Tendon Lengthening for Neuropathic Foot Problems

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By healing most forefoot ulcerations and lowering their recurrence rate, tendon lengthening should lower the incidence of metatarsal ulceration progression to infection and subsequent amputation.

Patients with neuropathy develop foot problems, some of which benefit from orthopedic surgery. Tendon lengthening is one procedure used to treat neuropathic foot problems. Tendon lengthening, such as gastrocnemius-soleus recession, has fewer complications than bony procedures in the foot and ankle and should be considered prior to bony procedures in diabetics, smokers, and patients with foot ulcers, with infection, or without pedal pulses.

Tendon imbalance, especially Achilles or gastrocnemius-soleus tightness, causes or aggravates most foot problems. Tendon imbalance correction by tendon lengthening can be helpful in primary or adjunctive treatment for many foot problems.

INTRODUCTION TO FOOT ULCERS

In 2005, an estimated 20.8 million people in the United States (7% of the population) had diabetes mellitus. Approximately 15% of those with diabetes mellitus will develop foot ulcers, which can lead to infection and amputation. Between 6% and 43% of people with diabetes and a foot ulcer will need an amputation. Approximately 85% of diabetic patients who have an amputation have foot ulcers.

Diabetic foot ulcers are a frequent and expensive problem. They are the most common chronic wounds in Western industrialized countries. In the United States alone, there are >500,000 diabetic foot ulcers annually. The average excess cost of treating 1 foot ulcer over a 2-year period is $28,000.

A foot infection is the most common reason for diabetic patient admission to the hospital. In 1 study of patients admitted for foot ulcer or foot infection, 50% had amputation and 20% had transtibial or more proximal amputation. In 2002 in the United States alone, 82,000 amputations occurred in diabetic patients. Since most diabetic patients who have an amputation have foot ulcers, if foot ulcers can be eliminated, most amputations in diabetics could potentially be prevented.

Diabetes is the most common cause of neuropathy. Neuropathy increases with age and duration of diabetes and is present in over half of diabetic patients older than 60 years. Neuropathy causes decreased sensation and tendon imbalance.

Tendon imbalance, especially Achilles and gastrocnemius-soleus tightness, causes increased stress in the foot. Increased stress in the forefoot can cause a callus, followed by a forefoot ulcer. Increased stress in the foot less commonly causes Charcot arthropathy, including foot arthritis, arch collapse, midfoot bony prominence, and midfoot ulcer.

Foot ulcers can also result from causes of neuropathy other than diabetes and can be treated in the same manner.

TREATMENT OF FOOT ULCERS

Foot ulcer treatment consists of managing infection, arterial disease, and high stress in the foot. Management of infection consists of antibiotics and debridement. The choice of antibiotic is best determined by deep culture and, if necessary, infectious disease consult. If the patient lacks both pedal pulses, vascular evaluation and treatment is recommended. Systematic review of hyperbaric oxygen therapy revealed a decrease in the number of
major amputations, but more studies are needed to confirm its effectiveness.31

Decreasing stress in the foot is known as off-loading. Tendon lengthening decreases stress in the foot.27 Tendon lengthening heals more ulcers than wound care and total contact casting.2,24-26,32-37 Treatment of foot ulcers with tendon lengthening has good support in the literature.2,24-26,32-35,38,39

Unloading mechanical stress with total contact casting, walking boots, and modified shoes helps heal foot ulcers.14 However, total contact casting is time consuming and has both a higher complication rate and higher rate of recurrent ulceration than does tendon lengthening.32,40

RESULTS OF TREATMENT OF FOOT ULCERS

Tendon Lengthening

The association of gastrocnemius-soleus contracture, neuropathy, and chronic ulceration of the forefoot has been reported by several authors.24-26 A high rate of successful healing of forefoot ulcers after Achilles lengthening has been reported in multiple studies (Table; Figures 1, 2).2,24-26,32-35 A high rate of healing of toe ulcers occurred after toe flexor tenotomies (Figure 3) and midfoot ulcers treated with tendon lengthening.2,29

In diabetic patients treated without tendon lengthening, the reported recurrence rate of foot ulcers after 3 years was 61%.41 After Achilles tendon lengthening, the forefoot ulcer recurrence rate was 14% (Table). A similar low rate of recurrence occurred with toe ulcers treated with toe

