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Chapter

Tendon Balancing for Diabetic Foot Ulcers, Foot Pain and Charcot Foot

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Abstract

Diabetes mellitus causes patients to develop sensory and motor neuropathy. Sensory neuropathy in patients with diabetes results in decrease in protective sensation. Motor neuropathy causes tendon imbalance. Tendon imbalance causes increased mechanical stress in the foot. This increased stress can cause foot pain and calluses and can progress to forefoot ulcers. Less often the ligaments fail before the skin, which can cause arch collapse and then a midfoot ulcer of Charcot foot. Foot pain in diabetics is common and frequently results from Achilles tendinitis, plantar fasciitis, midfoot arthritis and metatarsalgia. Tendon balancing can decrease stress in the foot which can relieve foot pain, heal forefoot and midfoot ulcers, prevent ulcer recurrence, and prevent progression of deformity in Charcot foot. Tendon balancing could prevent most of the amputations now being done on diabetic patients. Tendon balancing should be used earlier and more often in treatment of diabetic foot ulcers, foot pain and Charcot foot.

Keywords: diabetic foot ulcers, foot pain, Charcot foot, diabetes

1. Introduction

Patients with diabetic neuropathy develop foot problems, some of which can improve with surgery. Tendon balancing is one of the procedures used to treat diabetic foot problems. Tendon lengthening, such as gastrocnemius-soleus recession (GSR), has fewer complications than bony procedures in the foot [1–6].

Tendon lengthening should be performed before bony procedures in high-risk patients such as diabetics, patients with foot ulcers, infection, smokers and without pedal pulses [1–6]. Imbalance of tendons, especially Achilles tightness, can aggravate or cause many foot problems [1–7]. Tendon lengthening can be used as part of treatment for many foot problems [2, 7–12].

A large number of patients have diabetes and the number is increasing [13]. Foot ulcers are common in patients with diabetes mellitus [14, 15]. Foot ulcers can lead to infection and amputation. Amputation can result from infection from foot ulcers [15, 16]. Over 80% of amputations in diabetic patients have foot ulcers [15, 16].

The most common chronic wounds in industrialized countries are foot ulcers [17, 18]. The average excess cost of a foot ulcer over a two-year period is over $25,000 [19].

The most common reason for diabetic patient to be admitted to the hospital is foot infection [20]. Up to 50% (62/133) amputation and 20% (26/133) major amputation can occur in patients admitted for foot ulcer or foot infection [16]. Over 80,000
amputations have occurred in diabetic patients in the U.S in one year [21]. If foot ulcers could be cured, most amputations in diabetics could potentially be prevented [15, 16].

The most common cause of neuropathy is diabetes mellitus [22, 23]. Neuropathy causes decreased protective sensation and motor neuropathy causes tendon tightness [24–26]. Tightness of tendon, especially the Achilles, causes increased forces in the foot [27]. Increased forces in the forefoot can cause a callus followed by a forefoot ulcer [14, 27]. Increased forces in the foot can also cause Charcot foot, including foot arthritis, arch collapse, midfoot bony prominence and then midfoot ulcer [10, 28]. Foot ulcers can also result from other causes of neuropathy besides diabetes and can be treated in the same way [24, 26, 29].

2. Foot ulcer treatment

Foot ulcers are of managed by addressing infection, arterial disease and high forces in the foot. Infection is treated with antibiotics and debridement. Which antibiotic is determined by deep culture and, if needed, infectious disease consultation [30]. Vascular evaluation and treatment is recommended if the patient lacks both pedal pulses. Hyperbaric oxygen may a decrease the frequency of major amputations, but more studies are needed to confirm its causation in the decrease [31].

Off-loading consists of decreasing force in the foot. Forces in the foot can be decreased by tendon lengthening [27]. More ulcers than wound care and total contact casting (TCC) are healed by tendon lengthening [2, 24–26, 29, 32–39]. Tendon lengthening treatment of foot ulcers has good literature support [2, 24–27, 29, 33–41].

TCC, walking boots, and modified shoes helps heal foot ulcers [14]. However, TCC are difficult to apply, and has a higher complication rate and higher rate of recurrent ulceration than does tendon lengthening [32, 33]. Tendon lengthening removal of prominent metatarsal heads have similar results similar but with more transfer ulcers when only metatarsal head is removed [3].

