

A STUDY ON SURGICAL OFFLOADING OF TROPHIC ULCERS IN DIABETIC FOOT PATIENTS-OUR INSTITUTIONAL EXPERIENCE

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Abstract

Background: Chronic nonhealing ulcers in the foot are very common in Diabetic patients. These ulcers are seen on the plantar aspect and are associated with sensory loss of the foot. Diabetic foot ulcers are located at the site of maximum weight bearing such as ball of great toe, heel pad, metatarsal head, tips of the fingers. Surgical management is the most effective modality of treatment in such cases with internal offloading procedures. Aim of the study is to evaluate the effectiveness of surgical offloading procedures in healing of trophic ulcers in Diabetic foot patients. **Materials and Methods:** This study was conducted in Thanjavur Medical college with a sample size of 30 diabetic foot cases who presented with nonhealing ulcers on the plantar aspect. It was a prospective and descriptive study. Patients complete history was obtained, were clinically examined, relevant investigations were done. Appropriate offloading surgical procedures were planned like Keller's Arthroplasty, Floating metatarsal osteotomy, Flexor tenotomy, tendon transfer, Jones transfer, flap cover etc. Data was collected and analyzed by appropriate statistical methods. **Result:** Out of 30 patients 20 were male patients and 10 were female patients. 11 patients underwent keller's arthroplasty, 9 underwent metatarsal osteotomy, 5 underwent SSG, 4 underwent tendon transfer, 1 patient underwent flap cover. Average time taken for ulcer to heal was 6.5 weeks, 5 patients had wound infection and dehiscence due to uncontrolled Diabetes, recurrence seen in 2 patients, 90% of patients had their ulcer healed in 9 weeks. **Conclusion:** Surgical offloading procedures were effective in healing of Diabetic foot ulcers secondary to neuropathy and bony prominence. These procedures have least recurrence rates when compared with conventional methods of offloading like foot wear, casts and orthotics. The morbidity of having a nonhealing ulcer in Diabetics has reduced with these internal offloading procedures and patient could return to work at the earliest by 6 weeks.

INTRODUCTION

Major cause of amputation in the society is Diabetic foot is due to its neuropathy, vasculopathy and infection. Diabetic foot and its complications are often neglected and unaddressed problems in the society. There are estimated 537 million adults living with Diabetes Mellitus (DM) in the world. 3 in 4 adults with Diabetes live in low and middle income group in various countries.^[1-3] 25 % of Diabetic patients develop Diabetic foot syndrome of whom 85 % end up with amputation.^[4] Every 30 seconds a lower limb or part of a lower limb is lost somewhere in the world as a consequence of DM. It is important to prevent complications of Diabetic foot syndrome by identifying at risk foot patients and surgically

offloading the trophic ulcers in Diabetic foot patients which will in turn reduce amputation rates.

DM is one of the major health problems in health care systems and its incidence has increased dramatically over the past 2 decades.^[5] Diabetic foot ulcers are frequently related to elevated plantar pressure under a bony prominence. Autonomic sensory loss contributes to skin ulceration by producing trophic changes like coarse dry, inelastic skin. There may be an increase of pressure under the forefoot area with greater pressures localized to under the metatarsal heads and the heel. These are common pressure points in Diabetic foot patients. Clinical studies have shown that elevated plantar pressure is a cause of the development of plantar ulcers in diabetic patients,^[6-8] and that ulceration is often a precursor of lower extremity amputation,^[9] up to about 50% of people

with diabetes mellitus (depending on ethnicity²) will eventually have loss of sensation in the feet secondary to peripheral neuropathy that is sufficient to allow them to injure the soft tissues of the plantar surface, a condition that has been termed loss of protective sensation³. The treatment principle involves avoiding pressure on the ulcerated site called 'offloading'. offloading surgeries include percutaneous flexor tenotomy, mini-invasive floating metatarsal osteotomy or Keller arthroplasty, tendon transfers. Ulcers plantar to the interphalangeal joint of the hallux will be treated by a modified Keller resection arthroplasty (originally designed for the treatment of hallux valgus in otherwise healthy patients). Minimally invasive surgical offloading that includes correction of foot deformities has good short and long term results. The mainstay of treating and preventing ulcers is offloading. This may be done with shoes, orthotics and contact casts.^[10-12] But while these are frequently effective in the short run, in the long run ulcers often recur for a variety of reasons, including patients' lack of compliance. A more definitive method of offloading includes surgical correction of foot deformities.

