The Utility of Percutaneous Flexor Tenotomies in a Clinical Setting

Here's a review of the literature and an update on recommendations.

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Introduction

Pedal ulcerations can be a devastating manifestation experienced in diabetic patients. In those with diabetes, it has been shown that the intrinsic musculature of the foot atrophies leading to tendon contractions and ultimately digital deformities.[1] These deformities leave the dorsal and apical surfaces of the digit particularly vulnerable to continued microtrauma. Ultimately, toe deformities have been associated with the development of ulceration to the apical and dorsal surfaces, particularly in the presence of complicating factors such as neuropathy and peripheral vascular disease.[2] Any open wounds in diabetic patient, predispose them to a high risk for infection requiring surgical intervention and amputation.

Healing diabetic toe ulcers can be a challenging process for both the patient and podiatric physician. It is generally a process with not only high recurrence rates, but also one that is deleterious on the patient's quality of life. Pedal ulcerations in diabetics require frequent trips to the physician's office, daily wound care routines, increasing costs and yet, can still end in amputation. Traditionally, conservative approaches to these toe ulcerations have included pressure offloading using padding, insoles, therapeutic footwear along with routine debridements of the wound.[3]

It has been shown that surgical intervention through flexor tenotomies reduces the deformity which should allow for quicker wound healing and decreased amputation rates.[4] Historically, open tenotomies have been performed in the operating room and generally included adjunctive boney procedures (Figure 1). In these instances, the patient likely has to undergo pre-operative medical clearance due to the use of anesthesia and potentially even a vascular work-up. Often, these extensive medical work-ups can become more cumbersome to the patient than undergoing the surgery.[3] Additionally, full forefoot reconstructions on high-risk patients require extensive post-operative care such as a period of non-weight-bearing, pin care, and an extensive wound healing process of their incisions. With the combination of their extensive comorbidities, a simpler, more effective, and less invasive solution should be strongly considered.

Figure 1: Traditional forefoot reconstruction surgery.

It has been shown that surgical intervention through flexor tenotomies reduces the deformity which should allow for quicker wound healing and decreased amputation rates.

More recently, Camasta, et al. has described a less invasive proce-

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dure using percutaneous techniques that can be performed easily in the clinical setting.[5] The purpose of this article is to provide an update on the effectiveness of percutaneous flexor tenotomies as well as present recommendations on the indications, timing, and ultimately the benefits of the procedure.

Indications

Much like the procedure described by Camasta, et al., this procedure can be used to treat flexible digital contractures in patients with distal digital ulcerations.[5] When evaluating patients in the clinical setting, it is important to make sure they have a flexible or semi rigid digital deformity at the proximal interphalangeal joint with a reducible deformity at the metatarsophalangeal joint level.[5]

Figure 2: Digital deformities on a patient with prior hallux amputation.

A broadened list of indications can be proposed for the use of percutaneous flexor tenotomies in the clinical setting. First off, this procedure has been shown to be powerful not only as treatment for open wounds but also as a prophylactic treatment.[6] Patients who have digital deformities with distal digital hyperkeratotic lesions, especially those with petechiae, should undergo this procedure prophylactically before they can even begin to develop a full thickness, open wound.

Secondly, the clinical application of the percutaneous tenotomy has a very important role in post-amputation patients. Podiatric physicians should critically evaluate patients who have undergone a partial hallux amputation, a full hallux amputation, or a partial first ray amputation that have remaining digital deformities (Figure 2). These remaining digital deformities now take on more trauma and irritation in foot gear post-amputation, increasing the chance of developing toe ulcerations.

Figure 3: Complication seen in a patient waiting for medical clearance.

This procedure can be used to treat flexible digital contractures in patients with distal digital ulcerations.

Furthermore, this technique should be implemented in the clinical setting in patients who are at high risk with multiple comorbidities. These patients with complications risk having their traditional operating room procedures significantly delayed due to extensive pre-operative medical clearance, and having to undergo further testing, imaging, or examinations. The goal is to prevent patients with stable toe ulcerations having the unfortunate complication of becoming infected and needing urgent amputation due to delays while undergoing medical clearance (Figure 3). Being able to perform percutaneous flexor tenotomies in the clinical setting completely avoids waiting on delays to formal surgical intervention. Percutaneous flexor tenotomies also offer a much less risky procedure and more predictable outcome.[2]

Procedure

If performed correctly, this technique is quick, safe, and immediately effective. This technique should be performed using aseptic technique; however, because it is performed in the clinical setting, it does not require any sedation. The patient can remain seated or supine for the procedure. If necessary, the surgeon can use 3-5cc of the local anesthetic of their choice about the toe via a digital block. No tourniquet is needed for this technique.[5]

Figure 4: Percutaneous tenotomy technique using an 18-gauge needle.

