

## **Different Modalities Used for Reconstruction of Soft Tissue Defects of the Foot in Sohag University Hospital**

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## Abstract

**Background:** Foot trauma may have a major influence on life style in the form of chronic pain, ulcers and diminished function. These potential complications can be minimized by appropriate management of foot soft tissue injuries. Proper wound debridement and meticulous hemostasis are essential. The ultimate goal of reconstruction is to close the wound and to provide for bipedal ambulation.

**Methods:** During the period from January 2010 to December 2014, 164 patients with soft tissue defects in the foot underwent reconstruction in the plastic surgery department of Sohag university hospital. Reconstructive method was chosen according to the local finding of each defect as well as the general clinical status of the patient. Skin grafts, fasciocutaneous and myocutaneous flaps, either pedicled or free, were utilized. The minimal post-operative follow up was 6 months.

**Results:** 169 foot soft tissue defects in 164 consecutive patients were reconstructed. The etiology was acute trauma in 152 and chronic trauma in 12 cases. Modalities of reconstruction used were: 72 skin grafts, 51 cross-leg flaps, 15 flap repositioning and direct closure, 12 local flaps, 9 sural flaps, 5 dorsalis pedis flaps, 4 free flaps and 1 medial planter flap. Overall complication rate was 12%.

**Conclusion:** Reconstruction of the foot should start by the simplest procedure that can accomplish the desired anatomical and functional outcome. Although microsurgical progress has improved and changed the quality of lower limb reconstruction, pedicled flaps remain good solution in selected cases.

**Key-words:** foot injury; foot reconstruction; fasciocutaneous flap; sural flap; cross-leg flap

## **Introduction**

Reconstruction of foot soft tissue defects has been a challenge for reconstructive surgeons for many years [1], as the skin is different in various regions of the foot [2]. Soft tissue defects of the foot are usually caused by road traffic accidents, fall from height, heavy object trauma and burn [3]. The goal of reconstruction is to close the wound and to restore and/or maintain bipedal ambulation [1]. The first step of the reconstruction ladder described by Mathes and Nahai, 1997 was reconstruction by secondary intention, followed by direct closure, skin grafts, local flaps then distant flaps [4]. A new modified ladder was proposed by Janis and his colleagues in which a new modalities e.g. dermal matrices, negative pressure wound therapy and tissue expanders were included to achieve a better result in a simpler and a less complicated way [5]. In this report, we present a series of 169 foot soft tissue defects.

## **Patients and Methods**

The study included 164 consecutive patients with soft tissue defects in the foot. Patients were admitted and underwent reconstruction in the plastic surgery department of Sohag university hospital, during the period from January 2010 to December 2014. All patients were included in the study except; patients who were on chemotherapy or radiotherapy, patients who refused surgical interference, those with trivial trauma (as for example superficial clean cut wounds, superficial laceration) and patients with toes injuries. All patients underwent thorough local examination to ensure integrity of the limb vessels and nerves. Routine laboratory and radiological investigations were also done before surgery.

Reconstructive method was chosen according to the local finding of each defect and the general clinical status of the patient. The study was approved by the committee for research ethics in Faculty of Medicine, Sohag University, and an informed written consent was obtained from the patients or their

guardians. Post-operative follow-up and monitoring were applied for all of the patients. The hospital stay ranged from one day to 3 weeks. The outpatient's follow-up was at least for 6 months postoperatively.

## Results

This study included 164 patients (118 males and 46 females) with 169 foot soft tissue defects. The age of patients ranged from 1.5 to 75 years old with the mean age 17 years. Acute trauma was the cause of injury in 152 cases: the most common scenarios of injury were road traffic accidents, hard object trauma and deep burn. In 12 cases the cause was chronic trauma in the form of post orthopedic procedures complications.

The most commonly used procedures were the skin grafts (72 defects) followed by cross-leg flaps (51 defects). In 15 defects, it was possible to replace the elevated skin flap with closure of the wound, and regional pedicled fasciocutaneous flaps were used in another 15 defects: 9 sural flaps, 5 dorsalis pedis artery flaps and 1 medial plantar artery flap. Local flaps were used in 12 defects: 7 transposition flaps, 2 V-Y flaps, 2 rotation flaps and 1 rhombic flap. Four defects were reconstructed by free flaps: one of them with rectus abdominis myocutaneous flaps and in the other three defects, anterolateral thigh flaps were used. **Skin grafts** were used to reconstruct traumatic raw areas without exposed bone, tendons or neurovascular bundles. In majority of cases, grafts were applied after 3 to 7 days of dressing, but in few cases, where the wound was clean with no devitalized tissues, skin grafts have been performed immediately after the primary debridement (figure 1).

Figure 1: A: soft tissue injury before debridement and B: STG applied to the defect



**Local skin flaps** were used in small defects with mobile surrounding skin e.g. V-Y skin flap in the sole and transposition flaps. **Cross-leg flaps** were used to cover large soft tissue defects with exposed bone over the dorsum of the foot, ankle and both malleoli (figure 2 and 3). **Sural flaps** in our study were of pedicled type with the pedicle separation was performed after 3 weeks (figure 4).

