Percutaneous medial band plantar fasciotomy for treatment of chronic plantar hallux ulcers

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ARTICLE INFO

INTRODUCTION

Diabetic foot ulcers can lead to infections and amputations which have high morbidity and mortality. With a 1 year diabetic foot ulcer recurrence rate of 40%, conservative treatment is often exhausted, resulting in a need for surgical offloading.1 The choice of procedure varies based on anatomic location. The most common diabetic foot ulcer is located in the plantar hallux.2 Lesser toe ulcers are easily treated with a percutaneous flexor tenotomy,3 however for specifically hallux interphalangeal joint ulcers (IPJ), surgical options are traditionally arthroplasties.4-7 Open surgery that involves excising bone in close proximity to an ulcer carries the risk of surgical site infection and wound dehiscence.8

Tendo-Achilles lengthening (TAL) can be performed to offload forefoot ulcers, but carries up to 21.4% risk of transfer ulcer to the heel.8 Recently, Kim et al described a selective plantar fascia release to offload metatarsal head and toe ulcers, and reported no transfer ulcers to the heel, no surgical site infection, and no wound dehiscence.9 They performed the release on 60 patients with a small stab incision. Although they reported no surgical site complications, we had concerns about offering a procedure with an incision on a weight-bearing surface for patients who wanted to return to work or activity immediately after surgery. We describe a modification to the open plantar selective band plantar fasciotomy technique using an 18-gauge needle to minimize the surgical footprint.

MATERIALS AND METHODS

STUDY DESIGN

From August 31st, 2020 to January 1st, 2021, 6 patients with diabetic foot ulcers plantar to the hallux IPJ were treated with a selective medial band plantar fasciotomy with an 18-gauge needle. All ulcers were recalcitrant to conservative treatment of over 6 months consisting of felt pad offloading, prescription shoes, and trilaminer insoles. One ulcer was partial thickness at time of intervention, but had a history of ulcer recurrence. Ulcer sizes ranged from 0.1×0.1×0 cm partial thickness ulcers to 0.9×0.8×0.1 cm full thickness ulcers (Fig. 1). Healing was defined as epithelization of the ulcer. The follow-up period ranged from 12 months to 18 months. All patients had functional hallux limitus defined as limitation in dorsiflexion range of motion with the first ray loaded, and lacked radiographic evidence of degenerative changes to the first metatarsophalangeal joint. Two patients were lost to follow-up immediately after the procedure.

SURGICAL TECHNIQUE

All procedures were performed in clinic under local anesthesia. The medial plantar fascial band was identified by palpation while holding the hallux and first ray in dorsiflexion. The easiest area to palpate the fascial band was usually around 2 cm proximal to the tibial sesamoid.

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SURGICAL TECHNIQUE

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This area was then marked, indicating our entry point for the 18g needle. Local anesthesia was then administered 1cm proximal to the marked entry point to avoid clouding the ability to palpate the band during the procedure, which was critical to confirm completion of the procedure. The foot was prepped with chlorhexidine, and a hypodermic 18-gauge needle was inserted from the medial side of the plantar fascia (Fig. 2). Multiple careful swipes were made along the coronal plane with the needle with one hand while the other hand was loading the first ray applying tension to the plantar fascial band. This maneuver made the fasciotomy easier to perform. Care was made to transect a few fibers at a time while advancing a little deeper after each swipe. The superficial plantar fascia fibers have attachments to skin, so care was taken to keep the needle deep to dermis. Swipes performed from superficial to deep created skin dimpling, which was a sign of thorough transection of those superficial fibers.

In the author’s experience, it was difficult to feel the subtle increase in hallux dorsiflexion, so confirmation of the release was done by removing the needle and palpating for the defect. Another confirmation was done by re-inserting the needle and gently swiping the needle again in the coronal plane to feel for any snags of residual fibers. The flexor hallucis brevis and abductor hallucis brevis muscles were not violated during the procedure so bleeding was usually scant. Hemostasis was easily achieved by applying direct pressure to the entry point, and then dressed with gauze and Coban, or 4×4cm Covaderm bandage. The patient was allowed to ambulate immediately in their regular shoes.

Results

All 4 patients healed their plantar hallux ulcer within 13 weeks of the procedure. All puncture sites healed in less than 1 week (Fig. 3). No patient developed recurrence at final follow-up (Fig. 4). There were no surgical site infections or hematomas (Table 1). All patients had strong plantarflexion of the hallux at the level of the IPJ, confirming integrity of the flexor hallucis longus tendon. No patient developed hallux extensor or transfer ulcer to the 1st metatarsal head at final follow-up. Three
of the four patients developed transfer ulcers to the second toe after 11 weeks. One transfer ulcer resolved with conservative treatment. Two of the transfer ulcers underwent flexor tenotomy of the second toe with an 18g needle which healed in a month, with no additional transfer ulcers. One patient had mild pain at the surgical site along the arch that resolved without treatment. All patients were satisfied with the procedure.

**Discussion**

There are many surgical options for the treatment of diabetic foot ulcers located under the hallux IPJ. One surgical option is a TAL, which has a healing rate ranging from 85.7% to 100% when performed to treat forefoot and midfoot ulcers. However, the data on the recurrence rate is highly variable, ranging from 0% to 41.7%.