3. Results of foot ulcers treatment

3.1 Tendon lengthening

Multiple authors reported the association of gastrocnemius-soleus contracture, neuropathy, and chronic ulceration of the forefoot [24–26]. The high rate of successful healing of forefoot ulcers after Achilles lengthening was reported in multiple studies [24–26, 33–36, 41]. Also a high rate of healing of midfoot and toe ulcers also occurred after tendon lengthening [2, 29].

The recurrence rate of foot ulcers after three years in diabetic patients treated without tendon lengthening, was 61% (286/468) [42]. After Achilles tendon lengthening, forefoot ulcer recurrence rates were much lower, 14% [41]. There is also a low rate of recurrence of toe ulcers treated with toe flexor tenotomy and with midfoot ulcers treated with tendon lengthening [2, 29].

Mueller et al. reported recurrence 10 of 26 ulcers 2 years after Achilles lengthening [33]. Adding peroneus longus and posterior tibial to gastrocnemius–soleus recession (GSR) yielded less recurrence, 3 of 18 at 45 months follow-up [26]. Dayer and Assal also had a low recurrence (1/22) by adding tendon procedures such as peroneus longus transfer to gastrocnemius recession [36].
The intention of tendon lengthening is to decrease force on the area of ulceration. The pressure on the first metatarsal head should decrease with peroneus longus lengthening as the pressure on the fifth metatarsal should be decreased with posterior tibial lengthening. Force on the entire plantar forefoot should decrease with GSR. Armstrong et al. demonstrated that Achilles lengthening does in fact decrease pressure on the forefoot and recommended this procedure to help treat and prevent foot ulceration [27].

Multiple authors lengthened the Achilles tendon by Hoke's method of hemisection at 3 levels of the tendon [25, 33, 35]. Holstein warned that Hoke's procedure for diabetic forefoot ulcers caused 7/75 Achilles ruptures and 11/75 heel ulcers in his patients [35]. Achilles tenectomy for distal ulcers after transmetatarsal amputation had 4/32 (13%) plantar heel ulcers [34]. Subcutaneous tenotomy method of Strohmeyer was used by Yospovitch and Sheskin [24, 43]. Vulpius technique of GSR is used by this author [44]. A very low rate of heel ulcers and other complications of GSR has been reported [2, 26, 36, 41].

Takahashi and Shrestha used the Vulpius procedure successfully to correct Achilles tightness in 230 adults after cerebrovascular accident [1]. Ninety-eight were diabetics and the average age was 68 and had no tendon or incision problems.

The results appear to be good whatever technique of lengthening of the gastrocnemius-soleus or Achilles tendon, [41]. Choice of the surgeon can determine the technique of Achilles lengthening for forefoot ulcers.

Tendon lengthening literature shows better results than other treatments for forefoot and midfoot ulcers [41]. Tendon lengthening should be used more often to treat of diabetic ulcers forefoot and midfoot ulcers [2, 24–26, 29, 33–37, 40, 41].

3.2 Wound care and Total contact casting (TCC)

TCC resulted in healing in 90% (64/71) of foot ulcers [45]. However ulcer recurrence at 18 months follow-up occurred in 34% (22/64). A high complication rate of 31% (22/70) has also been reported with TCC [32]. A comparison of healed ulcers at two year follow-up revealed 81% (21/26) recurred after TCC but only 38% (10/27) recurred after Achilles lengthening was added in the only controlled randomized study available [33].

TCC is apparently not needed for forefoot ulcer healing, since TCC was not used in most more recent studies after Mueller’s article [26, 29, 33, 35, 41]. Wound care healed only 31% (142/458) of diabetic foot ulcers in 5 months in a meta-analysis of the literature [38]. An average of 80% of diabetic foot ulcers healed with TCC [39]. Tendon lengthening has better healing rate for ulcers than wound care and TCC [2, 24–26, 29, 33–36, 38–41].

Tendon lengthening also has less complications and a much lower recurrence rate than TCC [2, 24–26, 29, 32–36, 41]. This author agrees with other authors that tendon lengthening rather than TCC should be considered the “gold standard” treatment for forefoot ulcers [26, 36, 41].

