

Evaluation of Distally Based Fasciocutaneous Sural Flap for Reconstruction of the Distal Leg, Ankle and Proximal Foot

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Abstract:

Objective: The objective of the study is to evaluate the efficacy of reverse sural artery fasciocutaneous flap for coverage of lower third leg, posterior heel, malleoli and hind foot.

Patients and methods: Over a period of 4 years, a total of 31 patients with Soft tissue defect of lower third leg, heel, malleoli and hind foot were included. Preoperative data, the age and sex of each patient, cause and site of defect, dimension of flap, transposition of pedicle (through a tunnel or laid open and covered with a skin graft), postoperative results and complications were recorded. All patients were followed up in outpatient department for 12 months.

Results: Over a period of 4 years during February 2008 to February 2012, a total of 31 flaps were performed in 31 patients. Sixteenth patients were males and 15 were females. Their ages ranged from 8 to 55 years with a mean age of 31 years. There were three children. Road traffic accidents was the cause of the defects in 19 (61.2%) patients, DM in 5 (15.5%) patients, bullet injuries in three (9.6%) patients, Achilles tendon injuries in two patients (6.4%) patients, Malignant melanoma in one (3.2%) patient and foot amputation stumps in one (3.2%) patient. Postoperatively 24 flaps survived completely while marginal necrosis was seen in 5 patients and infection complete flap necrosis occurred in 2 patients. There was no considerable morbidity at donor site and all patients had satisfactory functional outcome.

Conclusions: The distally based superficial sural artery flap is a versatile, reliable procedure, useful in reconstruction of lower third leg, heel, and malleoli and hind foot defects. The surgical technique is safe, of short duration and provides alternative to micro surgical reconstruction. Some patients were not completely satisfied with their results mainly due to bulky flap that needed revision or due to parasthesia.

Key Words: Soft tissue defects distally based sural artery flap.

Introduction:

Soft-tissue defects of the lower third of the leg represent a major reconstructive challenge because of a severe shortage of locally available tissues that could be reliably used for coverage^(1, 2).

Trauma and other deforming process can involve soft tissue, underlying

bone, ligamentous structures and defects that expose the tendon and bone directly. The heel is a weight bearing area, and this area is traumatized frequently. In addition, the skin over these areas is tight and has poor circulation. There are many possible reconstructive options, including skin

grafts, local flaps, distant flaps and free flaps but their usage is limited and problems exist in these regions. Skin grafts are not suitable to cover the exposed bone, tendon, malleoli, heel, and weight bearing areas. Absence of peripheral pulses and peripheral vascular thromboses are contraindications to local flaps. Free tissue transfers provide excellent tissue coverage but require a microvascular team and equipment. In addition free tissue transfers are lengthy procedures⁽³⁾. So that the use of a regional flap is often required for the reconstruction of a soft tissue defect on the distal leg and foot.

For this purpose Masquelet et al. then reintroduced the sural flap in 1992, with a complete, concise description of the relevant anatomy and the surgical procedure⁽⁴⁾.

Surgical anatomy:

Masquelet et al. in 1992 reported a flap based on reverse flow, through an anastomosis between the median superficial sural artery originating from the popliteal artery and the lowermost perforator from the peroneal artery for reconstruction of moderate soft tissue defects of the distal part of the leg. The median superficial sural artery is the largest among the direct cutaneous arteries from the popliteal artery or its branches. The artery accompanies the median sural nerve and pierces the deep fascia in the lower two thirds of the posterior calf and runs supra fascially. It gives off several cutaneous branches to the overlying skin and distally forms an

arterial network with septocutaneous perforators from the peroneal artery. There is three to five perforators from peroneal artery in the posterolateral septum, the major one begins about 5 cm from lateral malleolus and is relatively constant. This distal anastomosis between the peroneal artery and the median superficial sural artery is the pivot point for the distally based neurocutaneous sural flap elevated from the lower two-thirds of the posterior calf.