MATERIALS AND METHODS

This was a prospective analytical study of 30 patients admitted with Diabetic nonhealing trophic ulcer at Thanjavur Medical College. Study was done after getting approval from the institutional ethical committee, and an informed consent was obtained from patients. The period of study was from June 2022 to November 2023. Patients were examined at a foot outpatient clinic specializing in the treatment of diabetic foot ulcers and were approached to take part in the study.

Inclusion criteria

1. Male and female diabetic patients above 18 years and below 75 years
2. Diabetic patients admitted with nonhealing trophic ulcers in the foot
3. Diabetic patients with failure of conservative treatment for trophic ulcers in the foot
4. Diabetic patients with recurrent trophic ulcer in the foot after callous excision/wound debridement
5. Diabetic patients with trophic ulcers in the foot with osteomyelitis.

Exclusion criteria

1. Ischemic/venous ulcers of the foot
2. Patients who are not willing for surgery
3. Patients who are unfit for surgery with other co morbidities
4. Nondiabetic Patients with ulcers in the foot
5. Patients with Marjolins/Malignant ulcers in the foot

6. Diabetic pregnant women with foot ulcers
7. Nondiabetic neuropathic ulcers

After taking complete history and complete clinical examination, patients were subjected to appropriate investigations which would help in deciding appropriate offloading procedure. Ankle Brachial Index (ABI, with hand Doppler assessment) and 5.07/10 g monofilament sensory test for Diabetic peripheral neuropathy [DPN], Plantar thermal monitoring for DPN, Digital biothesiometry study for DPN, Plantar pressure report (pedobarogram) were measured to evaluate the vascular status and level of sensory loss of the foot in Diabetic patients with trophic ulcers.

RESULTS

A total of 30 patients were included in the study and were operated with various surgical offloading [internal] procedures best suited for the deformity and site of plantar ulcer. Out of 30 patients 20 patients were males [66.6%] and 10 patients were females [33.3%] Table 1. The male Diabetic foot patients outnumbered the female patients who were included in the study.

The age preponderance among the Diabetic foot patients ranges from 32 to 75. The mean age of diabetic patients in the study was 57.83%. Patient as young as 32 years and as old as 75 years have developed diabetic foot complications.

Patients have either one limb involved or both in few patients. Majority of patients had their right foot involved [Table 2].

Site of the wound with which the patient presented varied among the study group. While most had trophic ulcers in the base of great toe and toe tips, few had ulcers over metatarsal head region, some over heel pad region and few had ulcers over mid foot [Table 3].

Ulcers over the base of great toe were treated by Kellers arthroplasty. Ulcers plantar to the interphalangeal joint of the hallux will be treated by a modified Keller resection arthroplasty (originally designed for the treatment of hallux valgus in otherwise healthy patients). Metatarsal ulcers treated by minimally invasive floating metatarsal osteotomy with or without K wire fixation and tendon transfer [peroneus longus to peroneus brevis] in some patients, Tip toe ulcers were treated by either closed or open flexor tenotomy, heel pad ulcers were treated with flap cover and split thickness skin grafting. 2 patients with forefoot ulcers with tight Achilles tendon underwent Gastrosoleus recession which will relieve pressure over forefoot [Table 4].

