

**Original Article****Role of Plastic Surgery in the Management of Diabetic Foot Ulcer**Most. Afroza Nazneen,¹ Mohammad Ali Choudhury²**Abstract**

Abstract: This article introduces plastic surgeons' various roles in managing diabetic foot ulcers. The role of plastic surgeons is multidimensional and, of course, challenging. Sometimes, the healing process of diabetic ulcer is as simple as only adequate wound care. Sometimes, the ulcer needs reconstruction through a skin graft or flap coverage. Unfortunately, some patients need amputation or disarticulation. Again, plastic surgeons are maximizing patients' future movement ability in the case of amputation. Thus, an experienced plastic surgeon can provide an optimum lifestyle to the diabetic patient.

Keywords: Diabetic foot, ulcers, diabetes, plastic surgery,

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Introduction

Diabetes is a systemic disease, and its manifestation on the foot is variable. Therefore, the mode of management of the diabetic foot varies according to these variables. These variables include age, affected site or sites, comorbidities, structures affected, etc.

The diabetic foot represents a condition that involves diabetic patients, characterized by the presence of infection or profound tissue destruction associated with neuropathy and peripheral arteriopathy.¹ It affects 15% of diabetic patients during their lifetime, causing soft tissue injuries called ulcers.² In developing countries like Bangladesh, this percentage is increasing daily with maluses of antibiotics and lack of proper foot care. This severe complication precedes 85% of the amputations performed in diabetic patients, associated with poor quality of life and a high mortality rate reaching up to 50% in 5 years.³⁻⁵

Ulcerative lesion formation is a process that includes several pathophysiological mechanisms.

In diabetic patients, a minor injury may remain unidentified by the patient due to peripheral neuropathy. However, it is increased due to local vascular suffering and may be complicated by bacterial infection. The infection may become devastating to ascend to the leg, sometimes causing septicemia, even death. Bacteria such as *Staphylococcus aureus*, *Enterobacter*, *Pseudomonas aeruginosa*, and *Escherichia coli* have been shown to play a role in slowing down the normal wound healing process.⁶

The surgical management of diabetic foot ulcers plays an integrative role in preventing complications. Early surgical intervention and proper antibiotic therapy are the best solutions to save the limb from amputation.⁷ Surgical debridement is the fastest and the most efficient method of removing necrotic and devitalized tissue. Particular attention should be paid to the correct delimitation of dead tissues from healthy tissues.¹ Postoperatively, patients should be closely monitored and educated to monitor their foot condition and to use the appropriate

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footwear.⁷ It is better to immobilize the foot and keep it elevated to prevent edema postoperatively. After stabilizing the patients, the treatment should be initialized by controlling blood glucose levels, using proper broad-spectrum antibiotics according to culture sensitivity, and optimizing the hemoglobin and albumin level. Local wound care starts with surgical wound excision, and the defect is healed by secondary intention or using a skin graft or flap coverage. A multidisciplinary approach and proper treatment prevent, in some cases, complications and avoid leg amputation, increasing the patient's quality of life.

Amputation may be an option for the treatment when necrosis or osteomyelitis is present. The long-term goal is to prevent injury to the affected or contralateral foot by maintaining blood glucose levels within normal limits and instructing patients to maintain proper foot care.

Results

Most of the patients were 40-49 years, though the ages varied from 30 to >69 years (Table 1). Sixty-six of the patients enrolled were female, and 44 were male. The patients enrolled in the study had different types of lesions involving different foot and leg areas (Table 2). The ulcers were treated through surgical debridement or wound excision. Among them, 79% had underlying osteomyelitis. After the surgical debridement, the defect was covered using skin grafts, local or distant flaps, or secondary healing. In the case of osteomyelitis, we did necrosed bone excision, curettage, K-wire fixation of the joint, and flap coverage (Figure I). In patients with toe gangrene, amputation or disarticulation was necessary.

Table I : Patients according to age

Age (years)	No. of patients treated
30-40	14
40-49	33
50-59	27
60-69	29
>69	07

Materials and Methods

A retrospective study was conducted in the Burn and Plastic Surgery Department of Rajshahi Medical College and Hospital, in which 110 patients of all ages and of both males and females had diabetic foot ulcers. The study period was from October 2021 to September 2022. The patients were admitted through the outpatient department and referred from the Department of General Surgery, Department of Orthopedic Surgery, Department of Nephrology, and different diabetic centers of Rajshahi and the nearest districts. The admitted patients had plantar, dorsal, and lateral foot ulcerations and toe necrosis, sometimes extending to the leg. In addition, the hematological status (hemoglobin), nutritional status (albumin), and glycemic control (HbA1C) were assessed. Wound cultures were drawn upon admission, and leg radiography was performed to assess bone involvement.



