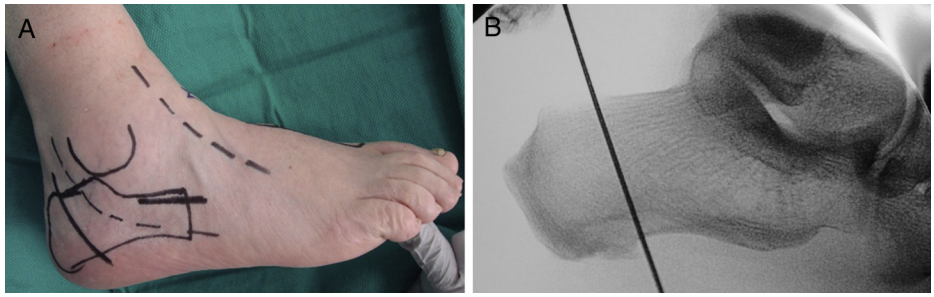

Fig. 1. Incision placement. (*A*) Separate incisions are used for the medial displacement posterior calcaneal osteotomy and Evans anterior calcaneal osteotomy. The sural nerve is typically anterior to the posterior calcaneal incision and inferior to the anterior calcaneal incision. The *dashed lines* serve as approximations of the typical nerve location of the sural and intermediate dorsal cutaneous nerves. (*B*) We typically lay a Kirschner wire over the skin using imaging guidance to ensure our posterior incision is in the ideal location. Proper placement of the incision allows minimal dissection.

size and length of the screw; however, placement of the drill and large-diameter screw through the Achilles tendon insertion in the posterior calcaneus is less than optimal. Furthermore, a large screw through the center of the graft is less than desirable. In contrast, we are able to space the 2 pins apart from each other within the graft. Plate fixation requires more extensive dissection, adds cost, and can require a second operation for removal.

We present a retrospective study of 9 consecutive patients (11 feet) who had undergone a double calcaneal osteotomy as part of treatment of flexible flatfoot deformity, with or without posterior tibial tendon dysfunction. Our typical surgical plan for patients with flexible flatfoot deformity has consisted of gastrocnemius recession, double calcaneal osteotomy, and Cotton midfoot osteotomy. However, the focus of the present study was to highlight our results with modified 2 Steinmann pin fixation of the double calcaneal osteotomy.

Patients and Methods

After institutional review board approval, we performed a retrospective analysis of consecutive patients who had undergone double calcaneal osteotomies that were fixated with 2 percutaneous Steinmann pins from June 2008 to July 2013. The inclusion criteria for the present study were 2 percutaneous Steinmann pin fixation and follow-up of at least 10 weeks with appropriate interval postoperative radiographs. Patients with any other form of double calcaneal osteotomy fixation were excluded. The senior author (T.J.B.) performed all procedures. Both investigators evaluated the radiographs to determine the interval to radiographic healing, which was defined as radiographic evidence of bone formation across the osteotomies. Clinical healing was determined by an absence of pain at the surgical sites. The other data collected included age, gender, tobacco use at the time of procedure, chronic medical comorbidities, postoperative complications, and follow-up period (in months).

Surgical Technique

The procedures are performed with the patient in the supine position under general anesthesia with a popliteal block. Separate incisions are used for the medial displacement posterior calcaneal osteotomy and the Evans anterior calcaneal osteotomy (Fig. 1*A*). The sural nerve is typically anterior to the posterior calcaneal incision and inferior to the anterior calcaneal incision. We typically lay a Kirschner wire over the skin under imaging to ensure our posterior incision is in the ideal location (Fig. 1*B*). The posterior incision is then carried down to the bone as we are posterior to the sural nerve. We try to minimize the periosteal dissection and only dissect where the osteotomy will be made. A Crego elevator is then used to free up the dorsal and plantar regions of the osteotomy of the calcaneus. The osteotomy is made with a standard sagittal saw, with the saw blade marked at 3 cm with a strip of tape to help improve depth perception and ensure the medial neurovascular structures are not violated. A long osteotomy guide is typically used to ensure the osteotomy is created in the same plane all the way through (Fig. 2). Next, a lamina spreader without teeth is introduced to the osteotomy to stretch the soft tissues to ease medial displacement of the posterior calcaneal tuber. The calcaneus is marked to ensure no dorsal or plantar displacement on translation of the posterior calcaneal tuber, because the pull of the Achilles tendon tends to displace the posterior tuber superiorly (Fig. 3).

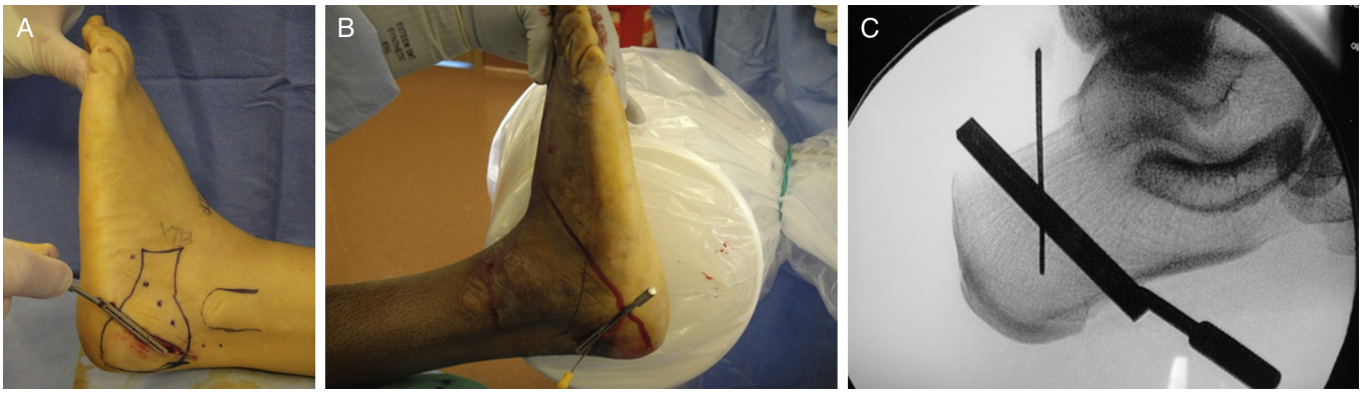

Fig. 2. Osteotomy guide technique. (*A*) A long osteotomy guide and guide pin are typically used to ensure that the osteotomy is created in the same plane all the way through. (*B* and *C*) Imaging can ensure that the osteotomy guide is at the proper angle and anterior to the Achilles insertion and plantar fascia origin.