Biomechanical cadaver studies have found that when the plantar flexion muscles eventually regained their strength after a TAL, Location specific surgical offloading such as IPJ arthroplasty or Kel- ler arthroplasties appear more favorable to TAL. A recent meta-analysis included nine studies quantitatively assessed the high efficacy and low recurrence rate of the resection arthroplasty procedure. They found a 6.5% rate of transfer ulcer to adjacent metatarsal heads or lesser toes, with no transfer ulcers to the heel. In terms of complications they found a 5.7% recurrence rate, 9.4% developed wound dehiscence and most concerning is that 16.4% developed infection.

Patients with hallux IPJ ulcerations have a component of hallux limitus. Biomechanical cadaver studies have found that when the plantar fascia is placed under higher tension, it reduces hallux dorsiflexion. Boffelli et al found that 28 of 29 patients with their first diabetic ulcer to the great toe had structural hallux limitus. Molines-Barroso et al conducted a prospective trial in patients with healed diabetic foot ulcers and found that structural hallux limitus was predictive of recurrence of ulceration in the hallux. Harton et al demonstrated that in individuals with no pathology of the first metatarsal phalangeal joint experience a 9.8 degree increase in dorsiflexion of the first metatarsal phalangeal joint following an in-step plantar fasciotomy. While this study was treating plantar fascitis in patients without diabetes, it does support our findings that an in-step plantar fasciotomy has the potential to treat plantar hallux ulcers.

The selective plantar fascia release for the treatment of non-healing diabetic plantar ulcerations was first described by Kim et al in 2012 for various locations of diabetic forefoot ulcers. They reported no surgical site complications, no transfer lesion to the heel, and an impressive 0% recurrence rate. However, they found a success rate of healing only 60% of all ulcers in the study. They did not report their results for the procedure performed for just the hallux IPJ. For lesser toe ulcers, we prefer the flexor tenotomy procedure which has a 97% healing rate and 6% recurrence rate. However for the plantar hallux IPJ ulcer, we found the selective medial band plantar fasciotomy to be very effective and believe that Kim et al’s selective plantar fasciotomy procedure for plantar hallux IPJ ulcers may have better results than the combined results for all forefoot ulcers.

Three of the four patients in our study developed transfer ulcers to the second toe, two of which required flexor tenotomy to heal. This is a shared problem with arthroplasties of the hallux to treat neuropathic hallux foot ulcers. Berner et al’s case series of 13 Keller arthroplasties to offload a hallux ulceration described 5 transfer ulcers to the adjacent metatarsal heads. Lew et al’s study on hallux IPJ arthroplasties found two transfer lesions in 13 patients, one to the second toe, and one to the second metatarsal head. In Rosenblum et al’s study of 45 hallux IPJ arthroplasties, 20% had problems healing either the ulcer or the surgical site. Two transfer lesions were also found to the second toe tip in the form of subungual hematoma. We believe that transfer ulcers to lesser toe tips are minor compared to metatarsal head ulcers, as they can be treated with high success and less invasive techniques than metatarsal head ulcers. Additionally, an infection of a lesser toe ulcer requiring amputation will have a better prognosis than hallux ulcers requiring amputation.

All of our patients healed their ulcers within 13 weeks, had no recurrence at 1 year follow-up, and had no surgical site infections or dehis- cence. There were no transfer lesions to the metatarsal heads or the heel. This procedure has promise to be an alternative to traditional open surgeries with less complications. Our paper is a small case series, and more research will be needed to evaluate the efficacy and reproducibility of our described technique. In conclusion, selective release of the medial plantar fascial band can be performed with an 18-gauge needle for the treatment of recurrent or recalcitrant neuropathic plantar hallux IPJ ulcers.

**Informed patient consent**

Verbal and written informed consent were obtained from all patients to be included in the study.

**Declaration of competing interest**

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

**Acknowledgement**

We would like to thank Dr Ersta Ferryanto, DPM for his medical illustration in Fig. 2.

**References**


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**Table 1**

Demographic information with baseline ulcer size, time to healing, follow-up duration, and complications.

<table>
<thead>
<tr>
<th>Age (Years) and Sex</th>
<th>Ulcer Size</th>
<th>Time to healing</th>
<th>Follow-up</th>
<th>Complications</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 YO F</td>
<td>0.1 × 0.1 cm partial thickness</td>
<td>2 weeks</td>
<td>12 months</td>
<td>New transfer ulcer to second toe after 1 year</td>
</tr>
<tr>
<td>41 YO M</td>
<td>0.9 × 0.5 cm full thickness</td>
<td>5.5 weeks</td>
<td>12 months</td>
<td>Mild arch pain</td>
</tr>
<tr>
<td>49 YO F</td>
<td>0.9 × 0.8 cm full thickness</td>
<td>13 weeks</td>
<td>12 months</td>
<td>Transfer ulcer to second toe 11 weeks later, requiring flexor tenotomy</td>
</tr>
<tr>
<td>52 YO M</td>
<td>0.2 × 0.2 cm full thickness</td>
<td>8 weeks</td>
<td>18 months</td>
<td>Transfer ulcer to second toe 9 months later requiring flexor tenotomy</td>
</tr>
</tbody>
</table>


