Doppler Assisted Reversed Neuro-Fascio-Cutaneous Flaps in Foot Reconstruction

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ABSTRACT

The loss of soft tissue at the level of the ankle and heel with bone & tendon exposure represents a challenging reconstructive problem because of the lack of locally available tissue, relatively poor circulation of the skin, weight-bearing requirement of the region.

The aim of this study is to specify the surgical technique and the outcome of 30 distally based neuro-fasciocutaneous flaps used for management of foot defects assisted by Doppler examination.

There were 30 patients presented by foot ulcers of different etiology the ulcer size varied from 2 x 3cm to 5 x 8cm. After ulcer excision the size varied from 4 x 6cm to 8 x 10cm.

The ulcer sites were 25 in heel area and 5 cases in the lateral side of foot.

Preoperative Doppler examination was done to localize the site of septo-cutaneous perforators from lateral malleolus.

The reversed sural flap was done for coverage of 25 heel ulcer and the reversed flap based upon the artery accompanying superficial peroneal nerve was used for coverage of lateral sided foot ulcer (5 cases). The overall results were satisfactory.

As regard Medium to large defect in the heel (weight bearing area of the foot). We recommend the use of reversed sural island flap:

• It is one stage operation without need for microsurgery.
• Elevation of the flap is easy and quick, also the vascular supply to the arterial network of the sural area is constant and reliable and there is no need to sacrifice any major artery or sensory nerve.
• There is minimal donor site morbidity.

As Regard the Lateral Side Defects of the Foot:

• We recommend the use of reversed flap based on the vascular axis of superficial peroneal nerve.
• It is easy and quick flap in dissection with reliable and constant vascular pedicle.
• It provides a good piece of skin with minimal donor site morbidity.

INTRODUCTION

The loss of soft tissue at the level of the ankle and heel with bone and tendon exposure represents a challenging reconstructive problem because of the lack of locally available tissue, relatively poor circulation of the skin, weight-bearing requirement of the region [1].

Therapeutic options include local, regional and free flaps. A local flap may not be possible because of inadequate tissue available to be moved from areas adjacent to the defect or due to limited flap mobilization. Reversed septo-cutaneous flaps such as the peroneal artery flap, anterior tibial and posterior tibial flaps are also another option. However, the major artery is killed and already the injured lower leg might be jeopardized.

An inferiorly based soleus muscle flap is an option but it is usually associated with limitations of bulkiness and unreliability owing to variable vascular anatomy of this distal flap.

Microsurgery can also be used, but such a technique requires a microvascular team, special equipment and also lengthy operation [2].

Since Masquelet et al., 1992 [3] first described the concept of the distally based neuro-cutaneous island flap supplied by the vascular axis around the sural nerve, similar flaps have reported and shown to be appropriate for reconstruction of medium to large defects around ankle and heel [4].

Aim of Work:

This study is to specify the surgical technique and the outcome of 30 distally based neuro-fasciocutaneous flaps used for management of foot defects assisted by Doppler examination.
PATIENTS AND METHODS

Since June 2003 to December 2005, there were 30 patients presented by foot ulcers of different etiology. All of them admitted to plastic surgery department, Assiut University Hospital. Their ages ranged from 5 years to 55 years with mean age 35.5 years. Eighteen were females and twelve were males.

There were different etiology to foot ulcer as trauma (12 cases), trophic ulcer (5 cases), chronic inflammation (5 cases), diabetic (4 cases), marjolin ulcer (3 cases) and one case of ischemic ulcer.

The ulcer size varied from 2x3cm to 5x8cm. After ulcer excision the size varied from 4x6cm to 8x10cm.

The ulcer site was 25 in heel area and 5 cases in the lateral side of foot.

For all cases, full history was taken, thorough medical examination, good vascular examination to lower limb and routine surgical fitness examination were done.

Preoperative Doppler examination was done to localize the site of septo-cutaneous perforator from lateral malleolus.

Reversed Sural Island Flap Surgical Technique:

After ulcer excision, when the patient in prone position, a skin island is marked along the axis of the sural nerve and lesser saphenous vein.
The perforators were identified by Doppler examination and by their distance from the lateral malleolus.

The pivot point of the pedicle is within 5-7cm above the lateral malleolus. The skin incision is begun from the proximal margin of the flap. The skin is then elevated with deep fascia along the lesser saphenous vein.

The flap is then dissected with a subcutaneous pedicle 4cm in width leaving the medial sural nerve intact.

Then the flap is rotated 180 degrees to reach the defect in heel and the donor site closed by split thickness graft.

Reversed Island Flap Based on the Artery Accompanying the Superficial Peroneal Nerve Surgical Technique:

The flap as designed in the lower 1/3 of the leg where the superficial peroneal nerve became superfascial in this area.

First, vertical line was drawn from the lateral malleolus, the flap was planned between this line and tibial crest.

The upper limit of the flap could extend 2cm proximal from the upper limit of the distal 1/3 of lower leg. The distal pivot point was just above the lateral malleolus.

