

Flexor Tenotomy Improves Healing and Prevention of Diabetes-Related Toe Ulcers: A Systematic Review



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ABSTRACT

Toe deformities are common in people with diabetes and are often associated with toe ulcers. Operative procedures have been used to reduce toe deformities, because these were proposed to be beneficial in the management of toe ulcers. The present systematic review investigated the effect of flexor tenotomy to address toe deformity for healing and preventing diabetes-related toe ulcers. Four electronic databases were searched in January 2016. Studies were included if they had reported the effects of flexor tenotomy for healing and/or preventing diabetes-related toe ulcers. Six studies with a total of 264 flexor tenotomies performed on toes with ulcers and 57 performed as a prophylactic procedure were included. The mean duration of preoperative ulceration was 207.9 (range 7 to 1825) days. The mean duration to postoperative ulcer healing was 29.5 days, with an overall healing rate of 97%. The rate of ulcer recurrence was 6%. All the toes that had undergone prophylactic flexor tenotomy remained free of ulceration. Overall, the rate of complications was low. Flexor tenotomy to address toe deformity is relatively safe and effective in healing and preventing diabetes-related toe ulcers. Flexor tenotomy should be considered in the management of diabetes-related toe ulcers in the presence of toe deformities.

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It has been estimated that 7% of the world's population has diabetes and that a person with diabetes has a 15% to 25% lifetime risk of developing a foot ulcer (1). Foot ulceration is a severe complication of diabetes, posing a threat to mortality and can lead to limb loss (2,3). The management of diabetes-related foot ulcers places a significant burden on both the health and the financial resources of individuals, caregivers, and healthcare services (3–5).

Although the development of diabetes-related foot ulceration is multifactorial, it is most frequently associated with peripheral neuropathy and foot deformity (6). Toe deformities, such as claw and hammer toes, often develop in people with diabetes (7), and toes are among the most common site of diabetes-related foot ulcers (8,9). Claw toes are characterized by hyperextension of the metatarsophalangeal joint with flexion of the proximal and distal interphalangeal joints (10). Hammer toes are also characterized by hyperextension of the metatarsophalangeal joint with flexion of the proximal interphalangeal joint but without flexion deformity at the distal interphalangeal joint (10). A toe deformity is believed to

increase the risk of developing a toe ulcer, because the prominent aspects (dorsal and plantar) of the toe are at risk of increased pressure (8). Conservative (nonoperative) measures such as total contact casting, controlled ankle motion walker, postoperative shoe, and felt padding are commonly used as the initial treatment to accommodate toe deformities (11,12). However, operative interventions such as flexor tenotomy are often considered when a toe deformity has been identified as a contributing factor to a toe ulcer and when conservative options have been unsuccessful (6,13,14).

The flexor tenotomy procedure typically involves the transection of the longitudinal fibers of the long flexor tendons with a scalpel blade or the sharp edge of a needle (15–17). Thus, the procedure reduces the flexed position of the toe deformity and decreases pressure on the apex of the toe, which is believed to aid in ulcer healing and prevention (6,13,14). Because flexor tenotomy is a minimally invasive surgery, it is becoming an increasingly popular option for patients with diabetes-related toe ulcers (18). The aim of the present systematic review was to investigate and summarize the effects of flexor tenotomy on diabetes-related toe ulcer healing and prevention.

Materials and Methods

Four electronic databases (MEDLINE, CINAHL, EMBASE, and PubMed) were searched from inception to January 2016. The search strategy was (diabet* or neuropath*) and (toe*) and (ulcer* or wound*) and (flexor or teno* or surg* or operat*). The

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search yields were transferred to Endnote™, version 7 (Thomson Reuters, Philadelphia, PA). Citation tracking was completed on all identified articles included in the refined library, using Google Scholar. No restriction was placed on the year of publication for the included articles. An outline of the systematic review conducted is presented in the Fig.

Two of us (D.R.B. and E.J.G.) independently assessed the items in the EndNote™ (Thomson Reuters) library for inclusion in the review. Studies were eligible for inclusion if they had investigated flexor tenotomy for reducing toe deformity, the patients had had diabetes and either a toe ulcer or were at risk of developing a toe ulcer, and ulcer healing and ulcer prevention were used as an outcome measure. All peer-reviewed publications were considered. The studies were excluded if they had included patients with a toe ulcer attributed to a condition other than diabetes, had used operative procedures other than flexor tenotomy (e.g., ulcer debridement alone or osteotomy), and/or had used outcome measures other than ulcer healing and prevention (e.g., plantar pressures). Non-English language reports were excluded. Studies that had included patients without a history of diabetes mellitus were included if the data from the patients with diabetes could be extracted. Any disparity between the reviewers (D.R.B. and E.J.G.) was discussed and resolved by consensus.

Two independent reviewers (D.R.B. and E.J.G.) assessed the quality of the included studies using the quality index tool (19). The quality index tool has been shown to have high criterion validity, internal consistency, and interrater and test–retest reliability (19). No studies were excluded because of the quality assessment.

