



# Surgical Off-loading of Plantar Hallux Ulcerations

These approaches can be used to treat DFUs.

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**I**ncreased pressures at the plantar aspect of the hallux leading to chronic hyperkeratosis and ulceration is a common finding in patients with diabetes mellitus. Alleviating increased plantar pressures in the foot, in addition to local wound care, is a key component to treating most diabetic foot ulcerations. The mechanics of off-loading the foot is the area of treatment in which podiatric physicians are experts. Our early intervention, conservative or surgical, may be the difference between healing and amputation.

Once local blood perfusion is confirmed to be adequate for healing, either by non-invasive studies or by referral to vascular surgery, aggressive off-loading should be initiated. Off-loading is important as local areas of sustained pressure may decrease local capillary blood perfusion leading to local tissue ischemia. As pressure increases, friction will also increase, leading to local trauma of the skin and deeper tissues. The local tissue ischemia and damage from friction may result in increases in inflammation, signaling the cellular cascade of events creating the hallmark hyperkeratosis. When neuropathy is present, these events often go unnoticed by the patient and ulceration may eventually follow.

The use of diabetic shoes to protect and off-load feet in patients with diabetes mellitus is appropriate



Figure 1: Lateral view plain radiograph demonstrating Keller bunionectomy.

when only hyperkeratosis is present. However, once these areas of increased pressure have progressed to ulcerations, shoes are typically inadequate.<sup>1</sup> The use of a total contact cast to offload diabetic foot ulcerations is

tar foot is healed with aggressive wound care and off-loading only to re-open in a few months at the same location. When this situation occurs, surgical options for permanent off-loading should be considered. The plantar hallux is one such area of common re-occurrence.

## Keller Bunionectomy

The Keller bunionectomy utilizes resection of the base of the proximal phalanx of the hallux to increase motion across the 1st MTP joint. The resection of bone is angled in a fashion to remove more bone dorsally than plantarly to help

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considered by many to be the gold standard. Other products, such as ankle immobilizing (CAM) boots and DH walker boots, have also shown to reduce pressure around wounds. However, these products often do not produce the same level of success to heal diabetic foot ulcers as total contact casts. It has been shown that these shortcomings may not be in the products themselves but in the ability of the patient to be compliant in their use.<sup>2</sup>

Often the ulceration on the plan-

prevent hallux instability (Figure 1). This procedure is ideal in patients who have end-stage hallux limitus and loss of joint mobility. Its advantage stems from the fact that no hardware needs to be implanted. However, it is a joint-destructive procedure.

Figure 2 displays an ulceration at the plantar surface of the right hallux in a 44-year-old male with diabetes mellitus. The ulceration had been present for six months and has

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Figure 2: Ulceration at the plantar surface of right hallux in a 44-year-old male with diabetes mellitus.



Figure 3: Healed plantar hallux ulceration after Keller bunionectomy.

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failed conservative measures. Figure 3 demonstrates resolution of this ulceration six weeks after the surgical intervention.

## Hallux IP Joint Arthroplasty

The simple resection of bone from the interphalangeal joint is also an effective procedure that works by decreasing the length of the lever arm of the proximal phalanx. In addition to the pressure reduction at the proximal phalanx, it often creates instability of the IP joint, allowing the distal phalanx to dorsiflex when pressure occurs, and reducing pressure at the distal phalanx level as well. However, the resultant hallux IP joint extension deformity may lead to weakness in the hallux during push-off and may be more likely if aggressive resection is performed.

A 56-year-old male with diabetes mellitus and chronic plantar hallux ulceration presents with an acute infection reaching the interphalangeal joint and the surrounding soft tissue necrosis (Figure 4). Joint arthroplasty was performed to provide off-loading and resect the potentially infected bone and joint (Figure 5). Resection of bone was also coupled with aggressive local wound care, which eventually led to healing five months thereafter (Figure 6).



Figure 4: Extensive soft tissue loss and infection involving the interphalangeal joint stemming from plantar hallux ulceration.



Figure 5: Oblique view plain radiograph demonstrating resection of the interphalangeal joint.



Figure 6: Healed plantar hallux ulceration after interphalangeal joint resection.



Figure 7: Chronic hyperkeratosis and ulceration at plantar hallux.

## Moberg Bunionectomy

This bunionectomy is best described as a closing wedge osteotomy at the base of the proximal phalanx. It changes the position of the hallux, dorsiflexing the resting position. There are many advantages with this procedure as it does not require surgical exposure into the first MTP joint, is joint saving, and may be performed through a limited incision. One potential drawback is that fixation hardware is placed with this procedure to secure the osteotomy. It may be fixated with two crossing percutaneous K-wires given that the plantar cortex is maintained with the osteotomy. These K-wires are removed in clinic once the osseous healing is occurring, usually four weeks after surgery. Additional types

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Figure 8: Lateral view plain radiograph demonstrating Moberg bunionectomy with hybrid staple-plate fixation.



Figure 9: Lateral view plain radiograph demonstrating Austin-Youngswick bunionectomy with single screw fixation.

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of fixation include the use of staples or small plates.