**Dorsalis pedis artery flap** was used to reconstruct defects of dorsum of the foot. Medial planter artery flap was used for the heel reconstruction (Figure 5). Free rectus abdominis myocutaneous and free anterolateral thigh fasciocutaneous flaps were used to reconstruct defects of the foot with bone or tendon exposed. Whenever possible, two veins were used for drainage and the skin island was used to monitor the viability of the flap.

Figure 2: A Soft tissue injury before debridement, B) Cross-leg flap immediate post-operative, and C) 2-weeks after separation and D) 4-weeks after separation.



Figure 3: A) soft tissue injury before debridement, B) Cross-leg flap elevated, C) immediate postoperative cross-leg flap and D) 4 weeks after separation.

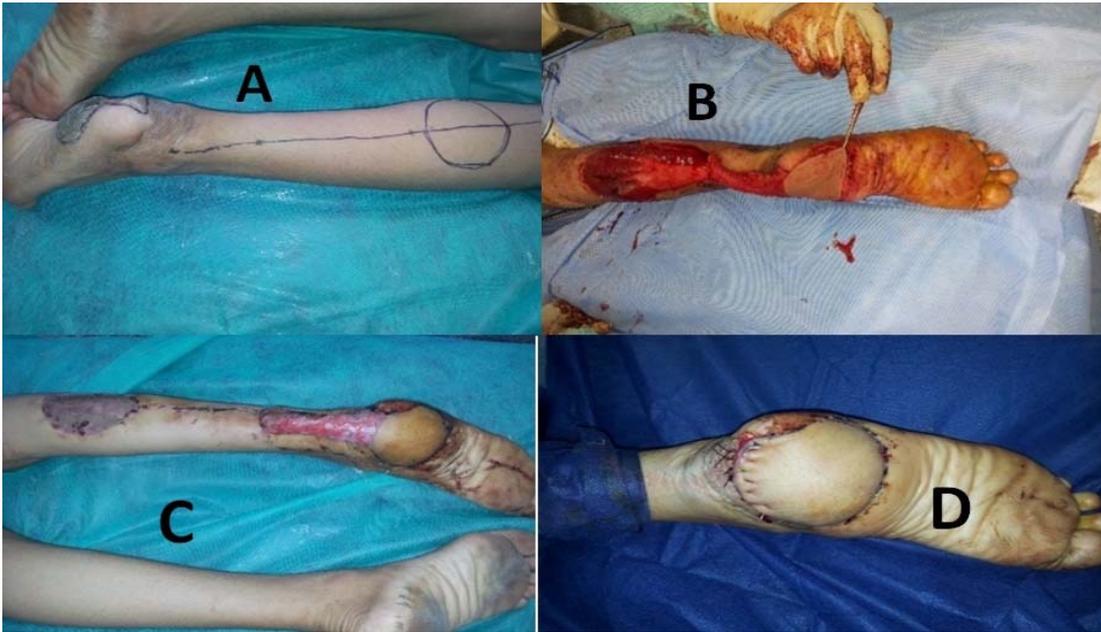


Figure 4: A) Markings of sural flap to reconstruct chronic heel ulcer, B) Sural flap elevated, C) 3-days post-operative, D) 2-weeks after pedicle separation.



Figure 5: A) Chronic neuropathic ulcer of the heel, B) 3-months after reconstruction with medial planter artery flap.

Regarding the site of the defect in the foot, we divided them into four regions: the area of the dorsum, the malleolar area, the sole and the heel (table 1).

Table 1: distribution of cases according to specific area of the foot

area	Number
Dorsum of the foot	111
The malleolar area	31
The heel	19
The sole of the foot	8

We had 17 complications in our series of different modalities of reconstructions, of which total failure occurred in 6 occasions (table 2). **Flap repositioning** complications were encountered in 3 out of 15 defects: complete failure in 2 flaps while marginal ischemia occurred in one flap which healed by secondary intention. **Skin grafts** used in our study were of split thickness type. Total loss occurred in one skin graft that was used to cover a raw area in the sole. Other complications in the form of graft contracture which affected the function of toes occurred in 4 cases: in all of them, the graft was used for the dorsum region. Graft contractures were corrected by surgical release. **Cross-leg flaps'** complications that required farther surgery were 3 out of 51, in the form of bulkiness of the flap which disturbed the patient in wearing shoes in two cases, while the third complication was the ugly donor site scar. **Sural flaps'** complications occurred in 4 out of 9 defects, total failure was encountered in 2 cases: in both of them, the flap was used to cover the medial malleolus, while marginal ischemia occurred in 2 flaps: one was mobilized to reconstruct the heel and the other was used for the medial malleolus. **Anterolateral thigh flaps** were used 3 times with total loss of one flap used for the dorsum region and partial ischemia in another one that was used for the heel while the third one has successfully reconstructed the sole. There were no complications reported in **dorsalis pedis artery flaps which** were successfully used in reconstruction of 5 defects: 4 to cover the dorsum and 1 for the medial malleolus.