Patients and Methods:

This study was conducted at plastic and reconstructive surgery in both of Duhok, and Sulaimani Hospitals of plastic and reconstructive surgery, over a period of 4 years from February 2008 to February 2012. It included 31 patients with Soft tissue defects of lower third leg, around the heel and ankle and hind foot. The age and sex of each patient, cause and site of defect, dimension of flap, transposition of pedicle (through a tunnel or laid open and covered with a skin graft), postoperative results and complications were recorded. X-rays of the recipient site were done in all cases to evaluate the condition of the underlying bone and to rule out osteomyelitis. The external fixator in post-traumatic patients was readjusted, if required. Doppler study preoperatively was done to determine the site of the perforator vessels and the condition of the sural artery and peroneal arteries before sacrificing any blood supply to the foot. All patients were followed up in

outpatients department for 12 months. The setting of the flap and functional outcome was recorded.

Results:

Over a period of 4 years during February 2008 to February 2012, a total of 31 flaps were performed in 31 patients. Sixteenth patients were male and 15 were female. Their ages ranged from 8 to 55 years with a mean age of 31 years. There were three children. Road traffic accidents was the cause of the defects in 19 (61.2%) patients, Diabetes mellitus in 5 (15.5%) patients, bullet injuries in three (9.6%) patients, Achilles injuries in two patients (6.4%) patients, Malignant melanoma in one (3.2%) patient and foot amputation stumps in one (3.2%) patient (Fig. 1).

The site of 31 defects comprised 18 (58%) distal tibia; 7 (22.5%) tendo-achillis and posterior heel defects; three (9.6%) malleolar region; two (6.4%) anterior ankle and one (3.25%) foot amputation stumps (Fig. 2).

The arc of rotation varied between 100 and 180 degrees. The time required to make the flap during surgery was approximately 2 hours.

In all cases, defects were covered with reverse sural flap with an addition of skin graft in 5 patients. The dimension of the flap ranged from 5 to 25 cm in length and from 4 to 12 in width. The mean length was 10 cm and width measured 8 cm. The largest flaps were transposed to dorsum of foot defects and posterior heel defect.

Flaps were island flaps in twenty four cases. Seven flaps were transposed in

peninsular flap. Four to the recipient site through a tunnel, and three were delayed. While pedicle of 24 flaps was laid open and covered with split thickness skin graft.

Out of 31 flaps; 24 (77.4%) showed the complete healing and functional recovery with no complication at the donor site as well. Flap complications were recorded in 7 (22.5%) out of 31 cases. Partial or tip necrosis occurred in five (16.1%) and complete necrosis occurred in two (6.4%) cases. Flap necrosis was clinically attributed to venous congestion. While in two cases, there was a technical mistake that pedicle was not positioned as a central part of the flap. Necrotic flaps were debrided out. Partial necrosis, cases was debrided and secondary closure was done in three patients while split thickness skin graft in rest of cases.

There was no infection and all of the patients were able to leave the hospital within a very short period of time (an average of 3 days) after surgery (Figure. 3).

With the patient in a lateral position or prone position, the flap is outlined at the posterior aspect of junction of upper and middle 1/3 leg (fig. 4). According to a previously prepared pattern of the recipient defect. The pivotal point of the pedicle as general 5cm (3 fingers) breadth above the lateral malleolus to allow anastomosis with the peroneal artery⁽³⁻⁶⁾. Skin incision is started along the line in which the fascial pedicle will be taken. The subdermal layer is dissected to expose the sural nerve,

accompanying superficial sural vessels and short saphenous vein.⁽⁷⁾

The subcutaneous fascial pedicle is elevated, with a width of 2cm to include the nerve and these vessels. At the proximal margin of the flap, the nerve and the vessels are ligated and severed. (Fig.5) The skin island is elevated with the deep fascia. (Fig.2) The donor site defect can be closed directly when the flap is less than 3cm wide .A larger donor site defect along with the pedicle must be covered with a split thickness skin graft (Fig. 3-4).

Postoperative measures:

- Elevation of the leg, in case of heel no weight bearing for 6th weeks
- Flap circulation monitored closely for 48 hours postoperatively including color, temperature, and refilling test.
- Potential causes of vasospasm as smoking, cold drink, cold room were avoided.
- Good hydration of the patient.
- Drain removed at the third postoperative day.
- Stitches are removed at 10 - 14 days.

