

Statement of Purpose

The purpose of this study is to report the surgical technique and radiographic findings for revision of the malunited hindfoot arthrodesis.

Literature Review

The triple arthrodesis is a powerful procedure for correcting painful deformity, arthritis and instability of the hindfoot. In most cases this procedure produces a stable, plantigrade foot, enabling patients to ambulate.

However, deformity recurrence has been reported to be between 9-20%.¹⁻⁴ In one long-term study, residual deformity was noted in up to 78% of patients.⁵ In addition, a malaligned arthrodesis places unwanted mechanical stress on the ankle joint which could lead to further disability. In the same study, at the second long-term follow up, degenerative changes at adjacent joint were seen, most notably of the ankle joint. Malunion is also a debilitating problem following primary triple arthrodesis. This may lead to a number of sequelae including further pain, gait abnormality, instability, and advancement of adjacent joint arthritis.

The literature on this problem is limited and primarily confined to case reports. A single study exists which evaluated clinical and radiographic outcomes after revision triple arthrodesis.⁶ Haddad and colleagues described their surgical technique and evaluated 33 patients in which revision arthrodesis was achieved in all cases.⁶ They also reported a treatment algorithm based on planes of deformity.

Toolan reported on the results of a biplanar midfoot osteotomy for rocker-bottom deformity and forefoot abduction after triple arthrodesis in 5 patients with a mean follow up of 18 months.⁷ Bony union was achieved in all cases at an average of six weeks and every patient was satisfied with the outcome.

Case Series

Institutional review board approval was obtained for the study. Twenty-three patients presented with malunited hindfoot arthrodeses (double or triple). Each patient underwent revision hindfoot arthrodesis. All patients had available preoperative and postoperative radiographs and were included in the study. Patients were followed radiographically for a minimum of 12 months postoperatively. All procedures were performed by a single surgeon. Fifteen patients presented with a rearfoot varus deformity; 8 had a rearfoot valgus deformity. Preoperative and postoperative radiographic angles measured included anteroposterior talo-first metatarsal angle, cuboid abduction angle, Meary's angle, and calcaneal inclination angle. See Tables 1-2 for radiographic analysis and comparison of valgus and varus. All measurements were made with digital software (Stentor Intelligent Informatics, I-Site Version 3.3.1, Philips Electronics, Andover, MA).

Table 1 – Valgus Radiographic Analysis

Valgus Malunion	Preoperative Values Mean (Range)	Postoperative Values Mean (Range)
Calcaneal Inclination	11 (2-19)	5 (-4-14)
Lateral Meary's Angle	9 (-25-13)	9 (-17-8)
Cuboid Abduction Angle	24 (18-37)	11 (-10-30)
AP Meary's Angle	-11 (-28-5)	-3 (-16-17)

Figure 1 - Posterior fusion mass osteotomy



Figure 2 - Midfoot osteotomy

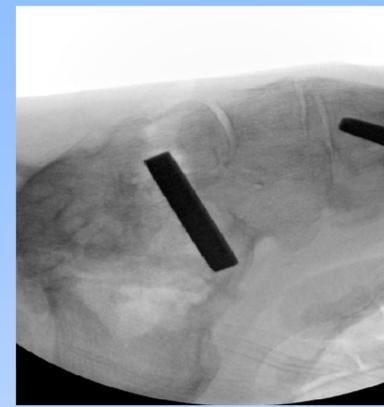
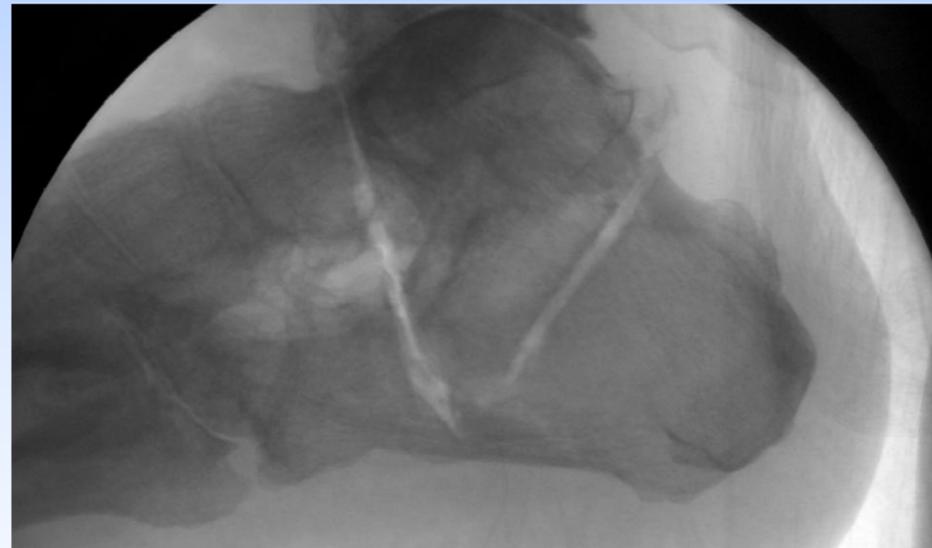