Table 2: Complications of various modalities of foot defect reconstruction

Modality of reconstruction	Total failure	Other Complications
Flaps repositioning	2	1
STGs	1	4
Cross-leg flaps	-	3
Sural flaps	2	2
Anterolateral thigh flaps	1	1
Total	6	11

## DISCUSSION

Foot injuries are still common in our region and complicated soft tissue defects usually result. If untreated properly, these injuries may have a major influence on life style in the form of chronic pain, ulcers and diminished function. Adequate wound debridement is the first step of any reconstructive procedure in the foot. The ultimate goal of reconstruction is to close the wound and to provide for bipedal ambulation. There is a variety of reconstructive techniques that can be applied for such defects. Good knowledge of the reconstruction ladder and its modification besides considering the patients' conditions and tolerability and the surgeon skill and experience will help in decision. In 8.9% of defects in our series, the wound could be repaired by replacing the elevated skin flaps without the need for any other procedures while skin grafts were sufficient for reconstruction in 42.6% of defects. Cross-leg flaps were used in 30.2%, while local skin flaps have been used in 7.1% of defects to reconstruct slightly complicated trauma which are not suitable for grafts. In the more complicated injuries in which local flaps were not sufficient, pedicled regional fasciocutaneous flaps were used to reconstruct 8.9% defects. When the defects were complicated with no availability of any other modalities, free flaps were used; this accounted for 2.4% of cases.

Split-thickness graft is indicated in covering of defects of large area [6], while full-thickness skin graft are not commonly used in the foot [7]. STG was used in reconstruction of approximately half of the injuries (42%) with success rate over 95%. It is important to be aware of the functional deformity of toes dorsiflexion when placing the graft on the dorsum as this occurred in 4 out of 72 defects. This deformity will affect patient's life and will need further surgery. Therefore postoperative physiotherapy is essential.

Local skin flaps are indicated to reconstruct a local defect with similar characters of the adjacent tissue or in the need for full-thickness tissue to cover relatively less vascular tissue without intact periosteum, paratenon or perichondrium when skin graft is insufficient [8]. Using local flaps in the foot is very limited due to tightness and paucity of skin, that's why only 12 out of 169 defects (7%) were reconstructed with local flaps. Transposition flap was the commonly used among other local flaps. All our local skin flaps were successful with no complications.

We used distant pedicled flaps in 66 out of 169 defects with success rate of 90 %: 51 of them were cross-leg flaps and the other 15 flaps were from the same leg. Cross-leg flap is a good choice in young patients but also could be used safely in patients less than 40 years old with no complications. The flap drawbacks are that it is a two stages procedure, morbidity of the donor and patients discomfort from the immobilization of the two limbs and limitation of its use in elderly due to the high incidence of joint stiffness and deep venous thrombosis[9]. Cross-leg flap was the second most common technique and most common distant flap to be used in our study with no failure rate documented. Complications of the flap that needed further surgery occurred in reconstruction of the dorsum in 3 defects in the form of bulky flap that compromised patient's quality of life, dorsiflexion of the toes and contracted ugly scar of the flap donor area. Sural flap is versatile and its main indications are defects of the heel, tendon Achilles, anterior and lateral aspect of the ankle, dorsum of the foot and lateral aspect of the hind foot. The advantages are

to cover large areas in the foot and ankle and provide short and simple technique that can be done without the complex techniques of the free flaps [10].

Sural flap had the highest complications and was encountered in 4 out of 9 defects (44%) among all distant flaps used. Complications ranged from partial ischemia and necrosis of flap edges (in 2 cases) up to total ischemia and flap loss (in 2 cases).

The dorsalis pedis flap is used mainly for reconstruction of the skin defects of the dorsum of the foot [11]. The flap advantages are coverage of defects over the lateral and medial aspects of the foot, ankle both malleoli, tendon Achilles and heel coverage. Reversed flow or turned over dorsalis pedis flap based on distal perforator is used to cover distal foot defects with graft over the fascia [12]. Dorsalis pedis artery flap has been used in reconstruction of 5 defects in our study. The flap covered defects over the dorsum and medial malleolus. Medial plantar perforator flap is a fasciocutaneous island flap of glabrous skin based on the perforators of the medial plantar artery [13]. This flap was successfully used in one injury in our series.

We don't have the choice to use dermal matrices or negative pressure wound therapy in our hospital, so free flaps were used to reconstruct foot defects after failure of other simple modalities.

In our series, the most frequent method in reconstruction of soft tissue defects of the foot were split thickness skin graft, fasciocutaneous flap, local skin flap and finally free flap. Simpler and safer techniques should be tried whenever possible. Although microsurgical progress has led to improvements in quality of lower limb reconstruction, pedicled flaps remain a good solution in selected cases. Recently fascial and fasciocutaneous flaps become more popular can provide an alternative for free tissue transfer.

**Conflict of interest:** The authors declare no conflict of interest.

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