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Dual plating with bone block arthrodesis of the first metatarsophalangeal joint: A clinical retrospective review

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ABSTRACT

Background: First metatarsal phalangeal joint (MTP) arthrodesis is challenging in the setting of bone loss. The purpose of this study was to describe the results of interpositional grafting and arthrodesis of the first MTP joint using two plates in a 90/90 configuration.
Materials and methods: Eleven patients had an MTP arthrodesis with 90–90 plating with an interpositional allograft. We analyzed the fusion rate, restoration of first ray length, patient satisfaction, and complication rates.
Results: The overall union rate was 90.9%, with an average restoration of 11 ± 4.5 mm in length to the first ray. The average time to fusion was 10.7 ± 1 weeks. The mean preoperative AOFAS score improved significantly. The complication rate was 18.2% and included one superficial wound infection and one non-union who underwent a successful fusion after revision.
Conclusion: Arthrodesis of the first MTP joint with two 90/90 plates and restoration of length using an interpositional graft has excellent patient satisfaction and functional outcomes.

1. Introduction

First metatarsal phalangeal joint (MTP) arthrodesis is a commonly performed procedure for the treatment of hallux rigidus, severe and recurrent bunion deformities, rheumatoid arthritis and other less common disorders of the joint [1,2]. There are different techniques for fixation of the joint to promote arthrodesis including oblique lag screw fixation, lag screw and dorsal plate fixation, crossed Kirschner wires, dorsal plate fixation, and various types of external fixation. Ideally, the fixation method should be reproducible, lead to a high rate of fusion, and have a low incidence of complications [3–10].

First MTP arthrodesis provides reliable results with decreased pain and improved patient satisfaction [11–14]. Arthrodesis surgery has reports of up to 92–99% fusion rate with a 96% patient satisfaction rate [13,15,16]. Despite these positive results, many patients do have complaints of stiffness as a result of the fusion. They have altered gait mechanisms in the form of decreased ankle plantar function at toe-off and decreased step gait [17].

In patients with a shortened first ray due to bone loss from rheumatoid arthritis, failed MTP arthrodesis, or failed silastic implant, an in situ MTP arthrodesis may lead to decreased union rates or transfer metatarsalgia. Therefore, some surgeons recommend restoring length using an interpositional graft in the fusion construct [9]. Restoring length may help decrease transfer metatarsalgia and improve weightbearing mechanics.

The purpose of this study was to describe the surgical technique, results and functional outcomes of interpositional grafting and arthrodesis of the first hallux metatarsophalangeal joint using two 90/90 plates. We retrospectively reviewed the radiographs of 11 feet in 8 patients with a shortened first ray who underwent a first MTP joint fusion with two 90/90 plates (locked plate and/or unlocked plate technique) in an effort to assess rate of fusion, time to fusion, time to weight-bearing, and complications.

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2. Materials and methods

This is a longitudinal, retrospective study of eleven feet operated on by a single orthopedic foot and ankle surgeon from October 2011 to October 2013. After institutional board review approval, these patients' charts and radiographs were then examined and analyzed. There were 5 females (63%) and 3 males (37%). The average patient age was 61 ± 10.5-years-old (range, 52–81 years). The clinical and radiological follow-up ranged from 6 to 23 months (mean 12.6 ± 7.8 months). No patients were lost to follow-up.

The causes for bone loss in the cohort of patients were varied. Five patients had significant bone loss from long-standing, poorly treated rheumatoid arthritis. Two patients (3 feet) had this procedure as a revision for failed MTP fusions secondary to pain and transfer lesions to the lesser toes. One patient had periarticular erosions from a failed hemiarthroplasty silastic implant. One patient with hallux rigidus and transfer metatarsalgia had a congenitally shortened first ray as compared to contralateral ray. One patient had bone loss secondary to subchondral cysts arising from long-standing hallux rigidus (Table 1).

Seven feet (63.4%) had concomitant procedures performed such as Weil-type osteotomy and interphalangeal arthroplasty of claw toes. Each patient completed a preoperative AOFAS score. The valgus angle, dorsiflexion angle, angle of inclination were digitally measured on standing radiographs of the foot (anteroposterior and lateral views). All patients had a trial of non-operative methods before proceeding with surgery. All fusions were performed using the same technique and postoperative regime.

To assess patient satisfaction and postoperative function, a questionnaire was administered to each patient at the time of the latest follow-up visit.