3.3 Metatarsal head removal

Foot surgeons have recommended metatarsal head resection to heal ulcers plantar to metatarsal heads. Even though this procedure frequently resulted in ulcer healing, transfer metatarsal ulcer frequently occurred later. Transfer ulcers occurred in 52% (53/101) of patients in the 35 months of follow-up after metatarsal head resection [3].
Repeated transfer ulcer and metatarsal head removal can result in gradual resection of the forefoot, then amputation stump ulcer and possible major amputation [42].

Tendon lengthening can be used instead of metatarsal head resection to decrease the potential for transfer ulcers resulting from the increased pressure on the forefoot. The metatarsal head should be removed if bone infection is severe enough to cause bone fragmentation or necrotic tissue. The metatarsal head can be removed if osteomyelitis persists after the ulcer healing and antibiotics completion [26].

3.4 Osteotomy of metatarsal

A high rate, 95% (21/22), of successful healing of neuropathic forefoot ulcers occurred after dorsiflexion metatarsal osteotomy [4]. However, a 68% complication rate occurred with seven patients developing acute Charcot disease, three developing midfoot ulcers, three deep wound infections, two transfer ulcers under adjacent metatarsal heads, and one transtibial amputation. Fewer complications occurred after tendon lengthening for forefoot ulcers resulted with no new or worsening Charcot arthritis or foot arthritis, new mid-foot ulcers, transfer metatarsal ulcers or wound infections [26]. After tendon lengthening complication rate is less than after metatarsal osteotomy and similar to non-operative treatment [4, 16, 26].

3.5 Amputation

Amputation becomes necessary when infection and gangrene progress. In one study of amputations in diabetic patients, 84% (67/80) were attributed to foot ulcers [16]. In diabetics with forefoot ulcers, ray amputation resulted in transfer ulcers occurred in 12% (11/89) and additional amputation in 18% (16/89) [46]. Transmetatarsal amputation has used to treat chronic diabetic forefoot ulcers [47]. This resulted in wound breakdown in 9% (8/85), transtibial amputation in 26% (17/65) and 30% (17/57) death. Tendon lengthening complication rates lower than above have been reported with for forefoot ulcers [26, 41]. To increase healing rate to 81%, Pinzur et al. recommended Achilles lengthening be done at same time as transmetatarsal amputation (52/64) [48]. Achilles tenotomy was recommended by Lieberman et al. with midfoot (Chopart) amputation for gangrene and/or infection [49]. For forefoot ulcers, tendon lengthening seems to be better than amputation. Also combining Achilles lengthening with ray or transmetatarsal amputation for forefoot gangrene and/or severe infection appears preferable. By putting glove over infected foot, doing tendon lengthening first, applying dressing to leg, removing glove and then preforming partial foot amputation, tendon lengthening can be done at time of amputation without infection of proximal incisions.

The reported amputation rate was 16% (80/514) and 17% (78/468) during three years after healing of foot ulcers, [23, 42]. No patients (0/16) required amputation for progressive infection at average follow-up of 45 months in one study of tendon lengthening for forefoot ulcers [26]. More proximal major amputation may become necessary when all other treatments fail.

4. Vascular disease

Gangrene in diabetics is primarily vascular problem. Arterial disease can aggravate most other diabetic foot problems. Vascular evaluation is recommended in patients
without pedal pulses. Patients with palpable dorsalis pedis or posterior tibial arteries require no additional studies. Arterial Doppler is recommend for patients without both of those pedal pulses. Ankle-brachial index (ABI) has been used by others for lower extremity arterial evaluation. The ABI is calculated by dividing systolic pressure at the ankle by that at the arm. An abnormal ABI is 0.90 or below [50]. Vascular surgery evaluation should be obtained if the Doppler study shows near or complete blockage or if ABI is abnormal.

Vascular disease has been considered to be a contraindication to TCC [45]. Foot ulcers in patients without both pedal pulses can be salvageable with tendon lengthening [26, 29, 34].

5. Tendon lengthening treatment

Patients with foot ulcers can be considered for tendon lengthening after vascular and infection have been treated. Diabetes mellitus and vascular disease are the most common co-morbidities with neuropathic foot problems [26, 29]. These patients frequently have complications. Tendon lengthening has less complications than bony procedures [1–6, 26, 29, 41]. Soft tissue procedures are usually performed first since they have lower complication rates, and then if they fail, bony procedures are done later.