<table>
<thead>
<tr>
<th>Year Published</th>
<th>Author</th>
<th>Level of Evidence</th>
<th>Neuropathy Cause</th>
<th>Ulcer Location</th>
<th>Tendon (Method)</th>
<th>No. Ulcers/Patients</th>
<th>Average Follow-up</th>
<th>Ulcers Healed</th>
<th>Ulcers Recurred</th>
<th>Complications</th>
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<tr>
<td>1971</td>
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<td>IV</td>
<td>Leprosy</td>
<td>Metatarsal heads, toes</td>
<td>Achilles (Yamamoto)25</td>
<td>15/8</td>
<td>4.5 y</td>
<td>13/15</td>
<td>2/13</td>
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<td>Barry et al33</td>
<td>IV</td>
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<td>Metatarsal stump</td>
<td>Achilles (tenectomy)</td>
<td>32/30</td>
<td>27 mo</td>
<td>30/32</td>
<td>0/30</td>
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<td>17 mo</td>
<td>14/15</td>
<td>0/14</td>
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<td>I</td>
<td>Diabetes mellitus</td>
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<td>10/27</td>
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<td>75/68</td>
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<td>10/68</td>
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<td>36 mo</td>
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<td>IV</td>
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<td>Metatarsal heads</td>
<td>Gastrocnemius-soleus recession (Vulpius45) with/without peroneus longus</td>
<td>19/16</td>
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<td>III</td>
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*Available for follow-up.
flexor tenotomy and with mid-foot ulcers treated with tendon lengthening.\textsuperscript{2,29}

Mueller et al\textsuperscript{32} reported that 10 of 26 ulcers recurred 2 years after using Achilles lengthening alone. The addition of peroneus longus and posterior tibial to gastrocnemius-soleus recession yielded a lower recurrence rate of 3 of 18 ulcers at 45-month follow-up.\textsuperscript{26} Dayer and Assal\textsuperscript{35} added tendon procedures in the foot to gastrocnemius recession and peroneus longus transfer with similar low recurrence (1 of 22).

The purpose of tendon lengthening is to decrease stress on the area of ulceration. Peroneus longus lengthening should decrease pressure on the first metatarsal head as posterior tibial lengthening should decrease pressure on the fifth metatarsal. Lengthening the gastrocnemius-soleus mechanism should decrease stress on the entire plantar forefoot (Figure 4). Armstrong et al\textsuperscript{27} confirmed that Achilles lengthening decreases pressure on the forefoot, recommending the procedure as an adjunctive therapeutic and prophylactic measure to reduce the risk of neuropathic ulceration.

Lin et al,\textsuperscript{25} Mueller et al,\textsuperscript{32} and Holstein et al\textsuperscript{34} lengthened the Achilles tendon by Hoke’s method of hemisection at 3 levels of the tendon.\textsuperscript{41} Holstein et al\textsuperscript{34} cautioned against overuse of Hoke’s method due to 7 of 75 Achilles ruptures and 11 of 75 heel ulcers in their patients with diabetic forefoot ulcers treated with tendon lengthening.

Barry et al\textsuperscript{33} reported 4 of 32 (13\%) plantar heel ulcers after Achilles tenectomy for distal ulcers after transmetatarsal amputation. Yosipovitch and Sheklin\textsuperscript{24} used the subcutaneous tenotomy method of Strohmeyer.\textsuperscript{42} Myerson et al\textsuperscript{43} used the Vulpius\textsuperscript{44} technique of gastrocnemius-soleus recession. gastrocnemius-soleus recession has a lower rate of heel ulcers (Table) and other complications.\textsuperscript{2,26,35}

The Vulpius\textsuperscript{44} procedure was used successfully by Takahashi and Shrestha\textsuperscript{1} to correct equinus deformity of the ankle in 230 adults after cerebrovascular accident. Average patient age was 68 years, and 98 patients had diabetes. There were no incision or tendon problems, and standing in a brace was allowed the next day.\textsuperscript{1}

Regardless of the technique of lengthening of the gastrocnemius-soleus or Achilles tendon, the results appear to be good (Table). The technique of Achilles lengthening for forefoot ulcers can be left to the discretion of the surgeon. The literature on tendon lengthening compares favorably with other treatments for forefoot and midfoot ulcers. Tendon lengthening seems to be a reasonable choice for treatment of neuropathic ulcers plantar to metatarsal heads, toes, and midfoot.\textsuperscript{2,24,26,29,32,35,38,39}

