Original Research Paper

Volume - 13 | Issue - 03 | March - 2023 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

General Surgery

NEEDLE FLEXOR TENOTOMY IN DIABETIC FOOT TOE ULCER: A SURGICAL ALTERNATIVE.

Dr. Aashik. J. S	Department of General Surgery KVG medical college, Sullia
Dr. Chandrasekhar S	Department of General Surgery KVG medical college, Sullia
Dr. Ranjith B	Department of General Surgery KVG medical college, Sullia
Dr. Greeshma S*	Department of General Surgery Kodagu Institute of Medical Sciences *Corresponding Author
Dr. Gopinath Pai	Department of General Surgery KVG medical college, Sullia
Dr Asha Abdul Salam	Department of General Surgery KVG medical college, Sullia

ABSTRACT **Introduction:** Diabetic toe ulcers are a potentially devastating complication of diabetes. In recent years, the percutaneous flexor tenotomy procedure for the correction of flexible claw and hammer-toe contraction deformities that has been proposed as a safe, minimally invasive and effective technique for facilitating the healing of toe-deformity related diabetic toe ulcers. **Methods** A retrospective observational study was performed with the inclusion of all consecutive flexor tenotomies from one hospital between July 2021 and July 2022. **Result** The average follow-up was upto 12 months. Out of 35 diabetic foot toe ulcers, 31 healed (88.6%) completely with a mean period of 3.77±1.7 months. **Conclusion** A percutaneous flexor tenotomy is a safe and effective off-loading technique that can be performed in an outpatient clinic. The presence of osteomyelitis is not a contraindication for this technique; however, an increased healing time can be expected.

KEYWORDS : Flexor tenotomy, Toe ulcer, Diabetes, Ulceration, Plantar pressure, Toe deformity

INTRODUCTION

Diabetes is one of the largest health challenges facing the world, India is said to be the Diabetic capital in the world. Usually Claw and hammer toe deformities develop in people with diabetes, leading to increased pressure on the distal end of the toes[1]. In otherwise normal individuals, too much pressure and stress on the pressure points in the foot may lead to the reflexive change in position due to responsive nerve endings. Claw toes occur due to the stiffness of the ligaments which is due to the non-enzymatic glycathion[2] of these ligaments. During weight bearing or gait, insensate and deformed toes, there will be an increased pressure and shear stress in combination with neuropathy, which then, may lead to abundant callus and the development of ulcers. Conservative treatment of these ulcers consists of wound care, sharp debridement and off-loading of the foot by means of shoe adaptations or casting which takes prolonged period for healing. A minimally invasive surgical alternative is flexor needle tenotomy.

Flexor tenotomy can also be performed for prevention of diabetic foot ulcers, when abundant callus is present on the distal end of claw and hammer toes. The minimally invasive technique of tenotomy was first described by Mankowitz. It is technically simple and less invasive, economically feasible and can be done as an outpatient procedure. The effectiveness of needle flexor tenotomy on diabetic foot ulcers is a grey area.

In low socioeconomic areas, due to complications like neuropathy, patients may not be aware of the wound or the ulcer that is caused in the foot, therefore their presentation to the Outpatient will be at a later stage. One may be infected whereas other may not be which is an important factor in healing.

Here, we estimate the duration for the diabetic ulcers to heal after flexor tenotomy. The aim of this study was to retrospectively investigate all consecutive flexor tenotomies in people with neuropathic diabetic foot ulcers on the distal end of the toe, to report healing and time to heal, and to investigate the influence of preoperative treatment, ulcer duration before flexor tenotomy, ulcer location, and infection on healing and time to heal.

MATERIALS AND METHODS:

We retrospectively reviewed the files of patients with diabetes treated at KVG Medical college between July 2021 to June 2022. All the patients had a claw toe deformity and ulcer at the tip of the distal phalanx and underwent flexor tenotomy. The medical files of these patients were reviewed for: (i) patient characteristics (gender, date of birth, diabetes type, neuropathy assessed with a peripheral arterial disease assessed by palpation of pulses in the lower limb, pre-operative treatment) ; (ii) ulcer characteristics (duration before flexor tenotomy, location, presence of infection based on clinical assessment, depth divided in three groups as superficial, penetrating to tendon or capsule, penetrating to bone or joint, date of flexor tenotomy, ulcer healing period, complications transfer lesions and re-ulceration (development of a new ulcer on the same location, after the previous ulcer was healed) during follow-up. (Table.1)