Level I and level III studies have only been done for metatarsal head ulcers [25, 33, 36]. JBJS instructions for authors explains levels of evidence. There are however many level IV studies demonstrating effectiveness of tendon lengthening for foot ulcers [24, 26, 29, 34, 35, 41]. Level IV studies have advantages that the study populations are more likely to be representative of the population of interest, results are closer to those obtained in clinical practice, have a higher relevance and external validity and can be better applied to clinical practice [51]. Tendon lengthenings as the treatment of choice for diabetic forefoot ulcers seems to be supported by the above studies.

5.1 Metatarsal head forefoot ulcers

If infection is present, patients with ulcers are treated with antibiotics then debridement and tendon lengthening [26]. The foot is covered with a sterile glove after the patient’s skin is prepped in the operating room. Calf and ankle level tendon lengthening is done first and dressing applied. Glove is then removed for debridement of the foot and lengthening of toe tendons if needed. If gangrene of forefoot is present, debridement of gangrenous tissue and GSR are done to decrease pressure on the forefoot and to aid wound healing [41, 46, 48]. Vascular evaluation and wound care are also suggested. If forefoot wound healing is delayed after only debridement, transmetatarsal amputation [34], or Charcot arthropathy with or without ulcer [2], they are offered GSR. If gangrene of midfoot and/or hindfoot is present, transtibial or transfemoral amputation is suggested. Achilles lengthening to prevent ulcers is recommended for progressive metatarsal calluses [27].

GSR is used to treat all patients with ulcers plantar to metatarsal heads [24–26, 33, 35, 41]. With the patient supine the surgery is performed, while the knee is flexed and externally rotated. A stack of towels is placed under foot with the surgeon is seated on the opposite side. Vulpian technique [1, 26] is used, transecting the gastrocnemius tendon and underlying aponeurosis of the soleus just distal to the gastrocnemius muscle [44]. Ankle is dorsiflexed to 20–30°. Staples are used to close midcalf posterior
longitudinal incision 5 cm. long after 3–0 absorbable suture closes the subcuticular layer. For recurrent ulcers and if patient can only tolerate local anesthesia percutaneous triple cut Achilles tenotomy can be used.

For first metatarsal ulcers peroneus longus (Z-type) lengthening is combined with GSR [26]. Incision is proximal to the ankle joint. The tendon repair is done with a 2–0 absorbable suture with no tension, with the first metatarsal is in maximum dorsiflexion and the foot is in maximum inversion. For fifth metatarsal ulcers posterior tibial lengthening is also performed [26]. Z-type lengthening is also performed through medial incision 5–10 cm. proximal to the ankle joint. Same technique is used to close these incisions. Repeat GSR or triple cut Achilles lengthening and percutaneous metatarsal osteotomy for recurrent metatarsal ulcers.

Full weight bearing is allowed immediately in a walking boot, which is worn for four to six weeks. Crutches or a walker is offered to the patient if needed for balance when surgery is bilateral. Ulcer treatment is clean dressings changed weekly. Skin staples are removed at two weeks. Diabetic-type shoes are recommended after six weeks. Double heel lift exercises are begun at 2 months and at 3 months single heel lift exercises. They can resume standing all day at work at 3 months. Running, jumping and climbing are allowed at 6 months.

5.2 Toe ulcer treatment

Percutaneous toe flexor tenotomy at the proximal portion of the proximal phalanx is used for plantar toe ulcers [29, 52]. This can be done in the office, but can be done in the operating room if the patient is there for some other reason. Alcohol is used to prepare the toe, and then local anesthetic is given. Toe is extended so the tendons are palpable. Through a small (2 mm) transverse incision, both flexor tendons are transected. A sudden increase in extension of the distal and proximal interphalangeal joints of the lesser toes confirms division of both flexor tendons. After the flexor hallucis longus (FHL) is divided a sudden increase in extension of the interphalangeal joint of the hallux occurs. Suture is not used unless bleeding is excessive but incision is covered with sterile gauze. A postoperative shoe, sandal or extra-depth shoe can be used. Patients are allowed full weight-bearing. Patients return weekly until the ulcer heals.

Percutaneous extensor and flexor tenotomy can be used for a dorsal ulcer of PIP joint. Percutaneous capsulotomy dorsal metatarsal-phalangeal (MP) and volar (PIP) are also performed if needed. Percutaneous phalangeal osteotomy is performed if correction is insufficient.

