

First Metatarsal-Phalangeal Joint Arthrodesis

Primary, Revision, and Salvage of Complications

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KEYWORDS

• Hallux valgus • Hallux rigidus • Fusion techniques • Osteoarthritis • Surgery

KEY POINTS

- First metatarsal-phalangeal joint arthrodesis is a required skill set for foot and ankle surgeons due to its ability to be applied to primary degenerative or rheumatologic arthritis and revision of prior failed surgery to this joint.
- Complications following first metatarsal-phalangeal joint arthrodesis are common following primary intervention and are both more frequent and more severe when revision arthrodesis is performed.
- The development of a nonunion and malunion following first metatarsal-phalangeal joint arthrodesis are predominantly the result of poor surgical technique and can be controlled with surgeon experience and meticulous technique. The use of hand-instrumentation or a crescentic saw to prepare the joint surfaces is preferred over power reamers.
- The use of staples and plates with a compression screw through the plate crossing the arthrodesis site should be avoided to reduce incidence of nonunion. Also, the use of staples and sagittal plane anatomically contoured plates should be avoided to reduce incidence of malunion.
- Plates that combine a thin but mechanically sound construct, out-of-plane screw orientation, locking and nonlocking screw fixation, and 1 or more eccentric drill slots to afford compression are ideally suited for both primary and revision first metatarsal-phalangeal joint arthrodesis.

INTRODUCTION

Arthrodesis of the first metatarsal-phalangeal joint (MTPJ) has been proposed for treatment of significant first MTPJ pathologic conditions due to the perceived safety and efficacy.¹⁻³ The author previously undertook a systematic review of electronic databases and other relevant sources to determine the incidence of complications

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following arthrodesis of the first MTPJ.⁴ Studies were eligible for inclusion only if they involved patients undergoing arthrodesis of the first MTPJ using modern osteosynthesis techniques (1980 onward time restriction), included a minimum of 30 feet in the publication, evaluated subjects at mean follow-up 12-months or longer duration, included details of complications requiring surgical intervention, and did not involve the use of structural bone graft. Thirty-seven studies involving a total of 2818 first MTPJ arthrodesis procedures were identified that met the inclusion criteria. The weighted mean age of subjects was 59.3 years, follow-up was 34.3 months, and union time was 64.3 days. For those studies that specifically mentioned the indications for first MTPJ arthrodesis, 2656 joints were included as follows (1) severe hallux valgus (47.2%), (2) hallux rigidus (32%), (3) rheumatoid arthritis (11.5%), and (4) revision of failed surgery (9.3%). Joint preparation involved 1 of 3 approaches: (1) hand instrumentation, (2) cup and cone power reamers, and (3) power straight or crescentic saw blades. The arthrodesis osteosynthesis constructs used consisted of 3 broad categories: (1) compression screw fixation, (2) dorsal plate plus or minus oblique compression screw fixation, and (3) staple fixation. Radiographically confirmed nonunion occurred in 5.4% (153 per 2818) with symptomatic nonunion occurring in 32.7% (50 per 153) of these. Salvage of nonunion is complex and involves revision arthrodesis with bulk allograft or autograft, hardware removal, and conversion to a soft-tissue interposition arthroplasty or stemmed prosthetic device, or amputation. Malunion and hardware removal occurred in 6.1% (39 per 640) with dorsal malunion accounting for 87.1% (34 per 39), and the remainder a valgus malunion. Malunion is revisited with realignment osteotomy. The incidence of hardware removal was 8.5% (69 per 817). The results of this study have subsequently been independently verified in another systematic review of joint pathologic conditions, preparation technique, and fixation methods for primary first MTPJ arthrodesis.⁵ Despite the high union rate with modern osteosynthesis techniques, efforts to reduce the incidence of malunion, hardware removal, and need for salvage following first MTPJ arthrodesis remain warranted.

PRIMARY FIRST METATARSAL-PHALANGEAL ARTHRODESIS

Through a dorsal-medial or direct medial incision the first MTPJ is exposed, followed by resection of the first metatarsal head articular cartilage at the anterior and inferior aspect and the base of the proximal phalanx, with care taken to protect the soft-tissue attachments at the plantar and lateral surfaces to preserve vascularity to the periarticular bone. Due to the higher osseous union rate demonstrated, I prefer to use hand instrumentation to resect the articular cartilage and subchondral bone⁵; however, a crescentic saw blade is useful to create symmetric cup-and-cone surfaces⁶ and is simple to perform with minimal cost (Fig. 1). I prefer not to use power reamers because these tend to polish sclerotic bone if the subchondral bone plate is not exposed properly, leading to nonunion (Fig. 2), especially when combined with locked plate technology (>12% in 2 large series),^{7,8} or are too aggressive and resect excessive bone. Concentrated bone marrow aspirate or cancellous bone graft are routinely harvested from the lateral calcaneus to aid in enhancing osseous union because they are simple to obtain and safe to perform.^{9,10} For either technique, the surgeon places the index finger on the insertion of the Achilles tendon at the posterior-superior aspect of the calcaneal tuber and the thumb on the origin of the plantar fascia at the inferior aspect of the calcaneal tuber as if using their hand to signal okay. This creates three-fourths of a circle between their index finger, thenar eminence, and thumb, with the remaining one-fourth of the circle being an imaginary line connecting the distal aspects of the

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