Table 1

Sex	Number	Percentage
Male	20	66.6%
Female	10	33.3%
Total	30	100%

Table 2

Side of the Foot involved	Number	Percentage
Right	16	53.33%
Left	11	36.66%
Both	3	10%

Table 3

Site of wound	Number	Percentage
Forefoot	24	80%
Midfoot	2	6.66%
Hindfoot	4	13.33%

Table 4

Offloading procedure	Number	Percentage
Kellers Arthroplasty	11	36.6%
Metatarsal Osteotomy	7	23.3%
Metatarsal Osteotomy with Tendon transfer	4	13.3%
Metatarsal Osteotomy with Gastrosoleus recession	2	6.6%
STSG	5	16.6%
Flap cover	1	3.3%



Figure 1: Kellers arthroplasty in a patient with great toe base ulcer



Figure 5: A great toe infected ulcer with osteomyelitis of PPX, treated by wound debridement and FHL tendon excision through proximal incision



Figure 2: Ulcer shows good healing at the end of 4 weeks



Figure 6: Ulcer healed completely 8 weeks after thorough wound debridement and primary suturing done over a drain in an otherwise unsalvageable toe if not debrided timely.



Figure 3: Ulcer at 3rd metatarsal head



Figure 4: Ulcer grossly reduced in size at 4 weeks follow up

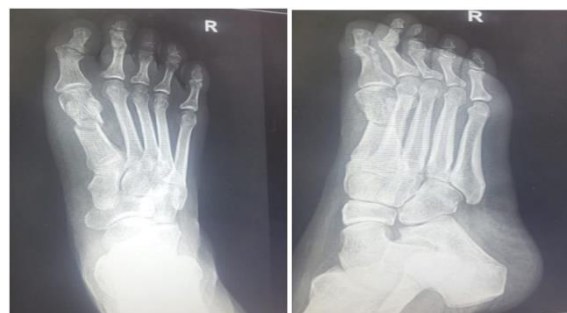


Figure 7: X ray showing a floating metatarsal osteotomy of 1st Metatarsal bone.



Figure 8: 3rd metatarsal head osteotomy done in a patient with osteomyelitis



Figure 9: 3rd Metatarsal floating osteotomy



Figure 10: Heel pad ulcer covered with Medial Plantar Artery flap and donor site covered with SSG



Figure 11: A well settled Medial Plantar artery flap after 12 weeks



Figure 12: Midfoot charcots deformity treated with excision of exostosis

Average time taken for a trophic ulcer to heal was 6.5 weeks. 5 patients had wound infection and dehiscence due to uncontrolled Diabetes, recurrence seen in 2 patients due to poor post op compliance, 90% of patients had their ulcer healed in 9 weeks.

DISCUSSION

Diabetic foot surgery plays an important role in the prevention and management of complications of DFU, and has been on the rise over the past 2 decades. Although surgical interventions for patients with DFU complications/deformities are not without risk, the surgical offloading of persistent foot ulcers can improve outcomes.^[13] In diabetic patients even before the patients develops ulcer, effort should be made to identify at risk foot for prevention of ulcers and its complications of as most patients will not develop ulcers if preventive measures are followed.^[11] This will help to reduce the complications of diabetic foot and limb amputation rates. Foot Complications are very common in uncontrolled diabetic patients.^[13] It is estimated that ulcer distribution in diabetic foot ulcer patients range from 25% at first toe, 23% - 50% at first MTP joint and 38% at other metatarsal heads.^[13] Around 56% of the diabetic foot ulcers become infected and 20% of the patients with infected wounds end up with some form of toe or forefoot amputation.^[14] Laborde,^[15] retrospectively reviewed 18 patients presenting with plantar toe ulcers treated with an open flexor tenotomy. All patients had a flexible claw toe deformity with toe tip ulcers on the distal plantar aspect of the hallux or lesser toes. The incision and the ulcer healed in all patients who underwent tenotomy. Two patients underwent a repeat procedure for ulcer recurrence. In our study all toe tip ulcers were treated mostly by open tenotomy and all ulcers healed by 8 weeks and no recurrence noted after 6 months follow up. Closed flexor tenotomy was performed in 1 patient under local anesthesia with 18-gauge needle. Multiple metatarsal head resections or a pan metatarsal head resection may be considered for nonhealing ulcers in the presence of an abnormal metatarsal parabola. Hamilton et al,^[16] had suggested combining lesser metatarsal head osteotomies with gastrocnemius recession and a peroneus longus to brevis tendon transfer in patients with multiple neuropathic forefoot ulcerations. In our study, Multiple metatarsal osteotomy was performed in 2 cases which included 1st and 3rd metatarsal osteotomies, whereas tendon transfer (PL to PB) was done for only 1st metatarsal osteotomy cases. 2 patients with multiple fore foot ulcers with tight Achilles tendon underwent gastrocnemius recession. Armstrong et al,^[17] compared the efficacy of a first MTP joint arthroplasty (similar procedure to keller) with nonsurgical management of ulcers at the plantar aspect of the hallux interphalangeal joint. They included 41 patients of which 21 underwent a first MTP joint arthroplasty. Patients ulcer in the operated

