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First Metatarsal Phalangeal Joint Arthrodesis without the Use of Hardware after Failed Arthroplasty: A Case Report

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Learning Point of the Article:

A first metatarsal phalangeal joint arthrodesis can be obtained in the setting of bone loss in a single stage procedure without the use of hardware.

Abstract

Introduction: First metatarsal phalangeal joint (MTPJ) arthroplasty has a high failure rate due to aseptic loosening, which leads to bone loss. The salvage procedure is conversion to an arthrodesis, but bone loss can make obtaining screw fixation difficult. Herein, we report a unique case of revision first-metatarsal arthrodesis without the use of hardware after a failed arthroplasty.

Case Report: A 60-year-old women presented to us with first MTPJ pain in the setting of failed arthroplasty. We performed an arthrodesis; however, intraoperatively, hardware fixation could not be obtained due to bone loss. We utilized allograft bone struts to maintain first ray length and to hold the correct hallux position during arthrodesis maturation.

Conclusion: Bone loss is a frequently encountered problem in revision surgery to a first MTPJ arthrodesis. An arthrodesis can be obtained without the use of hardware in scenarios where bone loss precludes screw fixation.

Keywords: Hallux rigidus, revision, bone loss, arthrodesis

Introduction

Arthritis of the first metatarsal phalangeal joint (MTPJ), also known as hallux rigidus, is the most common arthritic condition of the foot, affecting 2.5% of patients over the age of 50 years [1]. Pain and loss of range of motion, specifically dorsiflexion, can make ambulation difficult. Conservative management should be attempted first and includes nonsteroidal anti-inflammatories, activity modifications, and stiff-soled orthotics to limit first MTPJ dorsiflexion [2]. When conservative treatment fails, operative intervention can be considered.

For patients with mild arthritic change, a preserved joint space, and pain with dorsiflexion only, dorsal cheilectomy may be performed with excellent results [3]. For patients with end-stage hallux rigidus, first MTPJ arthrodesis is the gold standard treatment [4]. Some surgeons, in an attempt to maintain motion at the joint, have treated hallux rigidus with a first MTPJ arthroplasty using either a silastic or metal implant [5]. Arthroplasties of this joint have a high rate of loosening, however, and often require a salvage surgery to fuse the joint [6]. Bone loss associated with loosening of the implant can lead to a shortened first ray and make obtaining a fusion challenging [7]. If bone loss is severe, obtaining screw fixation to create a stable construct spanning the joint can be difficult. A staged procedure to establish bone stock and create a fusion is sometimes needed, but obtaining a fusion in a single procedure in the setting of severe bone loss would be ideal. We report a single-stage first MTPJ arthrodesis without the use of hardware after a failed MTPJ arthroplasty.

Case Report

A 60-year-old female with a medical history of hypertension presented to the orthopedic foot and ankle clinic with progressive pain about her right first MTPJ. She reported

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Author's Photo Gallery


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Figure 1: Anteroposterior and lateral preoperative images showing loose metatarsal phalangeal joint arthroplasty.

Figure 2: Fluoroscopic images showing bone loss within the proximal phalanx and first metatarsal.

having a first MTPJ arthroplasty in 2004 and long-standing pain in her first MTPJ that worsened with walking. She had attempted a Morton's extension orthotic without pain relief.

On physical examination, there was tenderness to palpation about the first MTPJ, with mild swelling and a well-healed dorsal surgical scar. Range of motion of the joint was painful through the entire arc of motion. There was also tenderness to palpation on the plantar aspect of the second and third MTPJs, with corresponding plantar-based calluses, but normal sensation throughout the foot, with palpable pedal pulses, and brisk capillary refill in all toes.

Three-view radiographic evaluation of the right foot showed a prior first MTPJ arthroplasty with perihardware lucency indicative of loosening components (Fig. 1) and a shortened first ray. The patient was diagnosed with failed first MTPJ arthroplasty secondary to loosening of the components, with concomitant second and third transfer metatarsalgia. After discussing treatment options, the patient chose to undergo surgical intervention involving hardware removal and first MTPJ arthrodesis, along with second and third metatarsal head Weil osteotomies to address her metatarsalgia. Her pre-operative metatarsophalangeal-interphalangeal (MTP-IP) score was 39.

In the operating room, an incision was made through her prior dorsal surgical incision. Dissection was carried down to the first MTPJ arthroplasty. The components were grossly loose and were removed without difficulty. Curettes and a drill bit were used to debride the intramedullary portion of the distal first metatarsal and the proximal aspect of the proximal phalanx (Fig. 2). A 2-cm bone gap was identified, and inadequate bone stock remained in the proximal phalanx to allow for hardware fixation. A decision was made to proceed with arthrodesis without the use of hardware. Ten cc of bone marrow was aspirated from the proximal tibia and mixed with a bone substitute (NovoGro®, Osteonovus, Toledo, Ohio) for later use. Fibular strut allograft with adequate length to fill the bone void was measured under fluoroscopy and cut to appropriate size to hold the toe out to length. Traction was applied to the toe, and the strut grafts were placed across the joint and within the medullary canal of the first metatarsal and then the proximal phalanx (Fig. 3). The strut graft provided stability to the joint through its tensile effect. The bone graft substitute was packed into the proximal phalanx, first metatarsal head, and remaining first MTPJ space (Fig. 4). Weil osteotomies were performed on the second and third metatarsal heads through separate dorsal incisions to restore a normal cascade. The patient was placed in a posterior, short-leg splint postoperatively and made non-weight bearing.