Figure 3 – Completed “V” osteotomy



Case Series

Technique points:

- Identify the CORA at or near the prior fusion sites
- An osteotome is positioned over the posterolateral fusion mass in an oblique fashion, representing the posterior cut. The osteotome is held with a Kocher while using fluoroscopy to identify the appropriate position (Figure 1)
- A medial or lateral based wedge is used for varus and valgus malalignment, respectively.
- Correction of midfoot deformities are accomplished with an osteotome using the same technique described above (Figure 2)
- The inferior aspect of the midfoot osteotomy converges with the inferior aspect of the posterior osteotomy, forming a “V”, and allowing triplanar correction (Figure 3)
- Similarly, varus and valgus correction can be obtained with medial and lateral based wedges. (Figures 4-7)
- Osteotomies may require dorsal or plantar modifications to accommodate dorsiflexion or plantarflexion deformity.
- Fixation is achieved by Steinman pins / various screws
- Tables 1 and 2 display our radiographic analysis

Table 2 – Varus Radiographic Analysis

Varus Malunion	Preoperative Values Mean (Range)	Postoperative Values Mean (Range)
Calcaneal Inclination	11 (-6-30)	5 (-5-19)
Lateral Meary's Angle	9 (-17-40)	9 (0-33)
Cuboid Abduction Angle	-2 (-29-10)	1 (-28-14)
AP Meary's Angle	20 (-4-34)	-3 (-16-17)

Analysis & Discussion

Malalignment after hindfoot arthrodesis may result from inadequate deformity correction. In other cases, gradual recurrence may be the result of progressive deformity driven by neuromuscular disease or subtle neuromuscular imbalances. Balancing the foot is the mainstay of deformity correction. The present study presents a systematic approach to multiplanar deformity correction. The apex of deformity for malunited hindfoot arthrodesis is usually present at the midfoot fusion mass, hindfoot fusion mass, or both. Osteotomies are ideally placed at or close to the CORA. The technique presented places both osteotomies at the deformity apex, demonstrating a consistent and reproducible approach for correction.

Stephens et al described a calcaneal dome osteotomy for revision triple arthrodesis with adequate correction of varus, valgus and equinus deformities.⁹ The series by Haddad et al reported on an algorithmic approach to address multiplanar deformities.⁶ Fourteen percent of those patients required further surgery as direct result of postoperative complications. Most of the cases requiring a revision were secondary to residual varus deformity.

Previous studies have reported good clinical outcome after revision surgery. Pell et al found that postoperative patient satisfaction after triple arthrodesis was highly correlated with correction of the deformity.⁸ Haddad et al, reported a positive correlation between radiographic correction and improvement in AOFAS scores.⁶ Our radiographic analysis demonstrated improvement in all measurements with the exception of the calcaneal inclination angle. However, absence of patient reported outcomes is a limitation of this study.

References

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Figure 4 - Intraoperative correction



Figure 5 - Postoperative radiograph demonstrating hindfoot correction



Figure 6 - Midfoot fixation



Figure 7 - Midfoot / hindfoot fixation