Total Contact Casting and Wound Care

Myerson et al\textsuperscript{43} had 90\% of foot ulcers heal with total contact casting. Ulcer recurrence occurred in 34\% at 18-month follow-up. The authors felt that total contact casting was labor intensive and expensive. The only controlled randomized comparison of healed ulcers at 2-year follow-up revealed that 81\% recurred after total contact casting, but only 38\% recurred after Achilles lengthening was added.\textsuperscript{32} A high complication rate of 31\% has also been reported with total contact casting.\textsuperscript{40}

Since total contact casting was not used in the recent studies, it is apparently not necessary for forefoot ulcer healing.\textsuperscript{26,29,34}

Meta-analysis of the literature revealed that good wound care healed only 31\% of diabetic foot

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*Figure 1:* Ulcer plantar to the first metatarsal head before tendon lengthening (peroneus longus and gastrocnemius-soleus recession) (A). Ulcer healed 6 weeks after tendon lengthening (B).

*Figure 2:* Ulcer plantar to fifth metatarsal head before tendon lengthening (posterior tibial and gastrocnemius-soleus recession) (A). Ulcer healed 6 weeks after tendon lengthening and wound care (B).

*Figure 3:* Toe ulcer before toe flexor tenotomy (A). Toe ulcer healed 2 months after tenotomy (B).

*Figure 4:* Tight Achilles tendon increases pressure on the forefoot (left). Normal Achilles allows normal pressure on the foot (right).
ulcers in 5 months. Total contact casting healed an average of 80% of diabetic foot ulcers. Tendon lengthening heals more ulcers than wound care and total contact casting. Dayer and Assal agree with Laborde that tendon lengthening rather than total contact casting should be considered the gold standard treatment for forefoot ulcers.

Metatarsal Osteotomy (Head Resection)

Metatarsal head resection has been used by orthopedic surgeons to help heal ulcers planar to metatarsal heads. This procedure usually results in ulcer healing, but a transfer metatarsal ulcer frequently develops later. Weiman et al found that 52% of patients developed transfer ulcers in 35 months of follow-up after metatarsal head resection. Repeated transfer ulcer and repeated metatarsal head resections could result in gradual resection of the entire forefoot, followed by amputation stump ulcer and possible transosseous amputation. Metatarsal head resection should be avoided if possible to decrease the potential for transfer ulcers resulting from an increase in pressure on the remaining forefoot. The metatarsal head should be removed if osteomyelitis is severe or if bone is fragmented, soft, or surrounded by pus or necrotic tissue. The metatarsal head should also be removed if osteomyelitis persists after the ulcer heals and antibiotics are completed. In Laborde’s study of 18 ulcers planar to metatarsal heads that healed after tendon lengthening, only 1 patient had metatarsal head resection, and none developed a transfer metatarsal head ulcer.

Metatarsal Osteotomy

In one study, dorsiflexion metatarsal osteotomy had a high rate of successful healing of neuropathic forefoot ulcers. There was, however, a 68% complication rate, with 7 patients developing acute Charcot disease, 3 developing midfoot ulcers, 3 with deep wound infections, 2 with transfer ulcers under adjacent metatarsal heads, and 1 requiring transosseous amputation. Tendon lengthening for forefoot ulcers resulted in no new or worsening Charcot arthropathy (Figure 4) or foot arthritis, new midfoot ulcers, transfer metatarsal ulcers, or wound infections. One patient subsequently required transfemoral amputation for progressive dry gangrene, but no amputations were performed for recurrent ulcer or progressive infection. Complication rates after tendon lengthening are less than those with metatarsal osteotomy and similar to nonoperative treatment. Many complications after tendon lengthening, such as gangrene and death, could be caused by diabetes and vascular disease rather than the surgery.

Amputation

Infection and gangrene can progress to the point that amputation becomes necessary. In a study of diabetic amputations, 84% were attributed to foot ulcers. Ray amputation has a high complication rate in diabetics with forefoot ulcers. In one study, transfer ulcers occurred in 12% of ray amputations, additional amputation in 18%. Krause et al used transmetatarsal amputation to treat chronic diabetic forefoot ulcers. In their study, wound breakdown occurred in 9% of feet and transosseous amputation in 26%; 30% died. Lower complication rates have been reported with tendon lengthening for forefoot ulcers. Pinzur et al recommended Achilles lengthening be done at the same time as transmetatarsal amputation to increase the healing rate to 81%. Lieberman et al recommended Achilles tenotomy be done with midfoot (Chopart) amputation for gangrene and/or infection. Tendon lengthening appears to be preferable to amputation for forefoot ulcers, as does combining Achilles lengthening with ray or transmetatarsal amputation for cases of forefoot gangrene and/or severe infection. After 3 years of observation of diabetic patients with prior foot ulcers, reported amputation rates were 16% (80 of 514) and 17% (78 of 468). In a study of tendon lengthening for forefoot ulcers, no patients required amputation for progressive infection at an average 45-month follow-up. The number of patients in tendon lengthening studies was small by comparison, and the expected amputation rate decrease after tendon lengthening needs to be evaluated by a study of more patients.