group healed significantly earlier than patients in the non operated group. Both groups were given equal treatment after ulcer healed, and the operated group had fewer recurrences of ulcer during 6-months follow-up. There was a high rate of postoperative infections in the operated group (40%), but this was compared with the 38% of patients in the control group who required antibiotics for infections during the treatment period. The results of this study suggest that a first MTP Joint arthroplasty is a safe and effective procedure in the treatment of noninfected, nonischemic ulcers posterior to the hallux. In our study group 11 patients underwent kellers arthroplasty for hallux ulcer. These patients were on plantar cast for a period of 3 weeks post operatively. These ulcers showed good healing rates at about 6 to 8 weeks. Kellers arthroplasty though initially performed for hallux valgus deformity is useful offloading procedure for hallux IP joint ulcers with good results. Limited ankle joint mobility, as seen clinically as a tight Achilles'-gastrocnemius-soleus complex, is a deforming force and a causative factor in plantar forefoot ulcerations.^[18] During normal gait 10° of dorsiflexion at the ankle is needed, decreased or no dorsiflexion will raise plantar pressures in the forefoot and impairs healing of the wound. To alleviate the plantar pressures in tight Achilles tendon, many surgeons suggested percutaneous Tendo-achilles lengthening(TAL) procedures. Armstrong et al,^[18] had established that the plantar pressures are reduced after percutaneous TAL in his studies. Lin et al,^[19] reported results of percutaneous TAL in 15 patients with plantar forefoot ulcers that did not heal despite 9 weeks of total contact casting. All except one ulcer healed (93%), with no recurrence noted after a mean 17.3-month follow-up. In the present study 2 patients underwent gastrocsoleus recession who have multiple forefoot ulcers and a tight Achilles tendon. We combined metatarsal osteotomy with gastrocsoleus recession in these patients and results were good as compared to doing only metatarsal osteotomy. The classic “rocker-bottom” deformity,^[20] is due to collapse of the midfoot arch. With the continued stress of weight bearing on insensate foot leads to local inflammation and fractures, dislocations, and deformity.^[21] Charcot arthropathy is one of the most characteristic deformity of the diabetic foot, occurs in 1% of the diabetic population and approximately 30% of individuals with peripheral neuropathy. Originally described by Charcot as the pied tabétiques in persons with tertiary syphilis.^[22] Studies have indicated that diabetic patients with Charcot foot deformities have an increased risk for ulceration and high amputation rates when compared with diabetic persons without Charcot deformity.^[23] In our study 1 case of midplantar ulcer with charcot foot was treated by excision of exostosis and debridement of the callous ulcer. A future midplantar joint fusion was planned in this patient once the ulcer heals.

CONCLUSION

Surgical management of diabetic foot deformities is the need of the hour to prevent evitable amputations of the limb. Now it is the new era of foot reconstruction to give an ulcer free life for diabetic patients who come with diabetic foot complications. Hence the surgical offloading of these deformities is a must for healing of the ulcers when appropriate procedure is chosen based on the location of the ulcer. Careful patient selection and thorough evaluation of the foot as well as attendant comorbidities are the cornerstones of achieving successful results in otherwise very complicated patients. Choosing the right combination of osteotomies with tendon transfers helps in prevention of recurrent ulcers in the patients. Post operative compliance of the patient is utmost important especially in continuing below knee plantar cast for 3 weeks with strict immobilization to prevent delay in healing ulcers and wound dehiscence.

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