



Hallux Interphalangeal Joint Arthroplasty

This is a well-known intervention for a hallux interphalangeal ulcer.

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Abstract

This case report describes a well-known intervention for a prevalent lesion, namely the diabetic foot ulcer plantar to the hallux of the interphalangeal joint. The hallux interphalangeal arthroplasty remains a valuable procedure for treating the chronic neuropathic ulcer. This article presents a case report of a frequently encountered condition. A discussion of the evaluation and management of this lesion is provided using this particular procedure. Although the duration of follow-up was only six months as opposed to the 12-month minimum required, the discussion presents a review of the pathomechanics involved in its etiology. Just prior to the patient's 12-month follow-up, she passed away from complications related to pneumonia.



Figure 1: Hallux interphalangeal ulceration of the great toe of the left foot.

numbness, tingling, and loss of protective sensation. Autonomic neuropathy often occurs with longstanding diabetes. It often accompanies the sensory symptoms.^{6,7} It often presents with increased skin temperature, decreased sweating, and dry skin. These combined factors play an additional role in tissue injury and breakdown. A motor neuropathy results in muscle weakness or limited motion of the intrinsic muscles of the foot.⁸

During the normal gait cycle, at heel strike, the foot becomes a mobile adaptor to the terrain by

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Introduction

Hallux interphalangeal ulcerations or ulcerations along the plantar aspect of the hallux interphalangeal joint is a common but challenging condition in the diabetic patient.¹ One of the most common sites of wounds on the sole of the diabetic foot is the plantar hallux.^{2,3} Furthermore, plantar ulcerations of the hallux are common occurrences in patients with diabetic neuropathy.⁴ Diabetes-related distal symmetric polyneuropathy results in a loss of protective sensation and subsequently a number of biomechanical

risk factors that conspire to cause tissue injury. Thus, the common link between diabetes mellitus and biomechanical changes of the foot are a direct result of diabetic peripheral neuropathy.⁵

Diabetic peripheral neuropathy is a symmetrical polyneuropathy that presents in a stocking and glove distribution with distal to proximal migration. The neuropathy can be sensory, motor, and autonomic in nature. Sensory symptoms include

unlocking the STJ and pronating the foot, and the leg internally rotates. The normal loading sequence of the forefoot during the gait cycle begins laterally and proceeds medially with 70 percent of normal toe loading occurring through the hallux. The metatarsals become fully loaded, and all five metatarsals are bearing weight at the end of the contact period. It is at this time that the vertical ground reaction forces peak at the ball and

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heel of the foot. As the foot moves into midstance, the STJ supinates and becomes a rigid lever for propulsion. Throughout midstance, the leg is externally rotating. During propulsion, there is a weight-bearing peak consumed only by the ball of the foot and toes. During the active phase of propulsion, the stance limb bears three times the body weight.

Normal pronation aids in shock absorption and adaptation; however, when pronation is abnormal, the foot becomes unstable during weight-bearing. Abnormal pronation leads to osseous instability, hypermobility, and subluxation of joints.

limited in the metatarsal phalangeal joint, compensation takes place distally at the interphalangeal joint. Again, in the diabetic foot, these additional negative forces can lead to tissue breakdown and ulceration. Limited joint mobility is associated with higher plantar pressures.^{10,11} The normal range of hallux dorsiflexion is approximately 50 degrees to the ground.¹² Marked reductions of hallux dorsiflexion are associated with high hallux pres-

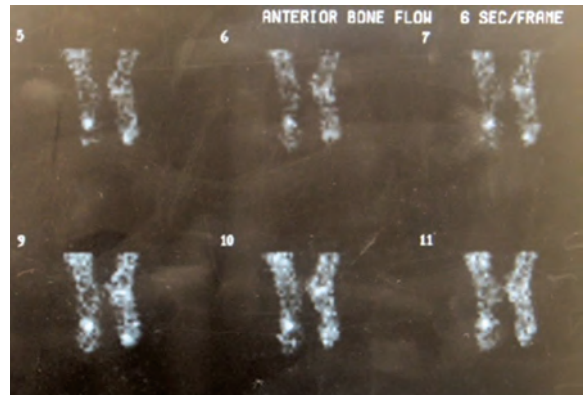


Figure 3: Pre-op three-phase bone scan showing increased uptake of the hallux left foot.

sure. This restriction of joint motion will often result in an a-propulsive gait, with the toe-off phase producing excessive pressure medially at the interphalangeal joint resulting in ulcerations.¹

Lack of an aggressive treatment plan can lead to recurrent ulcers and further complications such as amputation. If an amputation occurs at the hallux, the loading forces are shifted to the lesser digits increasing the risk of ulcerations elsewhere.⁷ A curative surgical procedure may be the only other option available to avoid hallux amputation.