Table.1	Minimum	Maximum	Mean	Std. Deviation
Age	36	72	60.00	7.203
Ulcer duration	20	80	53.74	15.691
HbA1c	6.50	14.60	7.7286	1.84177
Digit tenotomised	1	3	2.31	.583
Healing time months	2	8	3.77	1.726

Inclusion Criteria:

1) Diabetic foot with ulcer in the distal phalanx
2) Mild to moderate rigid flexor deformity

Exclusion Criteria:

1) Peripheral Vascular disease ulcers
2) Grade 4 and 5 Wagner wounds
3) Non diabetic Cellulitis
4) Charcot foot
5) Lost in follow up

Procedure:

Procedure was done by one common surgeon. The patient was asked to lie supine on the examination table with his or her feet at the lower edge of the bed. Precautions to ensure sterility were always followed. For a digital block, 5 mL of lidocaine was used; however, in diabetic patients with sensory neuropathy, this is often not necessary. The tendon was felt and cut using an 18-gauge needle. If the deformity was rigid, the toe was hyperextended at the proximal interphalangeal joint (osteoclasis). Pressure applied with dressing gauze for several minutes and a sterile dressing applied over the wound. The patient was allowed to bear weight in his or her normal shoes, and daily dressings of the ulcer was maintained. The patient was examined within 1 week to ensure that the wound had healed satisfactorily and then at regular intervals until the toe ulcers have healed. Patient was followed up for 1 year to know the healing status of the wound and if any complications post tenotomy was seen. The following data of the patients were

extracted from the electronic patient records as the results closest to the date before the procedure. (Diag 1)

Data Analysis:
The collected data will be analysed using SPSS version 20.0 (IBM Corp., NY, USA) and Microsoft excel 2013. The data will be presented in the form of tables and figures. The data will be represented as frequencies, percentages, mean ± standard deviation. Chi square test and t test will be used to assess the relationship between the variables and p value < 0.05 will be considered as significant.

RESULTS:

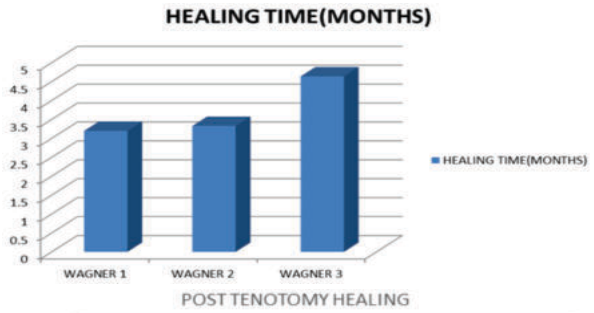
A total of 35 patients were taken up for the procedure, flexor tenotomy. Patient, foot and ulcer characteristics are described in Table 1 (group characteristics).

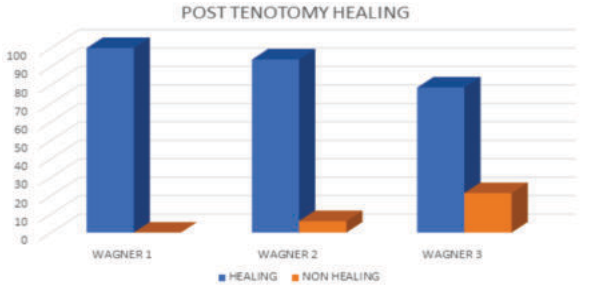
74 % were females and 26 % were males, 94 % of the population had neuropathy.

About 45.7% of the population presented with Wagner grade 2 ulcers and 40 % were of Wagner grade 3 ulcers.

From 35 ulcers, 31 healed (88.6%) completely. The longest duration for healing was found for infected ulcers that were penetrating to bone and also uncontrolled Diabetes Mellitus.

A significant relation was found between time to heal and ulcer classification and neuropathy with the shortest time to heal in superficial ulcers without infection (average of 3.3 months), and the longest time to heal (4.6 months) seen in infected ulcers penetrating to bone (Wagner Grade 3). Graph 1 and 2.





29 neuropathic patients (89%) showed complete healing post needle flexor tenotomy except for 4 cases (11 %).

Patient was followed up upto 1 year; Out of 35 tenotomies done, only 1 patient (2.86%) had transfer lesions and 2 patients (5.71%) ulcer recurrence. 31 patients (88.57%) were able to walk normally with footwear. Table 2.