Preoperative AP, oblique and lateral views were obtained for each patient. The amount of bone loss to be restored intra-operatively was determined by comparing the length of the first ray of the contralateral foot to the length of the first ray of the symptomatic foot. Postoperative radiographs included the AP, oblique, and lateral views at the 4, 8, 12, and 24-week appointments. After union was achieved, radiographs were obtained only if a complication occurred or if additional intervention was necessary. Union was determined radiographically by the presence of trabeculae bridging across the fusion site and clinically by a pain-free construct when stressed. Radiographic fusion was determined based on 3 cortices of osseous bridging across the MTP joint.

All complications were noted. Delayed union was defined as the absence of bridging trabeculae 4 months following the initial surgery. Nonunion was defined both radiographically as the absence of bridging trabeculae, sclerosis, and hypertrophic bone formation surrounding the fusion site more than 6 months following the initial surgery and clinically as a painful first MTP joint when stressed.

Table 1
Concurrent procedures.

Age	Sex	Pre-op diagnosis	Concurrent procedures
52	F	Failed 1st MTP fusion	ROH, EHL tenolysis; 5th MT partial head resection
79	F	RA	Hoffman 2–5th MT
79	F	RA	Hoffman 2–5th MT; extensor tenotomies 2–5
61	M	Congenitally shortened first ray	2nd MT Weil; 2nd toe PIPJ fusion
82	M	Failed hemiarthroplasty silastic implant	ROH; 2nd MT Weil
73	F	RA	Hoffman 2–5th MT
49	F	RA	Hoffman 2–5th MT
68	M	Failed 1st MTP fusion	ROH
49	F	Hallux rigidus	Bunionette correction
73	F	RA	Hoffman 2–5th MT
58	F	Failed 1st MTP fusion	ROH

MT, metatarsal; PIPJ, proximal interphalangeal joint; ROH, removal of hardware; RA, rheumatoid arthritis; MTP, metatarsophalangeal.

2.1. Operative technique

The patient was placed in a supine position on the operating table and was anesthetized with a regional ankle block anesthesia and intravenous sedation. The foot was exsanguinated and an esmarch tourniquet was placed around the ankle. An incision was made on the dorsal aspect of the first MTP joint. It was carried down through the subcutaneous tissues. The long extensor was freed up and retracted. A dorsal capsulotomy was then created and the head of the first metatarsal and base of the proximal phalanx were exposed subperiosteally. The dorsal osteophytes were removed with a rongeur and then the medial eminence was resected. For flat bone cuts, the distal end of the first metatarsal and the proximal end of the proximal phalanx were cut with a sagittal saw such that the subchondral bone was exposed and the articular surface was resected (Fig. 1). In cases with first MTP nonunions, the fibrous union was identified and resected. Flat cuts were then created as described above. The cuts were made parallel to each other aligning the fusion site in the functional position of the first MTP joint. The sagittal alignment was checked intra-operatively using a flat tray to simulate weightbearing. The MTP joint was positioned to allow the plantar surface of the great toe to be suspended off the flat plate by 2–3 mm with simulated weightbearing. Valgus alignment was determined by comparing the angulation to the contralateral foot. Rotation was set to neutral using the nail plate as a guide. Final visual checks were made to make sure that the surfaces were manually contoured to make the surfaces were congruent in the appropriate orientation of 5°–10° valgus and 10°–25° dorsiflexion and neutral rotation relative to the first metatarsal.

Allograft was then fashioned to regain length and maintain the alignment. The MTP joint space is maximally distracted and measured. We subtract 2 mm from this length to fashion our allograft. Subtracting 2 mm allows for allows for the contracture of vessels and minimizes vascular stretching. The tricortical iliac crest allograft was cut to be parallel to the prior cuts and re-establish length. On average, 11 ± 4.5 mm of length was regained. This position is temporarily secured by a dorsal K-wire. AP and lateral

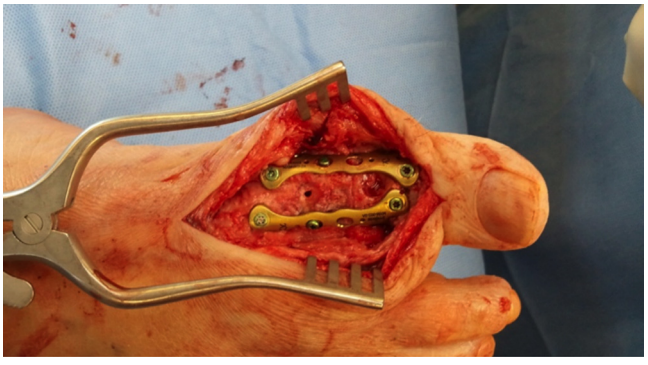

Fig. 1. Intraoperative photograph demonstrating with two 90/90 plates.