In 1994, Rosenblum, et al. presented their experiences with the hallux interphalangeal joint arthroplasty in the treatment of the chronic ulceration of the hallux.¹⁴

Anecdotally, the first metatarsal phalangeal joint arthroplasty procedure performed in this study was initially described by Keller in 1904 and subsequently in 1912 for the correction of a bunion deformity.^{15,16} After this, the procedure remained popular but more so for the treatment of arthritis of the first metatarsal phalangeal joint, particularly in elderly or sedentary patients.^{17,18}

Presently, it has become an alternative procedure to address the

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The pathologies that result from this abnormal pronation may include hallux abducto valgus, hallux limitus, hallux rigidus, and hammer-toes.⁹ Any biomechanical abnormality that results in hyperpronation can predispose the medial aspect of the great toe to ulceration. The resultant gait will often produce a final toe off along the medial aspect of the interphalangeal joint and may clinically manifest as a callus or ulcer. Another common mechanical abnormality resulting in increased stress across the interphalangeal joint is hallux limitus or rigidus. As motion becomes



Figure 2: Pre-op foot x-ray of the left foot showing loss of joint space at the first MPJ and IPJ, resulting in a rigidus deformity.

sures. Non-enzymatic glycosylation causes excessive cross-linking of collagen, and hence makes collagen stiffer, limiting the mobility of joints, ligaments, and muscles. These high plantar pressures and limited joint motion can all lead to tissue injury.¹³

Proximal and distal phalangeal exostosis, degenerative arthritis with secondary joint limitus/rigidus, and an accessory interphalangeal sesamoid bone are some of the common structural causes of the ulceration. In the presence of a large exostosis, secondary shoe pressure and reactive forces can lead to increased tissue stress and tissue breakdown in the diabetic patients with neuropathy. In the presence of advanced degenerative arthritis, a secondary interphalangeal joint limitus/rigidus deformity



Figure 4: Transverse Incisional Approach: A transverse incision is placed over the hallux interphalangeal joint.



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hallux ulceration in the diabetic patient.^{19,20} Studies conducted by Armstrong, et al., in 2003, were the first studies reporting its safety and efficacy in treating these chronic wounds of the plantar hallux as compared to non-surgical therapy.²¹ Simple resection arthroplasties have few complications which included infection, wound dehiscence, failure of fixation, recurrence of the lesion, and digital mal-alignment.

Case Report

A 70-year-old woman presented to Noyes Health/University of Rochester Medical Center with a neuropathic ulcer on the plantar medial aspect of the great toe of the left foot over



Figure 5: Transection of the extensor hallucis longus tendon is made to gain exposure to the interphalangeal joint and the head of the proximal phalanx.

sensation bilaterally; and on biomechanical examination, she exhibited a functional hallux limitus at the



Figure 6. Appearance of final closure.

plete blood count, blood chemistry profile, x-rays, and a three-phase bone scan. The abnormal findings were the following: (1) an abnormally elevated renal function, (2) x-rays indicating narrowing of the joint space of the metatarsal phalangeal joint as well as the interphalangeal joint of the hallux, (3) previous bunionectomy and previous Akin procedure with a metallic implant/fixation (Figure 2) and a three-phase bone scan showing increased uptake in the hallux on the delayed phase (Figure 3).

To rule out the presence of osteomyelitis, the patient was scheduled for a bone biopsy. However, the patient's condition failed to respond to conservative therapy. Consideration was given to perform a curative procedure to address the recalcitrant ulcer and the abnormalities predisposing this patient to this particular ulcer. A simple resection arthroplasty of the

interphalangeal joint was performed. A three-centimeter transverse incision was made across the hallux interphalangeal joint (Figure 4).

