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Functional Outcome and Patient Satisfaction after Flexor Tenotomy for Plantar Ulcers of the Toes

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ABSTRACT

Ulcers of the toes may cause a severe physical burden, especially in patients with diabetes, in whom they occur most frequently. Several treatments have been proposed for the underlying anatomical abnormalities, but they vary in effectiveness. We evaluated our results in using flexor tenotomy to treat ulcers with underlying flexible clawing of the toes. For 42 toes from 23 patients, 15 of whom were diabetic, all ulcers healed. The mean healing time was 4 weeks (range, 1-8 weeks), the mean follow-up was 11 months (range, 1-27 months), and one recurrence and one complication occurred. Postoperative American Orthopaedic Foot Ankle Society Midfoot scores were available for 15 patients: the mean was 77 (range, 43-100). The mean visual analogue scale (VAS) for patient satisfaction increased from 3.9 points (range, 0-10 points) preoperatively to 7.7 (range, 5-10 points) postoperatively. Flexor tenotomy is a simple treatment with low complications and recurrence rates and provides good-to-excellent functional outcomes in treating flexible clawing of the toes and the associated ulceration.

Ulcers of the foot are common, especially in adult patients with diabetes and are associated with high costs and substantial reductions in physical quality of life (1). Ulcers at the dorsum or at the plantar side under the tip of the toes are caused by increased pressure and friction (2, 3). This increased pressure often occurs from the combination of poor-fitting shoes and progressive anatomical abnormalities, such as claw toes, hammer toes, mallet toes, and curly toes, which displace the fat pads of the metatarsal heads (2, 4). These anatomical abnormalities occur from an imbalance between the extensor and flexor tendons (3, 5, 6). Various underlying illnesses can cause this imbalance: neurological disorders, rheumatic joint disorders, acute or borderline compartment syndrome of the foot, and, most often, diabetes (7, 8). These anatomical abnormalities have been studied most extensively in patients with diabetes, and several foot deformities attributed to diabetes have been identified. Poor nerve conductivity is correlated with muscle weakness, which causes more foot deformities (9). The plantar fat pad can also shift distally (10). In addition, these toe deformities are clearly associated with subsequent ulcers (11).

The treatments for toe abnormalities can be divided into conservative measures (e.g., shoe adaptations, toe orthosis, and total contact casting) and surgical measures. Surgical measures include those involving bony corrections, such as excising a part or an entire phalanx or corrections at the level of the metatarsals (3, 12–14), and those involving corrections of the soft tissues, such as repositioning the forefoot fat pad underneath the metatarsal heads, capsulotomy, or treatment at the level of the tendons (13). Examples of corrections of the tendons of the toes are extensor lengthening or tenotomy, selective lengthening of the proximal flexor, and flexor-to-extensor tendon transfer, with or without fusion of the interphalangeal joint (8, 15–17). Techniques are selected on the basis of whether the clawing is flexible or rigid, on the extent of the deformity, and on the surgeon's preference. All these techniques are technically demanding and often need extensive exposure, leading to secondary tissue damage, which may be especially unwanted in patients with diabetes.

A simple alternative procedure for correcting toe deformities is the flexor tendon tenotomy. First described by Ross and Menelaus in 1984 (18), who corrected 188 toe deformities in 62 children with a 95% success rate, this technique has proven useful in treating diabetic ulcers of the lesser toes (19, 20).

We report the results of a consecutive series of patients treated for an ulcer at the tip of the toe with a flexor tenotomy after unsuccessful conservative treatment with orthosis, shoe adaptation, and total contact casting.

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Patients and Methods

We reviewed our records of patients with flexible clawing of the toes and an existing or impending ulcer at the distal plantar tip of 1 or more toes that were treated with a flexor tenotomy at our institution between April 2006 (first procedure) and July 2008. The toe deformity was considered to be flexible if the deformity disappeared with plantar flexion of the ankle or when the entire toe returned to neutral when the flexion at the proximal interphalangeal joint was first manually corrected (a positive push-up test) (21).

All patients had been treated unsuccessfully with some combination of orthosis, shoe adaptation, or total contact casting.

The patient's age, sex, underlying illnesses (diabetes, rheumatic, none), and number of treated toes were determined from the medical charts. A photograph of each ulcer was taken before surgery (Figure 1).

Vascularity was assessed by the presence or absence of arterial pulsations in the dorsalis pedis and tibialis posterior arteries of the foot. Systolic toe pressures and ankle-brachial indexes were measured in many patients.

Ulcers were graded according to the Wagner classification (19, 22). When osteomyelitis was suspected, conventional radiographs were taken. (In this stage of diagnosis, conventional radiographs are preferred because they are more readily available and less expensive than magnetic resonance imaging and indium-111–labeled leukocyte scans [23]).

Surgical Procedure

Patients underwent outpatient percutaneous tenotomy as described by Tamir et al while under a selective toe block using lidocaine 1% without adrenaline (20). The forefoot is clasped in one hand, and the affected toe is simultaneously hyperextended with the thumb to create a ''bow-stringing'' of the flexor tendons. A 3-mm stab-wound incision is made with a #15 scalpel blade at the mid-level of the proximal phalanx, and the deep and the superficial flexor tendons are severed. The stab wound is left open, and a loose dressing is applied for 24 hours. At the last follow-up and most recent visit on record, data on the duration of follow-up (months), ulcer healing and recurrence, and complications were collected.