When all other treatments fail, more proximal major amputation may become necessary.

Vascular Evaluation

Some foot problems in diabetics are primarily vascular, such as dry gangrene. Arterial disease can aggravate many other diabetic foot problems. Patients without pedal pulses should have vascular evaluation. Pulses are measured by palpation of the dorsalis pedis and posterior tibial arteries. Patients without both of those pedal pulses are referred for arterial Doppler study. Some authors have used the ankle-brachial index for lower extremity arterial evaluation. The ankle-brachial index is calculated by dividing systolic pressure at the ankle by that at the arm. An abnormal ankle-brachial index is ≤0.9. If the Doppler study shows near or complete blockage or if the ankle-brachial index is abnormal, vascular surgery evaluation should be obtained. Myerson et al considered vascular disease a contraindication to total contact casting. Patients’ feet with foot ulcers without both pedal pulses can potentially be salvageable with tendon lengthening.
Diabetes mellitus and vascular disease are the most common comorbidities. Complications in these patients are frequent (Table). Soft tissue procedures such as tendon lengthening have fewer complications than bony procedures, thus, they are performed first, and if they fail, bony procedures are done later.

Tendon lengthening is promising, but more research is needed to better confirm its effectiveness for various types of foot ulcers. Only metatarsal head ulcers have level I and level III supporting evidence. Multiple level IV studies demonstrate the effectiveness of tendon lengthening for foot ulcers. The advantages to level IV studies are that the study populations are more likely to be representative of the population of interest and the results are closer to those obtained in clinical practice, have a higher relevance and external validity, and can be better applied to clinical practice. The aforementioned studies seem to support the use of tendon lengthening as the treatment of choice for diabetic forefoot ulcers.

In the following discussion of ulcers in various locations, the level of evidence for references supporting recommendations is given in parentheses. Levels of evidence are explained in The Journal of Bone and Joint Surgery instructions for authors.

Forefoot Ulcers Plantar to Metatarsal Heads

Patients with ulcers and infection are treated with antibiotics, soft tissue procedures such as tendon lengthening have fewer complications than bony procedures, thus, they are performed first, and if they fail, bony procedures are done later. Tendon lengthening is combined with gastrocnemius-soleus recession (IV26). Once the patient’s skin is prepped in the operating room, the foot is covered with a sterile glove. Tendon lengthening is done in the calf first and dressing applied. Then the glove is removed to debride the foot and lengthen toe tendons if needed. Patients with gangrene of the forefoot are offered debridement of gangrenous tissue and gastrocnemius-soleus recession to decrease pressure on the forefoot and aid wound healing (IV26,48) (Figure 5). Vascular evaluation and wound care are also recommended. If patients have delayed healing of a forefoot wound after debridement (V), transmetatarsal amputation (IV33) or Charcot arthropathy with or without ulcer (IV4), they are offered gastrocnemius-soleus recession (Figures 5-7). Patients with gangrene of the midfoot and/or hindfoot are offered transtibial or transfemoral amputation. Patients with progressive calluses are offered Achilles lengthening to prevent ulcers (V27) (Figure 8).

All patients with ulcers on the metatarsal heads are treated with gastrocnemius-soleus recession (I,32 III,25,35 IV24,26,34) (Figures 1, 2). Surgery is performed with the patient supine but the knee flexed and externally rotated. The foot is elevated on a stack of towels, and the surgeon is seated on the opposite side. Gastrocnemius-soleus recession is done using the Vulpius44 technique (IV1,26), transecting the gastrocnemius tendon just distal to the gastrocnemius muscle and transecting underlying aponeurosis of the soleus muscle in the mid-calf. The muscle is stretched in the operating room until 20° to 30° of ankle dorsiflexion is obtained. A midcalf posterior longitudinal incision 5 cm long is closed with staples after 3-0 absorbable sutures close the subcutaneous layer. Percutaneous triple-cut Achilles tenotomy is used for recurrent ulcers and if the patient can tolerate only local anesthesia.