	Frequency	Percentage
Transfer lesions	1	2.86
Ulcer recurrence	2	5.71
Weight bearing	31	88.57

DISCUSSION

In the toe, interossei and lumbricals normally flex the metatarsophalangeal joint and extend the proximal and distal interphalangeal joints. The action of the intrinsic muscles is opposed by the action of the long extensor and flexor tendons; hence, the toe remains balanced. In patients with diabetes, motor neuropathy can cause dysfunction of the interossei and lumbricals muscles.[3-5] The unopposed action of the extensor digitorum longus extends the metatarsophalangeal joint and the flexor digitorum longus flexes the interphalangeal joints causing a claw toe deformity.[6-8]

Flexor needle tenotomy is a minimally invasive surgical procedure for off-loading claw and hammer toe deformities. All four ulcers that did not heal were infected and penetrated to bone and had poor glycaemic control at the moment of flexor tenotomy.

Infected ulcers penetrating to bone are not a contra-indication for performing flexor tenotomy, as the 78.6% of the same healed completely without any significant complication. Flexor needle tenotomy, its complications include transfer lesions[9] and recurrence of the ulcer. But in the long run advantages outweigh the disadvantages. Literature so far reported low incidence of complications, two studies by Rasmussen and Tamir reported two (2/81) and nine (9/34) transfer ulcers respectively.[1011]

Frequent follow-up visits are essential for timely detection of these ulcers, or the callus formation, which is a pre-sign of these ulcers. Frequent follow-up visits and timely made shoe adaptations may prevent ulceration due to this complication.
Limitations of this study includes is that, there is no group for comparison, retrospective study, and sample size is small.

Conflict Of Interest

The authors declare that they have no conflict of interest.

Acknowledgements

The authors declare that they have no competing interests.

CONCLUSION

This study suggests that flexor tenotomy proves to be beneficial for neuropathic diabetic foot ulcers on the distal end of the toe, with a high healing percentage and shorter duration of healing. Only infected wounds or ulcers penetrating the bone (Wagner grade 3) showed delay in the healing period and complications of the procedure. Prophylactic flexor tenotomy may hold promise as a measure for prevention of ulceration on the distal end of the toe and should studied upon. Prospective research should be done, to confirm the results of this retrospective study and also its efficacy as a prophylactic procedure for diabetic foot ulcers in the distal end of the toes.

REFERENCES:

1. Bakker K, Apelqvist J, Schaper NC, International Working Group on Diabetic Foot Editorial Board: Practical guidelines on the management and prevention of the diabetic foot 2011. Diabetes Metab Res Rev 2012, 28(1 Suppl):225–31
2. La Fontaine J, Lavery LA, Hunt NA, Murdoch DP. The role of surgical off-loading to prevent recurrent ulcerations. Int J Low Extrem Wounds. 2014;13:320–34
3. Cavanagh P, Ulbrecht J. Biomechanics of the foot in diabetes mellitus. In: Bowker J, Levin ME, O'Neal LW, editors. The diabetic foot. St. Louis: Mosby; 1993. p. 207-26
4. Fernando DJ, Masson EA, Veves A, et al. Relationship of limited joint mobility to abnormal foot pressures and diabetic foot ulceration. Diabetes Care 1991;14:8-11
5. Mueller MJ, Hastings M, Commean PK, et al. Forefoot structural predictors of plantar pressures during walking in people with diabetes and peripheral neuropathy. J Biomech 2003;36:1009-17
6. Myerson MS, Shereff MJ. The pathological anatomy of claw and hammer toes. J Bone Joint Surg Am 1989;71:45-9
7. Green DR, Brekke M. Anatomy, biomechanics, and pathomechanics of lesser digital deformities. Clin Podiatr Med Surg 1996;13:179-200
8. Mann R, Inman B. Phasic activity of intrinsic muscles of the foot. J Bone Joint Surg Am 1964;46:469-81
9. Netten JJ, Bril A, van Baal JG. The effect of flexor tenotomy on healing and prevention of neuropathic diabetic foot ulcers on the distal end of the toe. J Foot Ankle Res 2013;6:3
10. Schmitz P. "The Effect of Percutaneous Flexor Tenotomy on Healing and Prevention of Foot Ulcers in Patients with Claw Deformity of the Toe." The Journal of Foot and Ankle Surgery, vol. 58, no. 6, 2019, pp. 1134–1137., doi:10.1053/j.jfas.2019.03.004
11. Tamir E, Vigler M, Avisar E, Finestone AS. Percutaneous tenotomy for the treatment of diabetic toe ulcers. Foot Ankle Int 2014;35:38