Patients completed the American Orthopaedic Foot and Ankle Society's (AOFAS) Midfoot Score (24). The AOFAS Midfoot Score was used because the AOFAS Lesser Metatarsophalangeal-Interphalangeal Scale relies partly on the motion of the lesser toes, which is expected to be poor after flexor tenotomy. The AOFAS Midfoot Scale ranges from 0 (worst functional outcome) to 100 points (best functional outcome) and provides measures of pain, limitations in daily activities, walking distance, walking surface, gait abnormalities, footwear requirements, and alignment. Patients indicated their satisfaction with their condition both preoperatively and postoperatively on a single 10-cm VAS ranging from 0 (no satisfaction) to 10 cm (excellent satisfaction) (25).

Results

Of the 23 patients (42 ulcers) meeting the inclusion criteria, 14 were men. The mean age at follow-up was 66.8 years (range, 38.9-85.8 years). In addition, 15 were diabetic, 5 had a rheumatic disorder, and in 3, no underlying illness could be identified. In 4 patients, pulsations could not be palpated at the foot, and in 3, only one of the arteries could be felt; 5 of these patients had diabetes. Seven patients had polyneuropathy.

Both systolic toe pressures and ankle-brachial indexes were available for 12 patients, and ankle-brachial indexes were available for 3 more. In 7 of these patients, toe pressure was below 70 mm Hg in the operated toe but still above 30 mm Hg, which was taken as the lower limit for healing potential (26).

From 1 to 6 toes were treated per patient (Table 1). The ulcers were present for a mean of 6.8 months (range, 1-24 months) before surgery; 95% were grades 0 through 2 (Table 2).

The mean duration of follow-up was 11 months (range, 1-27 months). One patient eventually died of causes unrelated to the procedure or diagnosis. All 42 ulcers were healed at a mean of 3.6 weeks after surgery (range, 1-8 weeks). In one patient with a grade 1 ulcer, an ulcer recurred at the second right toe about 23 months after the initial surgery. This patient's first right toe had been amputated before the tenotomy. The recurrence healed with conservative measures.

One 77-year-old woman sustained an iatrogenic volar plate injury that caused the toe to remain hyperextended. The toe was eventually amputated, and she recovered uneventfully.

For the 15 patients in whom the score was available, the mean postoperative AOFAS Midfoot Scale score was 77 (range, 43-100). The mean VAS score for patient satisfaction increased from 3.9 (range, 0-10) preoperatively to 7.7 (range, 5-10) postoperatively in these patients. Four patients rated preoperative and postoperative results identically, and 11 rated the result as improved. No patients scored worse after surgery.

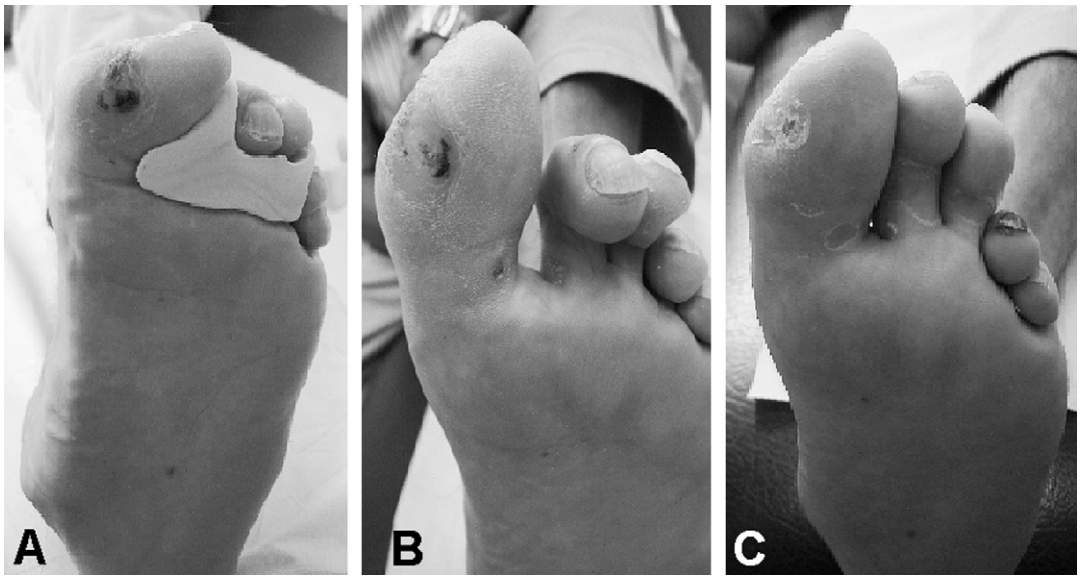

Fig. 1. A diabetic patient with an ulcer of the first toe of the left foot and impending ulcers on the second and third toes. (*A*) Before the tenotomy of the first toe, with the orthosis in situ. (*B*) Three weeks later, before the surgery of the second and third toe. (*C*) Four weeks after surgery.