The patient attempted to plantarflex the digit while the surgeon simultaneous hyperextends the digit as the FDL tendon is percutaneously released plantarly with a #15 blade, #11 blade, or 18-gauge needle at the sulcus that corresponds to the level of the proximal interphalangeal joint (PIPJ) (Figure 4). At our institution, we preferably recommend the use of 18-gauge needles. The technique requires tactile feel as the physician uses the sharpened, bevelled edge of the needle to transect through the tendon with a sweeping motion (Figure 5). When the tendon has been fully released, there will

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likely be a sudden increase in dorsiflexion of the toe. The physician can then verify this by asking the patient to again plantarflex the toe; and if the tendon has in fact been adequately transected, significant flexion should not be seen.[7] This procedure can be performed on any number of toes therapeutically or prophylactically. Primary closure of the site is optional.

The procedural site is normally dressed with topical antimicrobial ointment and gauze dressing to splint the toe in its corrected state. It's generally recommended to have patients keep this dressing in place for the first 24 hours. Upon removal, they should perform dressing changes at home daily with bacitracin or iodosorb until their two week post-procedural office visit.

It is recommended that patients who are at high risk, for example have a current open wound, be placed on doxycycline for 5-7 days. Those who are low risk and have no history of wounds do not need to be placed on antibiotics. Patients are encouraged to follow up at the two week point at which the incision sites are generally well healed.

The CPT code recommended is CPT 28010 (flexor tenotomy of single tendon, single toe) or 28011 (flexor tenotomy of multiple tendons, single toe).[8]

Results

Through a recent prospective study, Smith, et al. reported on the safety and effectiveness of performing office based percutaneous flexor tenotomies. 76 tenotomies were performed on 23 patients, in whom there were 11 toe ulcers and 41 pre-ulcerative lesions. They found that the mean time to healing the toes that had ulceration was 10.2 ± 4.3 days, and they reported no recurrence of ulcerations. All participants strongly agreed that they were satisfied with their outcomes, and 97% reported that they would recommend this procedure to others.[9]

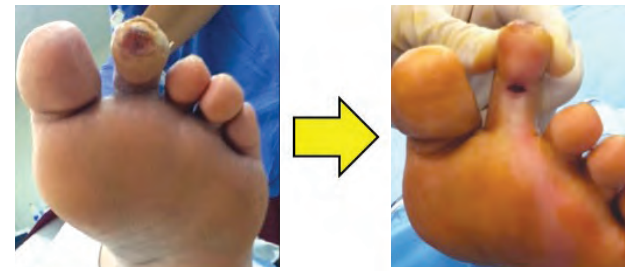

Figure 5: Pre- and Immediate post-percutaneous flexor tenotomy.

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Bonanno, et al., in a recent systematic review, discussed six studies with a total of 264 flexor tenotomies on both toes with and without ulceration. Their study consisted of 57 percutaneous flexor tenotomies that were performed prophylactically. They found that across the studies, the average time to healing the ulceration was 29.5 days with an overall healing rate of 97%.[6]

A retrospective study by Schmitz, et al. looked at patients who underwent percutaneous flexor tenotomies and evaluated the effects on healing and preventing toe ulcerations. About 265 tenotomies were conducted, including a group in which the tenotomy was performed therapeutically and another group done for prophylaxis. Of those with ulcerations, 95.1% healed with an average healing time of 27 days.[10] This seems to be consistent with much of the literature. Netten, et al. also reported a healing rate of 92% with a mean time to healing of 22 days and Kearney, et al. also published a healing rate of 98.3% with mean time of 52 days to healing.[11,12]

Figure 6: Pre- and post-flexor tenotomy clinical progression images.

From the research, percutaneous flexor tenotomies performed in the clinical setting appear to be a reliable technique and effective at healing digital toe ulcerations.

The podiatric physician should strongly consider the use of percutaneous flexor tenotomies more often as a prophylactic measure in diabetic patients with digital deformities. Netten, et al. found that in their group of nine prophylactically performed percutaneous flexor tenotomies, none resulted in an ulceration.[11] There are currently only a few studies looking at the outcomes of those who underwent this procedure prophylactically, which leaves potential for this to be further developed.