Figure I: Diabetic foot ulcer with osteomyelitis 3rd toe. (A) Radiological findings, (B) After K-wire Fixation, (C) After Transposition Flap coverage.

The patients usually come in an advanced stage with a leg infection, and empirical antibiotic treatment is started after drawing wound swabs for cultures.

Ulcerations on the dorsal part of the foot are usually covered by a skin graft, especially when the defect is large and the leg vascularization is poor. The reconstruction is performed when the wound cultures are sterile, any bacterial load being a threat to the skin graft (Figure II).

Plantar ulcerations on the pressure areas are usually covered by a local flap rotated or advanced from the areas where pressure is absent. Plantar ulcers usually appear over the pressure areas, so they are challenging to treat. Sometimes, patients refuse surgery; the only solutions are dressings and secondary healing. Every patient with ulceration requires radiography because this could hide an osteitic process. Secondary healing is usually time and money-consuming and sometimes not at all possible.^{8,9}

Discussion

Diabetic foot is a severe complication that requires a multidisciplinary team for proper management. The diabetologist aims at balancing blood sugar levels. The infectious disease specialist has the role of optimizing antibiotic therapy, the orthopedic surgeon evaluates and remedies the biomechanical abnormalities, the vascular surgeon improves the local blood flow, and the plastic surgeon has the role of transforming a chronic wound into a wound that heals normally or to

close the wound using reconstructive surgery techniques.³ X-ray scans are necessary to detect any signs of bone involvement, bearing in mind that osteomyelitis appears on X-rays after three weeks.

Studies show that this condition is more common in female patients or in rural areas with low economic status who have limited access to medical services and a solitary lifestyle, which was also the status of the enrolled patients.³ The common principle of these treatments is the

debridement process that must be performed through atraumatic surgical gestures that avoid damage to adjacent healthy tissues. It is considered that a wound is ready to be closed when all the signs of inflammation have disappeared and the wound has the following characteristics: the erythema surrounding the wound has reduced or disappeared, wound edges show no induration, and neo-epithelialization areas are present with fresh granulation and a sterile surface. The surface of an evolving wound with healthy granulation tissue decreases by about 10-15% per week.¹⁰⁻¹²

(A)



(B)



Figure II: Large wound extending from foot to leg was covered by Split thickness skin grafting

Defects can be healed using delayed primary closure or skin grafts, local or pedicled flaps, and free flaps. Choosing the optimal wound closure method is a complex process that requires assessing the viability of adjacent tissues, the size of the wound, its depth, and the chance of recovery. When the tissues are viable, the granulation is present, and the location of the wound is not in a pressure area, it is feasible to apply a skin graft that provides multiple sources of epithelialization. Otherwise, lack of granulation, atonic tissue, and localization on a pressure require the use of local flaps; rotation flap, transposition flap, medial plantar artery flap, distally based sural

flap, and perforator flap. Sometimes when the local flap is not healthy or available, we have to do cross leg flap or free flap. Figures I, II, III, IV, V, VI, VII show different flap techniques according to the site involved and the size of the ulcer. All these are limb-saving surgeries.



(A)



(B)

Figure III: Modified Transposition flap to cover Great toe Ulcer.

When the ulceration extends to the level of a joint, osteomyelitis should be suspected. In this case, an X-ray is needed to assess the bone lesion extension and plan for surgery. It is also important to check if any tendon is involved because the infection can spread proximally and distally along its path. When soft tissue necrosis, osteomyelitis, and uncontrolled infection are present, amputation should be considered. Our role is to provide the necessary support to restore the patient's limb to a functional level that allows him to perform routine daily activities.¹³



Figure IV: (A) Heel ulcer <3cm, (B) Marking of Rotation Flap, (C) After covering the heel ulcer.

Table II : Patients according to Site affected

Site affected	No. of patient treated
Forefoot	39
Heel	56
leg	15

In the long term, complications can arise with new ulcerative lesions or stress fractures. Thus, it is recommended that patients wear different orthotic devices to prevent these complications. The long-

term goal is to prevent injury to the affected or contralateral leg by maintaining health and glucose blood levels within normal limits and instructing patients to maintain proper feet care.