Peroneus longus (Z-type) lengthening is combined with gastrocnemius-soleus recession for first metatarsal ulcers (IV26). Incision is just proximal to the ankle joint. The tendon is repaired with a 2-0 absorbable suture so that there is no tension, while the first metatarsal is in...
maximum dorsiflexion and the foot is in maximum inversion. Posterior tibial lengthening is also performed for fifth metatarsal ulcers (V25). The incision is medial and 10 cm proximal to the ankle. At the musculotendinous junction, the part of the tendon over the muscle is cut so the muscle lengthens on full eversion of the foot. These incisions are closed in the same way as gastrocnemius-semimembranosus recession. Z-type lengthening of posterior tibial tendon is combined with triple-cut Achilles lengthening for recurrent fifth metatarsal ulcers.

Surgery is usually performed as an outpatient, and full weight bearing is allowed immediately in a cam walking boot, which is worn for 6 weeks. When surgery is bilateral, a walker or crutches are offered to the patient only if needed for balance. No local incision or ulcer treatment is done except for clean dressings. Skin staples are removed at 2 weeks. After 6 weeks, diabetic-type shoes are recommended.

**Toe Ulcers**

All plantar toe ulcers are treated with percutaneous toe flexor tenotomy at the proximal portion of the proximal phalanx (IV25,52) (Figure 3). Toe tenotomy is usually performed in the office, but occasionally it is performed in the operating room if the patient is there for some other procedure. Each toe is prepped with alcohol, and a local anesthetic is given. Each toe is held in extension so the tendons are palpable. Both flexor tendons are transected through a small transverse incision. Division of both flexor tendons is confirmed by the sudden increase in extension of the distal and proximal interphalangeal joints of the lesser toes. A sudden increase in extension of the interphalangeal joint of the hallux occurs after the flexor hallucis longus is divided. The incision is not sutured but is covered with sterile gauze. A postoperative shoe or sandal or extra-depth shoe is used at the patient’s discretion. Full weight bearing is allowed. Patients return in 3 to 5 days, then weekly until the ulcer heals.

A dorsal ulcer of the proximal interphalangeal joint is treated with percutaneous extensor and flexor tenotomy. If correction is insufficient, percutaneous dorsal metatarsophalangeal capsulotomy and volar proximal interphalangeal capsulotomy are also performed. For interdigital ulcers of the first web space, patients are offered percutaneous adductor tenotomy and lateral capsule release of the first metatarsophalangeal joint. An interdigital ulcer of the lesser toes may also have percutaneous capsular release in the lessor toe in addition to the first toe surgery (V). Toe amputation is usually performed for osteomyelitis in the toe, which is not controlled with antibiotics.

**Midfoot Ulcers and Charcot Arthropathy**

Midfoot ulcers sometimes develop plantar to the bony prominence in the area of arch collapse from neuropathic (Charcot) arthropathy. Some authors have recommended that Achilles lengthening be added to exostectomy or fusion for midfoot ulcers. Laborde56 used tendon lengthening alone as the initial treatment for midfoot ulcers with good preliminary results: 9 of 10 ulcers healed and 1 of 9 recurred with fewer complications than bony procedures (IV25,56; Figure 9). Tendon lengthening appears to help heal these ulcers, prevent progression of bony deformity, and promote consolidation of fragmented midfoot bone (IV2, Figure 9). The lack of progression of deformity and low recurrence rate also compare favorably with the 36% deformity progression and 37% ulceration after nonoperative treatment.56 If the ulcer fails to heal or recurs, removal of the midfoot bony prominence (exostectomy) is performed (IV3). A longitudinal incision through the ulcer is used to remove the bony prominence. If the ulcer fails to heal or recurs, if there is no bony prominence and the foot is unstable, midfoot fusion is performed (IV4). A longitudinal incision over the unstable tarsals is used to remove joint surfaces and stabilize the tarsals with screws. No postoperative casts are used because of the fear of pressure sores in patients with neuropathy. Weight bearing is discouraged for 6 weeks. Other postoperative care is the same as for metatarsal ulcers except that a custom insert is used in the boot, and later in the shoe, to accommodate arch collapse or rocker-bottom foot deformity. Midfoot ulcers have healed more slowly than forefoot ulcers.

