# Elements of Success After Metatarsectomy Healing of Neuropathic Diabetic Foot Ulcers

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**Abstract-** Diabetic foot ulcer (DFU) is one of the most significant and destructive complications in diabetic patients. It is not only the main cause of patients' foot amputation but is also related to their mortality rate. The aim of this study was to evaluate the results of metatarsectomy in the recovery of diabetic-resistant foot neuropathic wounds to evaluate its clinical effectiveness. This quasi-experimental, before-and-after study was done on 16 diabetic patients with refractory neuropathic ulcers, who were referred to the vascular surgery ward undergoing metatarsectomy. Patients were followed up for two weeks, one month, and three months after surgery and were evaluated for complete recovery, partial recovery, and no response. Of 16 diabetic patients with 16 refractory diabetics plantar fasciitis, 12 (75%) were male and 4 (25%) were female. The mean age of patients was 56.63. There were 5 patients with type 1 diabetes and 11 patients with type 2 diabetes. 10 patients (62.5%) had the underlying non-diabetic disease. 50% of patients had had a history of amputation. The mean duration of diabetes in 16 patients was 18.06 years. All wounds healed completely with an average healing time of 4 months (100% epithelialization). The results of the present study demonstrate that metatarsectomy can be used as a primary technique for offloading in the treatment of diabetic-resistant neuropathic wounds in the soul instead of non-surgical methods. The results prove that this method with a high recovery rate and significant clinical effectiveness can be used as an effective method in the first line of treatment of diabetic-resistant neuropathic wounds of the sole.



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## Introduction

A diabetic foot ulcer is one of the most notable and destructive complications in diabetic patients (1). The risk of people with diabetes mellitus (DM) experiencing a foot ulcer at some stages of their lives could be approximately 15% (2), Around 30% of these wounds heal with the standard of wound management (2,3). Peripheral neuropathy is one of the most important causes of diabetic foot ulcers. This complication, which occurs in 30 to 50 percent of diabetic patients (4), plays a crucial role in the incidence of DFU underneath the metatarsal plantar heads (5). Peripheral neuropathy development and loss of protective sensation (LOPS) in diabetes cause

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them not to notice injury or discomfort, consequently, an ulcer can expand in a foot with normal anatomy (6). Dysfunction in lower extremities increases plantar peak pressure (PP) and, as a result, lesions become resistant to healing (5). Therefore, the main component in effective DFU treatment is the elimination of abnormal mechanical pressure points (offloading) to promote healing or prevent recurrent DFU (7). There are currently several methods used for offloading, including no removable mechanical methods such as the total contact casting (TCC), removable mechanical devices such as the knee-high cam-walker, and an internal offloading through bone and joint deformity correction by osteotomy, metatarsal head resection (MHR), accessory bone excision, arthroplasty, or arthrodesis (8).

Nonoperative methods with TCC, removable cam walker (RCM), or custom-made orthotics and shoes were used to reduce the pressure from ulcers, but in more studies, there are frequently ulcer recurrence and complications such as difficulty controlling wounds regularly, swelling of the skin, and arterial obstruction (9). Metatarsal head resection (MHR) is a simple procedure that decreases the pressure plantar to the affected metatarsal and has been proposed as an effective surgical offloading technique for the treatment of chronic neuropathic ulcers under the metatarsal head (10). Several studies, for instance (3,10-12), have been conducted on MHR. This method was chosen because it is one of the most feasible ways for treating DFU (13). The basics of this method were to remove the head and neck of the metatarsal through one plantar transverse incision. The MHR technique has changed progressively to achieve better results and fewer complications after surgery (14). For it, the choosing of the operation procedure should be established by related factors such as patient compliance, vascular status, age, the reason for surgery, type of approach, and bone quality (15). Reports published in the last two decades show that the use of this method has had good results in the short and long term and reduces the risk of major amputation at an early stage (16). The present paper tries to evaluate the clinical effectiveness of MHR in diabetic patients of the vascular surgery ward by examining the postoperative results of this method on the healing and treatment of resistant neuropathic wounds of diabetic patients.

## Materials and Methods

This is a quasi-experimental study that is performed before and after referral of patients with a metatarsal refractory neuropathic diabetic ulcer who have to meet the study inclusion criteria. These patients were chosen through the ones who went under the surgery of metatarsal head resection over 4 years from 2016 to 2020. The code of thesis ethics is IR.GUMS.REC.1399.165. The study inclusion criteria are a diabetic person aged between 40 to 79, who has had a chronic ulcer for more than one month due to forefoot deformity, which does not have any detected arterial ischemia in the ABI test and went under metatarsal head resection surgery. And the exclusion criteria of the study are having arterial ischemia, lack of desire for further follow-up, obvious osteomyelitis, and having a past medical history of any neoplasia and coagulopathy. Demographic information of patients such as age, sex, type of diabetes, underlying disease except for diabetes, duration of diabetes, and the history of amputation was collected by checklists from patient's files and telephone interviews with them. Patients joining the study, after obtaining informed consent, underwent local, spinal, or general anesthesia by making an incision on the dorsal part of the metatarsal causing compression ulcer of the sole, and then underwent metatarsal head resection and also metacarpophalangeal joint disarticulation. After the dorsal foot ulcer healing, keratinized tissue of the foot ulcer is debrided if necessary and in the case of presenting infection, the base of the plantar foot wound should also be debrided Since the patients in 2 weeks, 1 month, and 3 months after the surgery were followed up and they asked and checked about the complete and partial recovery and also lack of response to treatment and the data were gathered. All patients received surgery using a single operative protocol. As mentioned earlier, the procedure is done by excising the metatarsal head through (figure 2).