At her 2-week follow-up, she was transitioned to a short-leg cast and continued her weight bearing restrictions. Radiographs at 1 month showed callus formation and graft consolidation at the first MTPJ (Fig. 5). The patient was transitioned to a fracture boot at 6 weeks, but was kept non-weight bearing until 3 months postoperatively. At her 3-month follow-up, the patient was transitioned to a forefoot rocker sole shoe with carbon plate insert and allowed to weight bear as tolerated. She reported no pain in her great toe. A computed tomography scan was obtained at 4 months postoperatively, which showed continued consolidation of the fusion. At 5 months postoperatively, the patient was back to wearing her normal shoes and reported no activity limitations, including jogging. At 2 years postoperatively, she reported no pain in the toe and was completely satisfied with the procedure. Her final MTP-IP score was 83.

Discussion

Primary first MTPJ arthrodesis is the gold standard procedure to address the advanced stages of hallux rigidus. Reported satisfaction rates are between 81% and 100% [8]. Techniques to prepare the joint surfaces for fusion include conical reaming and flat cuts [9]. These methods rely on adequate bone stock to maintain the length of the first ray and for implant fixation during the maturation of the arthrodesis. In revision scenarios, a shortened first ray can become problematic, and, if the joint is fused in situ, can lead to transfer metatarsalgia [10].

The dowel technique, described by Malagelada et al., utilizes a dorsal plate and iliac crest autograft shaped into a dowel to

Figure 3: Fluoroscopic image showing strut grafts in place across the metatarsal phalangeal joint.

Figure 4: Fluoroscopic image showing final strut graft and bone graft substitute construct spanning the metatarsal phalangeal joint.

Figure 5: 1-month post-operative anteroposterior image demonstrating maturation of arthrodesis.

conform and press-fit into the intramedullary canal of the metatarsal and proximal phalanx to maintain the length and alignment of the first ray [11]. They had a 100% fusion rate, with a 13% rate of symptomatic hardware requiring removal of the dorsal plate. A separate dowel technique, described by Tauro and Muirhead, used an iliac crest autograft dowel to obtain a first MTPJ arthrodesis during primary treatment of hallux rigidus [12]. In their technique, a dowel shaped piece of bone was removed across the joint in a dorsal-to-plantar direction while the great toe was held in ten degrees of dorsiflexion. A matching autograft dowel was then placed across the joint. They had a 92% fusion rate, and 72% of patients were satisfied.

Our decision to proceed without hardware was made intraoperatively purely due to inadequate bone stock for screw fixation. However, there are advantages to not using hardware, the foremost being cost savings. While implant prices vary widely depending on vendor-hospital contracts, Hyer et al. found that a dorsal plate construct for first MTPJ arthrodesis cost $603 on average [13]. Second, rates of symptomatic hardware requiring implant removal after first MTPJ fusion have been reported to be as high as 17% [14]; this complication is eliminated if no hardware is used. We used allograft bone to create our construct. Prior techniques have used iliac crest autograft. Using allograft, we eliminated the risk of donor-site morbidity for the patient. Finally, by foregoing a metallic implant, a potential nidus for infection is eliminated, as infection rates after foot and ankle surgery can range from 1% to 5.3% [15].

There are also drawbacks to this technique. First, while the dowels, combined with maintained collateral ligaments, provided sufficient stability in our patient for a fusion to mature, they do not provide as much stability as a dorsal plate construct. The compression achieved across the joint with dowels is presumably less than that achieved by a lag screw or compression plate, and this may lead to an increased risk of non-union. This necessitated a prolonged period of immobilization and non-weight bearing for our patient to allow for a solid arthrodesis to develop. Arthrodesis in a revision scenario has delayed union and non-union rates of 42% and 17%, respectively [6]. Second, setting and maintaining the position of the great toe are more difficult without an implant to hold the correct position. With an implant, the recommended fusion angles of ten to 20 degrees of hallux dorsiflexion and valgus [14] can be set and maintained by the hardware. In our case, the bone dowels were contoured and the bone graft packed in a manner to set the position of the toe, but there is an increased risk that the toe could drift to an improper position.

Conclusions

Revision MTPJ fusions present many challenges to foot and ankle surgeons. Most daunting among these challenges is the variable degree of bone loss. Within this case, we have shown that a successful arthrodesis can be obtained in the setting of bone loss without hardware.

Clinical Message

Bone loss after a failed first MTPJ arthroplasty presents a clinical challenge. Within this report, we demonstrated that an arthrodesis can be obtained in the setting of bone loss, and the patient can have a successful outcome, without the use of hardware.

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