Thomas and Huffman55 recommended lengthening the Achilles in Charcot arthropathy. For Charcot arthropathy, especially in the early stages, tendon lengthening has the potential to relieve pain, promote consolidation, prevent progression of deformity, and heal or prevent midfoot ulceration from arch collapse (IV4). Bony procedures are less commonly done if tendon lengthening fails. Amputation is used a last resort.

**Foot and Ankle Pain**

Diabetic patients with foot ulcers usually lost protective sensation because of neuropathy. They usually do not report foot pain unless they have severe arthropathy or infection. Diabetic patients without ulcers tend to have less neuropathy and, not uncommonly, develop painful foot problems such as Achilles tendinitis, metatarsalgia, foot arthritis, and plantar fasciitis.

As early as 1973, McGlamry and Kitting7 reported that equinus deformity is the underlying cause of most foot problems and that permanent correction is only achieved by correction of equinus. Gastrocnemius tightness is common in patients with Charcot arthropathy, plantar fasciitis, Achilles tendinitis, metatarsalgia, foot and ankle arthritis, Morton’s neuroma, and hallux valgus.55,58
Even in patients without neuropathy, gastrocnemius recession has been recommended for the treatment of these problems.8-12 Anderson10 felt that gastrocnemius tightness causes metatarsalgia, plantar fasciitis, and Achilles tendinitis. He felt gastrocnemius tightness, if left untreated, causes progressive arch collapse, foot arthritis, and flat foot, which progress to posterior tibial tendon dysfunction and heel valgus. He reported 94% patient satisfaction using gastrocnemius recession for plantar fasciitis. He felt that gastrocnemius recession not only helped the pain of these conditions, but prevented the described progression. He also used gastrocnemius recession for pain relief in patients with arch collapse, foot and ankle arthritis, Achilles tendinitis, plantar fasciitis, and posterior tibial tendinitis (V8-12). Gastrocnemius recession may be useful in preventing these problems and foot ulcers (V10,27).

Non-ulcer Toe Problems (V)

Diabetic patients with painful hammer, mallet, or claw toes, especially with progressive toe callus, are offered toe flexor tenotomy after failure of nonoperative treatment. These procedures are also done both for pain relief and to help prevent future ulcers. Percutaneous volar proximal interphalangeal capsulotomy and/or percutaneous longitudinal pins are inserted if correction is insufficient. Pins are removed after 4 to 6 weeks. Open interphalangeal joint resection and fusion is avoided in patients without both pedal pulses and with infection. For interdigital corns of the first web space, patients are offered percutaneous adductor tenotomy, lateral capsule release of first metatarsophalangeal joint, and percutaneous longitudinal pinning. Interdigital corns of lesser toes may have percutaneous capsular release in the lesser toe metatarsophalangeal joint in addition to first toe surgery. Patients with painful arthritis of the first metatarsophalangeal joint are treated initially with percutaneous flexor hallucis longus tenotomy to relieve pain and prevent ulceration with less expected complications than with open surgery.19 If flexor hallucis longus tenotomy fails to relieve pain and if the patient has a pedal pulse, metatarsophalangeal fusion or resection arthroplasty is performed.

The Need for Additional Studies

More studies need to be done to determine if daily calf stretching can prevent calf tightness and progression to forefront callus, forefront ulceration, and Charcot arthritis in diabetic patients. Since calf stretching may help and probably would not harm diabetic patients, it seems reasonable to recommend prophylactic calf stretching to these patients.

Armstrong et al27 recommended Achilles tendon lengthening to prevent reulceration in patients with prior ulcers. Additional studies should be done to determine if tendon lengthening is helpful in preventing ulceration in patients with progressive callus (Figure 8), prior ulcers, and impending ulcers. Barry et al33 found that Achilles tenectomy healed 94% of recurrent ulcers following transmetatarsal amputation (Figure 6). Thomas and Huffman35 recommended lengthening the Achilles in Charcot arthropathy. More studies should also be done to confirm that tendon lengthening heals midfoot ulcers (Figure 9),2 transmetatarsal stump ulcers (Figure 6),10 and ischemic wounds of the foot (Figure 5).46,49 and also to determine if the procedure prevents progression of deformity of Charcot arthritis of the midfoot (Figure 7)2,10 and ankle.

Preliminary results of tendon lengthening have been encouraging; however, further studies need to be done to determine if tendon lengthening relieves foot and ankle pain from multiple causes and if the procedure prevents foot ulcers, arch collapse, arthritis, and other foot problems.

References