### Data analysis

All the registered data entered the SPSS software version 22 and was analyzed. Statistical tables and graphs were used to describe the data and for hypothesis testing Fisher’s exact test at 5% error was used.

## Results

Totally 16 cases that fulfill the inclusion criteria have entered the study. 12 out of 16 cases were male (75%) and 4 of them were female (25%). The average age is 56/63 with a minimum of 40 and a maximum of 77. 5 patients (31.25%) with type 1 and 11 (68.75%) of them with type 2 diabetes 10 patients (62.5%) have underlying diseases other than diabetes and 6 patients (37.5%) have only diabetes. Underlying diseases other than diabetes include hypertension, hyperlipidemia, and ischemic heart

diseases. 8 patients (50%) have passed medical amputation and the others do not have former amputation history. The average period of having diabetes was 18.06 years, which the 5 and 37 years were lowest and highest respect, and the average time for wound healing after surgery was 4 months with a minimum of 2 and a maximum of 10 months (Figure 1). 16 patients (100%) after metatarsal head resection recovered completely with 100% epithelialization (Figure 2)

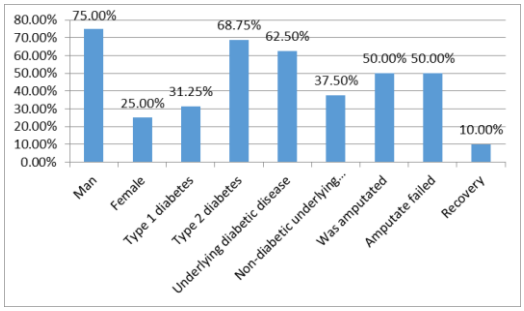


**Figure 1.** Patients' characteristics and their potential risk factors

**Figure 2.** Metatarsal head resection (MHR)

## Discussion

Of the 16 patients studied, 16 wounds (100%) were completely healed after metatarsal resection (100% epithelialization). The mean duration of wound healing after surgery was 4 months, the minimum time required for wound healing was 2 months, and the maximum It has been 10 months. The results of the above study showed that the recovery in the metatarsal resection method is faster, the recovery rate is better and the infection and recurrence rate is less than the non-surgical method. This study introduced metatarsal resection of the head as a reliable and efficient surgical method for the treatment of diabetic refractory neuropathic ulcers of the sole (17).

The present study, based on the results of previous studies, suggests the preference of metatarsal head resection due to better effect and efficiency compared to the non-surgical method in healing resistant diabetic plantar neuropathic wounds .The findings of our study show that the mean obtained from the duration of recovery in our study (4 months) is consistent with the mean obtained from the length of recovery with a similar study (18). Preceding studies have compared the efficiency of MHR with treatment (19). Patients with diabetes mellitus and neuropathic forefoot wounds, panmetatarsal head resection (PMHR) compared with nonoperative administration of wounds led to a shorter time of healing and decreased lower limb morbidity (20). In 16 patients studied in our study, complete wound healing was reported, which is the same as the results obtained from the study of Sheriff Motamedi *et al*., (21). This study also proposed metatarsal resection of the head as the only medical approach from a therapeutic point of view and cost-effective for the treatment of resistant diabetic foot neuropathic ulcers.

Comparing the results of the above studies with the present studies, it is found that metatarsal resection of the head due to high recovery rate (100% in the present study, 100% in the study of Sheriff Motamedi *et al*., 93.6% in the meta-analysis of Yamin Kay *et al*.,) It is a recommended reference in the treatment of diabetic refractory neuropathic ulcers of the soles of the feet. In addition, according to studies, this method is very cost-effective compared to non-surgical methods, with fewer complications and better effectiveness for wound healing.

The evaluation of the present study showed that metatarsal resection surgery, which was previously performed to correct structural abnormalities of the foot in rheumatoid arthritis and orthopedic applications, can be used as a primary technique for offloading in the treatment of resistant diabetic foot ulcers. Used non-surgical methods. The results show that this method with a high recovery rate, significant clinical effectiveness, and improving the quality of life of patients can be considered as an efficient and effective method in the first line of treatment of resistant diabetic foot neuropathic wounds.

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