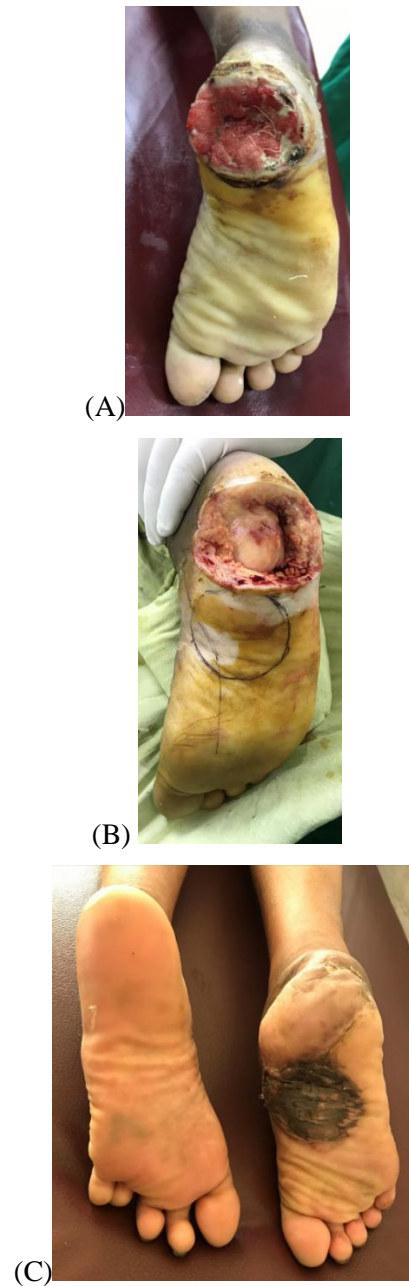


Figure V: Medial Plantar artery flap for Heel Ulcer >3cm

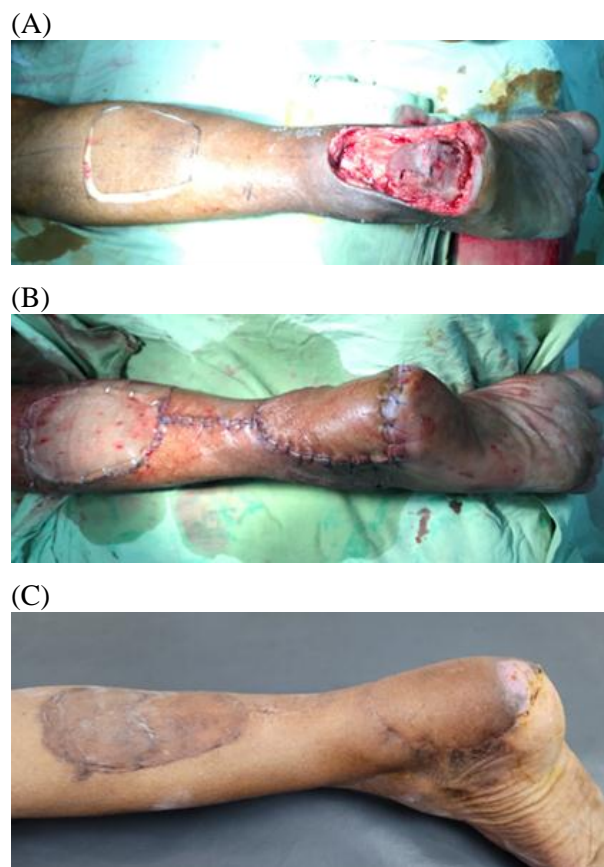


Figure VI: (A) exposed heel and tendoachilis, (B) & (C) Per-operative and post-operative picture of distally based sural artery flap.

Conclusion

A diabetic foot ulcer is a severe complication that requires the collaboration of a multidisciplinary team. The Department of Plastic Surgery plays a fundamental role in preventing the spread of infection and further complications. These limb-saving surgeries are essential to maintain quality of life and daily job.

Table III: Management applied our patients

Mode of management	No. of patient treated
Simple wound care	19
Skin grafting	12
Flap coverage	
a. Sural flap	24

b. Rotation/ Rotation flap	modified	44
c. Medial plantar artery flap		11



Figure VII: Exposed 1st MP joint covered by Modified Rotation flap

Even if amputation is considered a debilitating surgery, this may prove lifesaving in some cases. The prevention of diabetic foot ulcers is essential, and it can be realized through constant clinical evaluation and early treatment of any suspicious lesions, thus lowering the amputation rate and increasing the quality of life.

Conflict of interest: None declared

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