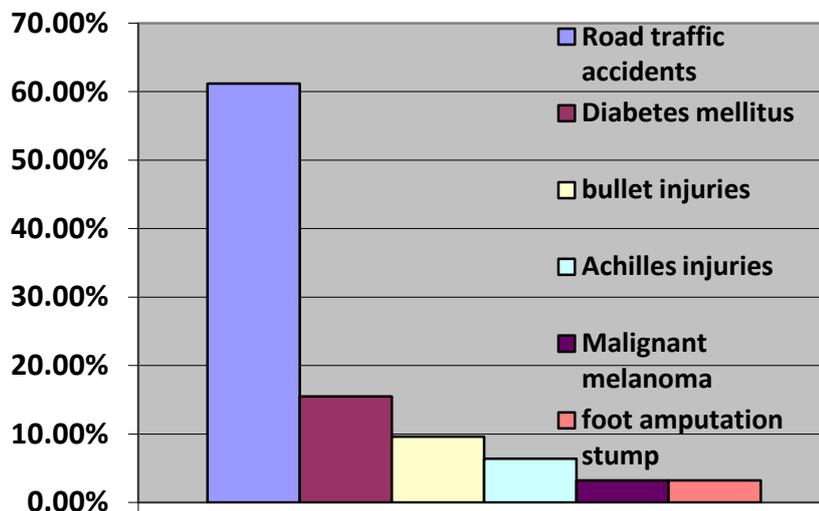


Figure (1): Etiology of soft tissue defect in the foot

Site of soft tissue defect

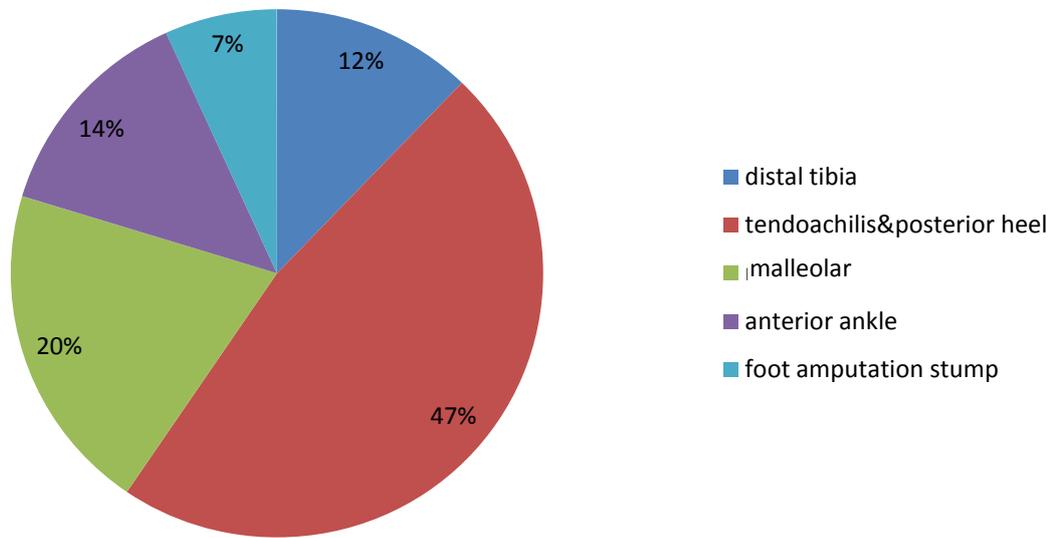


Figure (2): Sites of soft tissue defect in the leg.