Data from each study were independently extracted from the available text and analyzed by us and then cross-checked to confirm the accuracy. The data used from each study included the number of patients, number of flexor tenotomies performed on toes with diabetes-related ulcers, number of flexor tenotomies performed prophylactically, duration of diabetes-related toe ulcers at flexor tenotomy, interval to post-operative ulcer healing, postoperative ulcer healing rate, and complications. With the

exception of the follow-up period, all periods reported in the studies were converted to days to allow the data to be pooled and compared. The data were synthesized descriptively.

Results

The electronic database search yielded 435 results (Fig). Once all the reports had been screened for eligibility, 6 studies were included (Table 1) (15–18,20,21). The study designs of all the included studies were retrospective case series (level of evidence 4).

The 6 studies included a total of 321 flexor tenotomies performed on 202 patients with diabetes (72 males, 75 females; mean age 64.7 years). However, age and gender were unable to be extracted for the 55 patients in the study by Tamir et al (16). All 6 studies included patients who had undergone flexor tenotomy to treat a diabetes-related toe ulcer, with all ulcers located on the apex (distal tip) of the toe (15,16,20). Of the 6 studies, 3 also included patients who had undergone the same operative procedure as a preventative intervention (17,18,21). A total of 264 flexor tenotomies were performed on toes with diabetes-related ulcers and 57 were performed prophylactically. Four studies reported a mean follow-up period of 13 to 40 (range 3 to 65) months (15,17,18,20), and two reported a median follow-up of 22 to 31 (range 2 to 48) months (16,21).

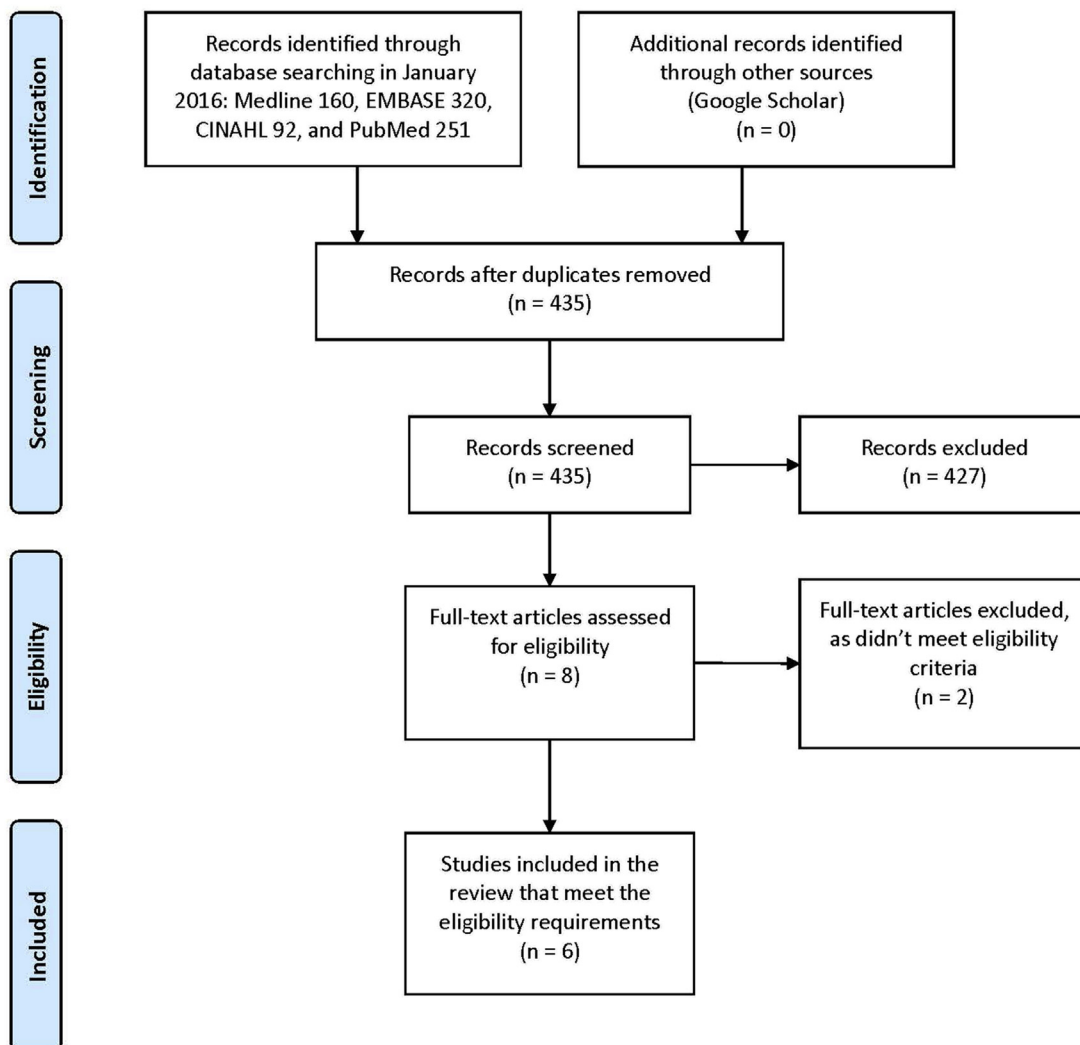


Fig. Flowchart showing the review process.

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