

Takedown Interpositional Arthroplasty with Acellular Dermal Matrix for the Revision of First Metatarsophalangeal Joint Malunion

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Introduction & Purpose

The 1st metatarsophalangeal (MTP) joint arthrodesis has been utilized for treatment of severe or recurrent hallux valgus and varus deformities, rheumatoid arthritis, and osteoarthritis.(1-3) One pitfall to this procedure is the complications following a malpositioned hallux on the 1st metatarsal. The recommended position of the first MTP joint is 10-15 degrees in valgus, 20-30 degrees of dorsiflexion in reference to the axis of the first metatarsal, and in neutral rotation.(2-3) With inappropriate positioning, the hallux may provide an abnormal opposition to the ground reactive force resulting in increased or decreased loads to the hallux, ulceration, or adjacent joint arthritis.(1,5,6)

There is a paucity of literature regarding the treatment of a malunited 1st MTP joint arthrodesis. A crescentic saw osteotomy and opening wedge osteotomy have been described for the treatment of a malunited 1st MTP joint arthrodesis. (6,7) However, they have the disadvantage of being technically challenging. (7)

The Keller arthroplasty has been shown to improve first MTP joint range of motion in specific patient populations.(8) However, complications such as transfer metatarsalgia, decreased toe strength, cock-up deformity, and hallux malleus have been associated with this procedure. (9) Thus, procedures such as an interpositional arthroplasty to “reduce the complications, maintain range of motion at the first MTP joint, and provide more predictable pain relief” have been described to ultimately provide mechanical offloading. (9)

The current report describes the revision of a malunited arthrodesis of the first MTP joint with an interpositional arthroplasty and acellular dermal matrix to treat a chronic non-healing ulceration.

Case

Patient presents to office with a chronic diabetic foot ulceration located on the plantar aspect of the right first metatarsal head. After treatment consisting of offloading insoles, oral antibiotics, and wound care, the patient was unable to heal the wound. The patient underwent attempted realignment arthrodesis of the first MTP joint to relieve the osseous prominence. Internal fixation was achieved with an interfragmentary screw with a dorsal 1st MTP joint locking plate (Fig 1a-1b) (Wright Medical Technologies, Memphis, TN, USA). Patient experienced an uneventful post-operative recovery. However, 3.5 years after her 1st MTP joint arthrodesis, she returned to the clinic with complaints of a full thickness plantar hallux ulceration. The ulceration had a hyperkeratotic rim and mild erythema and edema. There were no signs of a sinus tract, drainage and did not probe to bone. Conservative measures, which involved silver alginate dressings, sharp debridement, topical/oral antibiotics, and offloading inserts were attempted over the course of several months. During this time, a second ulceration formed on the plantar aspect of the 1st MTP joint with no signs of acute infection. The chronic, non-healing nature of the wound was secondary to the malposition of the 1st MTP arthrodesis.



Figure 1a.



Figure 1b.



Figure 2



Figure 3a.



Figure 3b.



Figure 4a

Figure 4b



Figure 4c

Procedure

Hardware removal, 1st MTP joint interpositional arthroplasty with acellular dermal matrix, hallux IPJ arthrodesis, and gastrocnemius recession were performed in order to provide surgical offloading of the wound. The patient and surgeon agreed to the surgical intervention to prevent further ulceration distally and possible subsequent infection. The patient received a regional blockade prior to transport into the operating room. General anesthesia was obtained and a well-padded pneumatic thigh tourniquet applied. A modified Strayer technique was first performed.(10) The 1st MTP joint hardware was removed without complication. The union site was identified which was noted to be plantarflexed and abducted, and thus causing excessive pressure on the plantar hallux. A sagittal saw was used to perform a bone block resection from the head of the first metatarsal to the base of the proximal phalanx. A conical reamer was applied to the first metatarsal head in order to provide a more anatomical shape and eliminate sharp corners. A 5x5cm collagen matrix was placed into the arthroplasty site and wrapped around the first metatarsal head (Figure 2). This was maintained and secured into the surrounding capsular tissue with absorbable suture. (11) Next, the incision was carried distally where the hallux IPJ was exposed. Planal wedge resection was performed to correct the valgus deformity of the hallux IPJ. Once the wedge was removed, the hallux was able to be realigned. Two 2.0mm headless screws were placed across the arthrodesis site in standard fashion. Headless screws were selected in order to minimize the risk of pressure ulceration at the distal tuft of the hallux. Deep and superficial subcutaneous closure was obtained with absorbable suture and skin was closed with non-absorbable suture. A well-padded short leg posterior splint was applied to the operative extremity. Patient was non-weightbearing for 6 weeks. Serial wound debridements to the plantar IPJ and MPJ ulcerations with local antibiotics were performed until full epithelialization at 5 weeks post-operative (Fig 3a-3b). Patient has a final follow-up of 16 months without evidence of pre-ulcerative or full-thickness lesions or non-union to the IPJ.

Patient had an uneventful postoperative course with evidence of contraction to the ulceration. Antibiotic ointment and local wound care were continued. By the fifth postoperative month, the ulceration had completely epithelialized. At the 16 month follow-up, the patient remains free from recurrent ulceration (Fig 4a-4b).

Discussion

Ulcerations present on the plantar aspect of the 1st MTP joint and hallux IPJ may be present due to structural “foot deformities, limited joint mobility, peripheral neuropathy, presence of callus, and soft tissue thickness”(12) which result in an increased plantar pressure and a poor environment for soft tissue healing. Hallux ulcerations may arise due to the limited range of motion at the first MPJ.(13)

In this report, the plantarflexed position at the first MTP joint promoted the deforming force. This caused increased stress to the hallux IPJ and increased hallux purchase during the gait cycle. In addition to the malpositioned hallux, the first MTP joint immobility may magnify the plantar pressures resulting in ulcer formation.(15)

The acellular regenerative tissue matrix was used to provide a platform made up of an intact basement membrane, collagen fibers, fibronectin, proteoglycans, hyaluronan, and elastin. (16) This framework and an abundance of vascular channels allows the host to initiate the regenerative, as opposed to the reparative or scarring, process. The proper foundation of biochemical components allows further angiogenesis, cellular migration/differentiation, and influx of growth factors which allows the graft to incorporate and integrate with the surrounding tissue. The arrival of fibroblasts will promote increased collagen production, and with the presence of elastin rich microfibrils, the newly formed tissue will be grossly indistinguishable from the surrounding tissue. (16) The application of the acellular matrix thus aids in augmenting the soft tissue envelope surrounding the hallux and thus helps to prevent recurrence of full-thickness ulcerations to the area.

The current report describes the treatment of the malunited arthrodesis of the first MPJ with an interpositional arthroplasty with the use of an acellular dermal matrix. The goals of this procedure were to reduce the malpositioned hallux, treat the ulcerations present, and prevent recurrence.

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