Our institution is currently in the process of a peer reviewed publication on our use of this technique in the clinical setting. We have previously reported a small subset of our data which looked at 56 lesser digits in 32 patients of which there were 32 pre-ulcerative lesions and 24 toes with ulcers. With an average follow-up of over 20 months, the overall ulceration healing rate was around 96.5% (Figure 6).

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Complications

The literature on percutaneous flexor tenotomies reports relatively low incidences of complications. Complications that can occur with this procedure as with any procedure include infection, new deformity, recurrence of wound, or amputation.

Several authors have reported on transfer ulcerations which are ulcers developing on adjacent areas of the foot due to transfer of pressures and microtrauma. Two studies by Rasmussen and Tamir reported two and nine transfer ulcers respectively[10,13]. Smith, et al. documented that the most prevalent complication they encountered was that 14.5% of their patients sustained a transfer lesion in about 95.5 ± 98.1 days.[9]

Smith, et al. also reported that the infection rate was minimal at 2.8% and they documented that of 250 flexor tenotomy procedures, there were between 0-18% recurrences at 22 months median follow-up.[9] Bonanno's systematic review found a complication rate of 14% in a group of 321 flexor tenotomies. They found an ulcer recurrence rate of only 6% and identified that four toes required amputation due to infection.[6] They also reported on the occurrence of transfer ulcerations.

In a retrospective study by Schmitz, et al., they documented four (4.0%) infections, one (1.0%) bleeding, one (1.0%) second intervention, and one (1.0%) amputation in their study of 101 procedures. They found that in 11 (10.9%) feet, re-ulceration occurred.[10] Netten, et al. reported on 35 patients in whom three amputations occurred and seven recurrent ulcerations were documented.[11] Similarly in a report of 58 flexor tenotomies, Kearney, et al. had three cases of infection and two amputations.[12]

In our own small series of data thus far, we have no reported cases of infection, and the future amputation rate was found to be about 5.4%.

Conclusions

Ultimately, percutaneous flexor tenotomies are a highly effective procedure for the treatment, as well as the prevention of digital ulcerations in the diabetic population. We advocate for its use in the clinical setting early and often.

Through clinical research, the percutaneous flexor tenotomy continues to prove to be an effective minimally invasive procedure. (2,9,10) It is safe to perform in the clinical setting, not only to expedite the healing process of distal toe ulcerations but also as a powerful tool to prophylactically prevent the development of toe ulcerations in those with digital deformities.

Ultimately, percutaneous flexor tenotomies are a highly effective procedure for the treatment, as well as the prevention of digital ulcerations in the diabetic population.

The advantages of the percutaneous flexor tenotomies seem to significantly outweigh the disadvantages. This procedure has a very low complication rate and reversely a very high patient satisfaction rate. The results of these clinically based percutaneous flexor tenotomies are frequently equivalent to or better than that of an open hammertoe repair. It should be advocated for expanded indications on when to perform this procedure in the clinical setting. Podiatric physicians should consider performing percutaneous flexor tenotomies not only on those with digital deformities with apical toe ulcerations but also prophylactically on those with digital deformities and pre-ulcerative lesions, those with prior hallux or first ray amputations, and patients with multiple comorbidities who are at high surgical risk.

Performing this procedure in the clinical setting additionally offers a huge economic benefit to both your practice, and the patient. The CPT code used is the same as that used in a formal surgical case; it avoids having to wait on patient transportation, operating room turnaround time, and utilization of the various levels of operating room staff. By avoiding the need for medical clearance and the potential for further clinical testing, you decrease the time tied up getting the patient prepared for the operating room as well as saving the patient added trips to the hospital and various additional medical procedural bills. Furthermore, there is the potential to greatly increase the opportunity for generating revenue in the clinical setting due to quickness of the procedure and more strategic use of staffing.

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In conclusion, this procedure has proved to be simple, safe, and highly predictable. It should be integrated into the podiatric physician's workup and algorithm for treatment of diabetic patients with digital deformities and should be used earlier and more often in the clinical setting. **PM**

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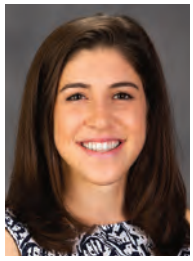

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