Figure 7 shows ulceration in a 30-year-old male with diabetes mellitus present for over seven months before surgery was pursued. This chronic, festering ulceration began as hyperkeratosis that had itself begun years prior.

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The ulceration would heal and re-occur over the seven-month period while treated aggressively with local wound care. Figure 8 demonstrates the result of surgical intervention with a Moberg bunionectomy.

### **Austin-Youngswick Bunionectomy**

The Austin-Youngswick bunionectomy is a commonly utilized procedure used to address hallux limitus, achieving results by plantarflexing the head of the 1st metatarsal (Figure 9). This osteotomy changes the axis at which the hallux functions on the MTP joint, resulting in potentially increased dorsiflexion of the hallux at rest and increased dorsiflexion with ROM. This procedure requires

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the placement of fixation hardware and the healing of an osteotomy of the 1st metatarsal.

Often, how much motion may be gained is unpredictable. While increased dorsiflexion of the hallux may be gained by more aggressive plantarflexion of the 1st metatarsal head, this increased plantarflexion will increase local pressures under the 1st metatarsal head and a possible transfer lesion. In addition, aggressive plantarflexion of the 1st metatarsal may also result in floating of the hallux and eventual hallux hammertoe.

### 1st MTP Joint Fusion

While arthrodesis of the 1st MTP joint may seem aggressive, it is a viable option in cases of medial column instability. Often, when excessive pronation occurs, flexion contractures and equinus of the hallux proceed as the flexor muscles are recruited to assist in stabilizing the foot and push-off in gait. Arthrodesis of the hallux corrects the hallux flexion deformity. It may also help provide stability to the medial column in cases when more



Figure 10: Chronic ulceration with severe hyperkeratosis at the left hallux.



Figure 11: Healed plantar hallux ulceration after successful 1st MTP joint arthrodesis.

advanced surgery to correct the flat foot is not felt to be appropriate. The drawbacks of this procedure include healing of the arthrodesis site as well as the need to place internal fixation.

A 73-year-old male with T2DM presented to the clinic with left plantar hallux ulcer that he stated had been present for “10 years.” (Figure 10) Radiographs were performed and no signs of underlying osteomyelitis were detected. Local wound care and off-loading were trialed, but eventually surgery was scheduled. The patient had severe pes valgus and hallux equinus which persisted at rest and in response a 1st MTP joint arthrodesis was performed. The ulceration healed six weeks after surgery (Figure 11).

### TAL and Gastrocnemius Recession

Percutaneous tendo-Achilles lengthening and gastrocnemius recession are both described as successful procedures to relieve abnormal forefoot pressures, allowing ulcerations to heal. While the percutaneous tendo-Achilles lengthening is a very powerful adjunctive procedure, there are many risks associated with it. Most importantly, the amount of lengthening is difficult to control and being too aggressive with the procedure can risk tendon rupture and loss of plantar flexion muscle strength. Over-lengthening may result in a calcaneal gait, and in patients with an insensate heel the procedure may result in a new site of ulceration.

The loss of plantar flexion strength due to over-lengthening may also lead to flexor muscle recruitment to help with push-off during gait and could result in increased pressures at the plantar hallux. Another adjunctive procedure, the gastrocnemius recession, has gained in popularity over the years. The primary advantages of the gastrocnemius recession is the maintained integrity of the soleus muscle and the insertion of the triceps surae. There is lower risk of both weakness and rupture of the tendo-Achilles after the procedure.

The final advantage of the gastrocnemius recession over the percutaneous tendo-Achilles lengthening, which may be most applicable to patients with diabetes mellitus,

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is the post-operative course. After undergoing a percutaneous tendo-Achilles lengthening, a period of non-weight-bearing is required. This might prove to be too difficult for patients who are already older, fragile, or deconditioned. The gastrocnemius recession does permit immediate protected weight-bearing in an ankle-immobilizing (CAM) boot or total contact cast, which allows for increased compliance and typically is already being utilized before surgery as part of the off-loading wound care plan.

Whenever performing surgery on patients with diabetes mellitus, evaluating the capacity to heal should always be performed. Non-invasive vascular studies should be considered in any ulceration with delayed healing and

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before scheduling surgery. Checking Hemoglobin A1c levels to determine the level of blood glucose control may provide predictive value in healing as well as patient compliance to post-operative instruction. Additionally, as chronic ulcerations are typically in proximity to the surgical incision site, a closely monitored post-operative course is also recommended, especially as diabetes mellitus does compromise the immune response.

Lastly, it is important to note that being too aggressive with these procedures, or any surgical off-loading procedures, may lead to transfer lesions. Transfer lesions occur when pressure is reduced in one area only to cause a new area of pressure at an adjacent location. The ultimate goal when performing surgical off-loading is not to just reduce pressure at a specific location, but rather to evenly distribute plantar pressures. In any case, it is always important to discuss this risk with patients before surgery as it is a potential complication with any surgical off-loading procedure. **PM**

## References

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<sup>2</sup> Armstrong, D.G., et al., Activity patterns of patients with diabetic foot ulceration: patients with active ulceration may not adhere to a standard pressure off-loading regimen. *Diabetes Care*, 2003. 26(9): p. 2595-7.



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