

INTRODUCTION

Adult acquired flatfoot deformity (AAFD), often a result of posterior tibial tendon dysfunction, can lead to a severe painful foot and ankle deformity (1). It is a progressive disorder first classified by Johnson and Strom and later modified by Myerson (2, 3). One procedure described in the treatment of AAFD is the Evans osteotomy. It is a lateral column lengthening osteotomy of the anterior process of the calcaneus, originally described by Evans in 1975 (4). Due to the inherently unstable nature of the osteotomy, complications can occur, including dorsal migration of the distal articular fragment and nonunion from the limited bony interface (5-7). An anterior body Z-osteotomy is a novel technique that is inherently more stable by design of the osteotomy (Fig. 1). An anatomic cadaveric study was performed to determine if adequate lengthening can be achieved with this more stable construct as well as to describe what length of central arms are reasonable for stability after distraction.

METHODS

Anatomic dissection was performed in ten fresh cadaveric below-knee specimens. Once the anterior process of the calcaneus was exposed, digital calipers were used to find the center of the anterior process. The distal arm of the Z-osteotomy exits dorsal to the central arm of the Z-osteotomy and 1.0 cm proximal to the calcaneocuboid joint (Fig. 2), while the proximal arm exits plantarly. The central axis length of 20 mm was selected in 5 specimens and 15 mm in the other 5 specimens (Fig. 3). A sagittal saw was used to complete the osteotomy, an 8-mm wedge was placed in both the distal and proximal arms, and the osteotomy was fixated with 18-mm staples (Fig. 4). We used digital calipers to measure the amount of bone apposition on the central arm between the wedges.

RESULTS

The cadaveric specimen demographics are listed in Table 1. When comparing the 20 mm to 15 mm central arm groups with 8mm wedge distraction, the average bony apposition was 10.66 mm and 7.61 mm, respectively. The minimum bony apposition in the 20 mm group was 6.13 mm and maximum was 14.94 mm. In the 15 mm group, the minimum bony apposition was 5.61 mm and maximum was 10.6 mm.

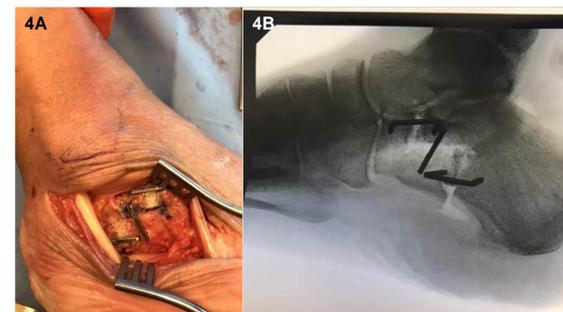
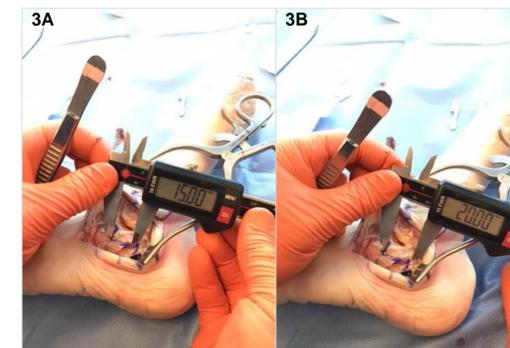
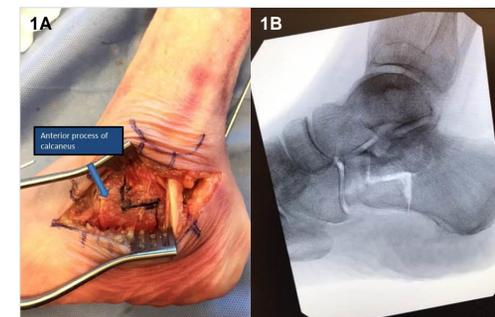


Figure 1: (A) Clinical illustration of the anterior calcaneal body Z-osteotomy; (B) lateral ankle radiograph following the completed Z-osteotomy.

Figure 2: Illustration of the distal arm of the Z-osteotomy being drawn 1.0 cm proximal to the calcaneocuboid joint.

Figure 3: Digital calipers were used to measure the central arm of the osteotomy at 15 mm and 20 mm.

Figure 4: (A) Final construct with 18-mm staples and 8-mm wedges; (B) Lateral ankle radiograph illustrating final construct.

REFERENCES

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Table 1. Specimen Characteristics (n=10)

Right-sided	7
Left-sided	3
Male	5
Female	5
Average Age at Death	69.3
Average BMI at Death	23.0

DISCUSSION

Saunders et al (8) compared the step-cut lengthening calcaneal osteotomy to the traditional Evans osteotomy in a 2017 retrospective study. They found the Evans group required more hardware removal and used a larger graft size. The two groups had similar outcomes scores and correction of deformity. The step-cut lengthening group showed significantly earlier union at 8.77 weeks, compared to 12.6 weeks, and had fewer overall nonunions. They defined union as greater than 50% union on postoperative CT and noted that the majority of early union occurred across the horizontal limb of the osteotomy. They described the vertical limb being 12 mm from the calcaneocuboid joint and one third of the vertical height of the calcaneal neck. However, they do not describe the length of the horizontal cut.

In our specimens, the anterior body calcaneal Z-osteotomy does provide enough bony apposition. We found adequate stability and bone overlap with both the 15 mm and 20 mm central arms at an 8-mm graft distraction. If larger graft distraction is desired, one may want to select the 20 mm central arm length to assure adequate bone overlap and stability. The staple fixation appeared to provide adequate stability but we did not objectively measure this. Staples may simplify the technique compared to the challenges of screw fixation described by others (8).