After marking, skin flap was elevated bilaterally beginning from the distal end of the island to the pivot point. Then the proximal edge of the flap was incised, the superficial peroneal nerve was ligated and cutting the fascia was included in the flap.

The pedicle was elevated as a fasciocutaneous unit between the elevated flap. The pedicle extended at least 3cm around the superficial peroneal nerve to avoid injury of the paraneural vascular network and venous drainage.

The flap was transposed to the defect and the donor covered by skin graft.

Post-Operative Care:

Intra-operative and post-operative broad spectrum antibiotic was given for one week.

Non-steroidal anti-inflammatory drugs were given and the patient lied in prone position with elevated leg to avoid edema and improve the venous drainage.

Continuous monitoring to the skin flap by observing the skin color, temperature and refilling.

The skin graft of the donor was dressed at the end of first week.

The patient wears a silicon heel pad from the starting of weight bearing.

Follow up period varied from 6 to 30 months.

RESULTS

In this study 30 patients were operated upon for foot defects by using both reversed sural and reversed superficial peroneal nerve flap.

Evaluation Parameters Included:

- Ample coverage and flap survival.
- Presence of foot pain.
- Donor site morbidity.
- Response to light touch and two point discrimination test.

As Regard Reversed Sural Flap (25 Cases):

There was complete survival of flaps in all cases except one case who was complaining of ischemic ulcer after revascularization, who developed partial necrosis in the distal 1/4 at the end of first week that needed debridement and closure by split thickness skin graft.

There were no cases developed foot pain or infection.

As regards the donor site morbidity, there were good take of graft in all cases.

There were good response to light touch in all flaps. The two point discrimination test was inferior than the healthy leg but remained within a measurable range.

As Regard Reversed Superficial Peroneal Nerve Flap (5 Cases):

There were complete survival of all flaps.

There were 3 cases developed paraesthesia on the lateral aspect of the leg that gradually regained during follow up period.

All flaps were insensate so it is suitable for reconstruction of the non weight-bearing area (lateral aspect of foot).

There was good take of graft over the donor site.
DISCUSSION

The coverage of foot and ankle still remains a challenge to reconstructive surgeons. It is due to limited mobility and availability of the overlying skin, the unique weight-bearing requirement and relatively poor circulation of the skin [5].

The ideal replacement should provide anatomical contour, durable skin, protective sensibility and relative soft tissue fixation to underlying structures [6].

In this study we did 30 reversed neuro-fascio-cutaneous flaps for reconstruction of foot (25
reversed sural flap for heel defects and 5 reversed island flap based on the vascular axis accompanying superficial peroneal nerve for lateral side of foot).

Doppler examination was done for detection of skin perforators (5-7cm for reversed sural and 1cm above lateral malleolus).

As regard the reversed sural flap (25 cases), there was complete survival of all cases except one who developed partial necrosis in the distal 1/4 of the flap who needed debridement at the end of the 7th day was and split thickness graft.

There no ulceration found in weight-bearing area during the period of the study and also there was good take of graft in donor site.

All these flaps were sensitive to light touch and the static two point discriminations were inferior to those of healthy foot but within a measurable range.

Our technique is different from Hasegawa et al., [7] who reported the distally based superficial sural artery who sacrificed sural nerve during dissection, in our technique we preserve the sural nerve during dissection.

The flap could be elevated in all parts of sural region and can easily reach as far as the heel pad and instep area so it is available for reconstruction of medium to large foot defects.

Our results were coexistent with Sheng-Feng and Fu-Chan Wei, [2] who reported 20 reversed sural island flap for reconstruction of the foot. They reported complete survival of the flaps except one developed partial necrosis that needed split thickness graft.

As regard the reversed superficial peronal nerve flap (5 cases), we used this flap for lateral side defects. There was no flap loss and good coverage in our series.

There was no ulceration in both the flap and the donor site. There was parasthesia on the lateral aspect of the leg that regained within 6 months.

Our results were superior than Koray and Ege, [8] who worked upon 4 patients and reported cyanosis in one flap and partial necrosis in 1/4 of the flap that needed debridement and secondary suture. Parasthesia of the lateral aspect of the leg was also reported.

Conclusion:

As regards medium to large sized defects in the heel (weight bearing area of the foot), the use of reversed sural island flap was recommended for the following:

• It is one stage operation with no need for microsurgery.
• It provides a large piece of skin for large sized heel defect.
• Elevation of the flap is easy and quick and the vascular supply to the arterial network of the sural area is constant and reliable and there is no need to sacrifice any major artery or sensory nerve.
• There is minimal donor site morbidity.

As regards the lateral side of the foot, we recommend the use of reversed flap based on the vascular axis of superficial peroneal nerve was recommended, for the following:

• It is easy and quick flap in dissection with reliable and constant vascular pedicle.
• It provides a good piece of skin with minimal donor site morbidity.

REFERENCES