For interdigital ulcers of the first web space, patients are offered percutaneous adductor tenotomy, and lateral capsule release of the first MP joint. An interdigital ulcer of the lessor toes may also have percutaneous MP capsular release in the lessor toe in addition to first toe surgery. Percutaneous phalangeal osteotomy or removal of prominent bone is performed if ulcer persists or recurs. Toe amputation is usually performed for osteomyelitis in the toe which is not controlled with antibiotics.

5.3 Charcot foot

Midfoot ulcers can develop plantar to the bony prominence in the area of arch collapse from Charcot neuropathic arthropathy (Charcot foot). Exostectomy or fusion have recommended to be combined with Achilles lengthening (GSR) alone as the initial
Treatment for midfoot ulcers: 9/10 ulcers healed, 1/9 recurred with less complications than bony procedures [2, 5, 6]. Tendon lengthening (GSR) seems to heal these ulcers, prevent progression of bony deformity and promote consolidation of fragmented midfoot bone [2, 57]. The lack of progression of deformity and low recurrence rate of GSR also compare favorably with the 41/140 (36%) deformity progression and 43/140 (37%) ulceration after non-operative treatment [56, 57].

Removal of plantar bony prominence percutaneously with a burr is now routinely added to GSR. Posterior tibial lengthening can be added for lateral midfoot ulcers and peroneal tendon lengthening for medial midfoot ulcers. GSR results in much fewer heel ulcers than does Achilles tendon lengthening [1, 41, 58, 59]. If the ulcer fails to heal or recurs, then tendon lengthening and percutaneous removal of the midfoot bony prominence (exostectomy) can be repeated [5, 41]. If the ulcer fails to heal or recurs, if there is no bony prominence and the foot is unstable, then midfoot fusion can be performed [6]. Soft tissue surgery is advantageous because diabetic patients have a higher complication rate with foot and ankle surgery [60].

Lengthening the Achilles in Charcot arthropathy was recommended by Thomas and Huffman [55]. Tendon lengthening is recommended for early stage Charcot foot to relieve pain, promote consolidation, prevent progression of deformity and heal or prevent midfoot ulceration from arch collapse [2, 57]. Bony procedures are less commonly done if tendon lengthening fails. Amputation is kept as a last resort.

5.4 Results of tendon lengthening

A 47% decrease in major amputations in Medicare patients with diabetic foot ulcers between 2000 and 2010 has been reported [61]. In the same period Achilles tendon lengthening increased 89% and gastrocnemius recession increased 575%. The authors felt the main cause of decrease in major amputations was the increase in tendon lengthening. Recently performed a literature review on diabetic foot ulcer treatment and gave the highest recommendation (supported by strong evidence) to tendon lengthening [62].

Available evidence seems to indicate that tendon lengthening is the most effective treatment for plantar diabetic foot ulcers with the least complications [41, 57]. Tendon lengthening can also relieve foot pain, prevent ulcers and Charcot foot, and stop progression of Charcot arch collapse to rocker bottom foot, midfoot ulceration and amputation [57, 63]. Tendon lengthening may be combined with other modalities but should be done as soon as possible to promote rapid healing before the ulcer gets infected and to better prevent new, recurrent and transfer ulcers, progression of deformity and amputation [41, 57].

Yammine and Assi noted underuse of tendon lengthening which offered excellent outcomes with more ulcers healed faster with less recurrence, transfer ulcers, infection and amputation than nonsurgical treatment [64, 65]. This author recommends tendon lengthening as part of initial treatment for diabetic plantar forefoot and midfoot ulcers and Charcot of the midfoot [41, 57].

6. Pain in foot

Diabetic patients without ulcers tend to have less neuropathy. They frequently develop painful foot problems including Achilles tendinitis, plantar fasciitis, foot arthritis and metatarsalgia.
McGlamery and Kitting stated that tight Achilles is the underlying cause of most foot problems and that permanent correction is only achieved by correction of Achilles tightness [7]. Achilles tightness is common in patients with Charcot foot, plantar fasciitis, Achilles tendinitis, metatarsalgia, foot arthritis, Morton’s neuroma and hallux valgus [66, 67].