Transection of the extensor hallucis longus tendon allowed exposure of the joint and resection of the head of the proximal phalanx of the hallux (Figure 5). Portions of the head of the proximal phalanx as well as specimens of bone from the base

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The patient's medical history was significant for controlled diabetes mellitus, peripheral neuropathy, sarcoidosis, rheumatoid arthritis, chronic renal failure, chronic obstructive pulmonary disease, and hypertension.

six months duration. The patient could not remember sustaining trauma to the area or any activity that could have precipitated the lesion. The patient was treated with conservative care for over six months. The conservative care of the ulcer consisted of serial debridement in the office, offloading and pressure relief, use of various dressings, and antibiotic therapy.

The patient's medical history was significant for controlled diabetes mellitus, peripheral neuropathy, sarcoidosis, rheumatoid arthritis, chronic renal failure, chronic obstructive pulmonary disease, and hypertension. She has had previous surgeries which have included a right knee replacement, appendectomy, left foot bunionectomy, hysterectomy, ORIF of the ankle, and a cystocele repair. The patient's vital signs were within normal limits and review of the vascular and musculoskeletal systems was unremarkable. The only abnormal finding was diminished

metatarsophalangeal joint, overpronation foot type, and final toe-off at the interphalangeal joint.

Physical examination revealed a full thickness ulcer along the plantar medial aspect of the hallux interphalangeal joint of the left foot (Figure 1). The ulcer measured approximately .4 cm (length) x .5 cm (width) x .1cm (depth). It was regular in shape, and its borders were surrounded by hyperkeratosis. A minimal serous exudate was noted draining from the wound. The ulcer was not tender to palpation.

Diagnostic testing was performed consisting of a com-



Figure 7: Post-op foot x-ray of the left foot showing resection of the head of the proximal phalanx.



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of the distal phalanx were submitted to pathology and microbiology for analysis. The wound was closed in anatomic layers and sterile dressings were applied (Figure 6). None of the resected specimens were positive for osteomyelitis. In this case, where osteomyelitis was suspected, pin fixation was not used. Post-operative x-rays were taken to ensure adequate resection of bone (Figure 7).

In this case, the patient developed wound dehiscence along the dorsal incision; however, she did go on to heal using traditional wound care in less than four weeks. There was no incidence of a recurrence. This case was followed for a minimum of six months post-operatively.

Discussion

The management of a hallux interphalangeal joint ulceration is often difficult owing to the predisposing fac-

tors, including biomechanical, structural abnormalities, and any co-existing morbidities. Increased stress or pressures at the great toe can result in callus formation. In the case of a diabetic patient with neuropathy, this

eration had to be made to perform a more curative procedure, and thus avoid amputation of the hallux. The hallux interphalangeal joint arthroplasty proved to be a viable option in the treatment of this particular ulcer.

The hallux interphalangeal joint arthroplasty proved to be a viable option in the treatment of this particular ulcer. Not only did it prove to be curative, but the procedure was technically not difficult and involved minimal soft tissue and osseous disruption.

may lead to ulceration as well as possible amputation. In the case reported here, peripheral neuropathy, hyperpronation, and a hallux rigidus were all underlying factors.

Once the ulcer failed to heal using traditional conservative care, consid-

Not only did it prove to be curative, but the procedure was technically not difficult and involved minimal soft tissue and osseous disruption. It also benefited the patient in that it not only preserved the biomechanics of

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the first ray but improved it. Potential complications were minimal. These outcomes must be weighed against those of the traditional alternative... amputation of the hallux.

Care must be taken to select patients for this procedure. Most of these patients who exhibit diabetic neuropathy have co-existing morbidities making them less than ideal surgical candidates. Traditionally, surgeons have been reluctant to perform this type of operative procedure on the diabetic patient; however, as our knowledge of diabetes has increased, as well as advances in endovascular repair, more and more of these patients are being considered acceptable surgical candidates. Adherence to strict glycemic control should be implemented prior to surgical intervention to ensure good outcomes. In this case, the patient's hemoglobin A1c was 5. Despite the patient's other medical conditions, she tolerated IV sedation anesthesia, and the procedure went very well.

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In this case, once the hallux interphalangeal joint arthroplasty was performed, and the complication of the wound dehiscence along the incision healed, the patient's condition resolved and she healed uneventfully. The patient suffered numerous co-existing morbidities and passed away just short of her 12-month follow-up secondary to complications related to pneumonia. **PM**

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