Gastrocnemius recession (GR) has been recommended for the treatment of these problems in patients without neuropathy or diabetes [8–12, 68]. Anderson et al. felt that gastrocnemius tightness causes metatarsalgia, plantar fasciitis, Achilles tendinitis and arch pain [10, 68]. Achilles tightness, can cause progressive arch collapse, foot arthritis and flat foot which can progress to posterior tibial tendon dysfunction and heel valgus. High (94%, 32/34) patient satisfaction has been reported using GSR for plantar fasciitis. Anderson felt GR not only helped the pain of these conditions but prevents the progression described above [10, 68]. Several authors recommend GR for pain relief in patients with arch collapse, foot and ankle arthritis, Achilles tendinitis, plantar fasciitis, posterior tibial tendinitis [8–12, 68]. GR may be useful in preventing these problems and foot ulcers so is especially useful in diabetic patients [10, 27].

7. Other toe problems

Painful hammer, mallet or claw toes, especially with progressive toe callus, are offered toe flexor tenotomy after failure of non-operative treatment. These procedures are also done both for pain relief and to help prevent future ulcers in diabetic patients. Percutaneous capsulotomy and/or percutaneous phalangeal osteotomy are performed if correction is insufficient. Percutaneous interphalangeal joint resection and fusion is less commonly performed. Percutaneous pins are used as needed and removed at 3 weeks.

For interdigital corns of the first web space, patients are offered percutaneous shaving of bone under corn and adductor tenotomy of first metatarsal-phalangeal (MP) joint. Interdigital corns of lesser toes may have percutaneous shaving of bone under corn and capsular release in the lesser toe MP joint in addition if needed.

Inactive high-risk patients with painful arthritis of the first MP joint can be treated initially with percutaneous FHL tenotomy to relieve pain and prevent ulceration with less expected complications than with bone surgery [69]. More commonly, percutaneous resection of bone spurs, dorsal MP joint (cheilectomy) and proximal phalangeal dorsal closing wedge osteotomy is performed [70]. DePrado’s book on percutaneous is an excellent “how to” book on percutaneous foot surgery [70].

For bunions, percutaneous or open chevron metatarsal osteotomy and proximal phalanx osteotomy are performed [70, 71]. Most patients having first ray surgery for arthritis or bunions also have GSR for Achilles tightness. If they have diabetes, GSR will more likely relieve their pain and prevent foot ulcers, Charcot foot and amputation [41, 57]. If they have Achilles tendinitis, posterior tibial tendinitis or dysfunction, midfoot arthritis or metatarsalgia in addition to their first MP pain, they are more likely to have their pain relieved than if they have bunionectomy alone [41, 68].

8. Additional studies

Additional studies should be done in diabetics to see if frequent eccentric calf stretching can prevent calf tightness, forefoot calluses, forefoot ulceration and
Charcot arthritis. Since calf stretching would not harm diabetic patients, this author recommends prophylactic eccentric calf stretching to these patients.

Achilles tendon lengthening has been recommended to prevent re- ulceration in patients with prior ulcers [27]. More studies are needed to confirm tendon lengthening is helpful in preventing ulceration in patients with progressive callus, prior ulcers, and impending ulcers [27] and whether tendon lengthening should be used as part of primary initial treatment for foot ulcers and Charcot foot [41, 57].

Thomas and Huffman recommended lengthening the Achilles in Charcot foot [55]. More studies should also be done to confirm that tendon lengthening heals most midfoot ulcers [2], transmetatarsal stump ulcers [34], and ischemic wounds of forefoot [48, 49]. Further studies are also needed to confirm tendon lengthening prevents Charcot foot, prevents progression of deformity of Charcot arthritis of the midfoot [2, 10] and ankle, and prevents foot ulcers and amputation in patients with Charcot foot [57].

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

9. Conclusions

The literature indicates that tendon lengthening is effective treatment for neuropathic forefoot ulcerations and that the complication rate seems to be low. By healing most forefoot ulcerations and lowering their recurrence rate more than all other treatments, this procedure should lower the incidence of progression of metatarsal ulceration to infection and subsequent amputation. More studies need to be done to confirm tendon lengthening is an effective treatment for Charcot foot and other foot problems and confirm tendon lengthening should be part of initial treatment of diabetic foot problems.

Conflict of interest

The author declares no conflict of interest.

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