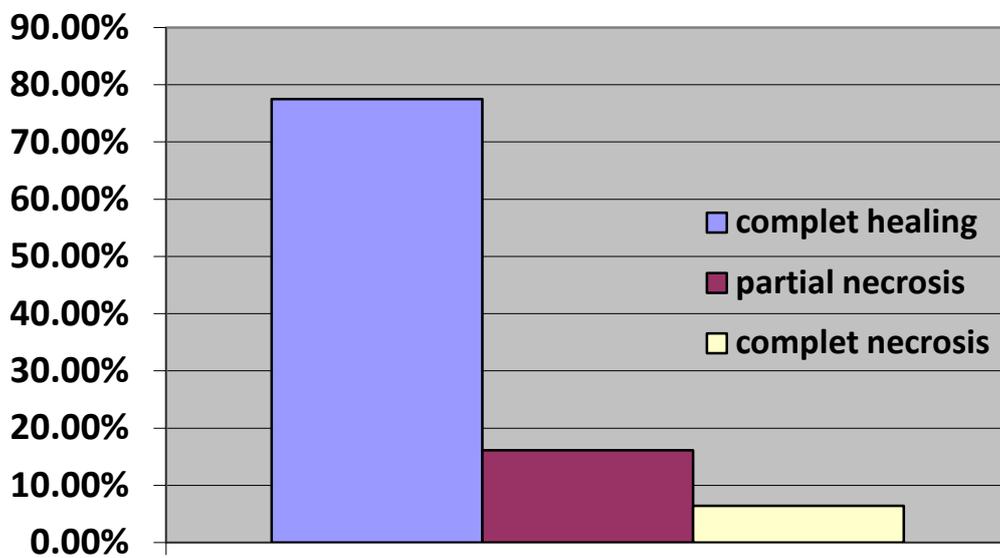


Figure (3): Post operative complications

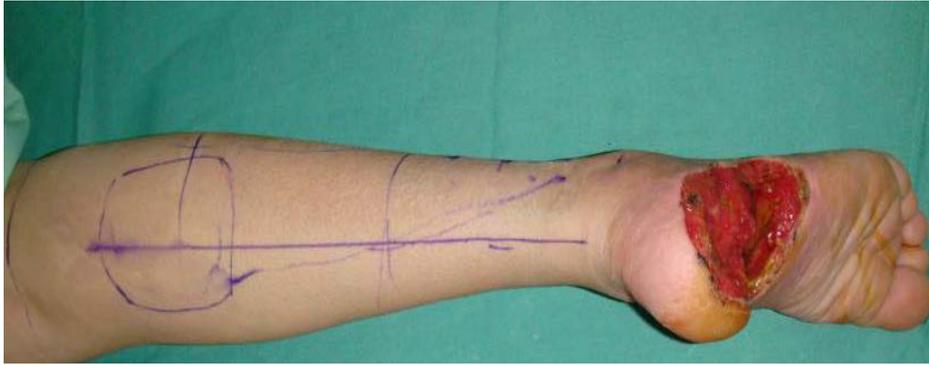


Figure (4): The flap is outlined at the posterior aspect of junction of upper and middle 1/3 leg

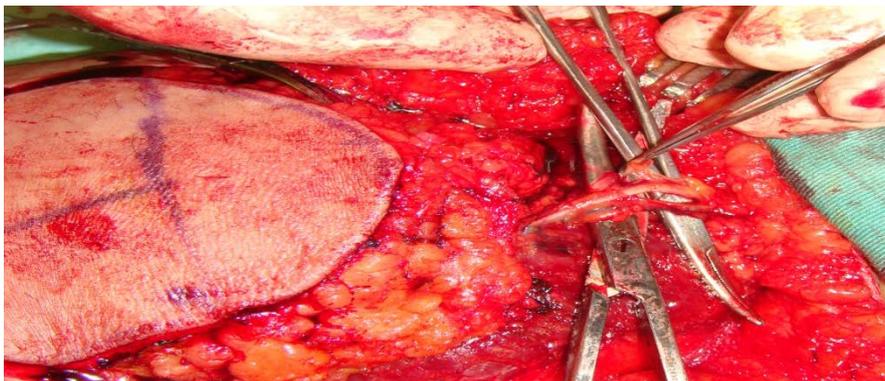


Figure (5): The proximal margin of the flap, the nerve and the vessels are ligated and severed



Figure (6): The skin island is elevated with the deep fascia



Figure (7): Closure of defect

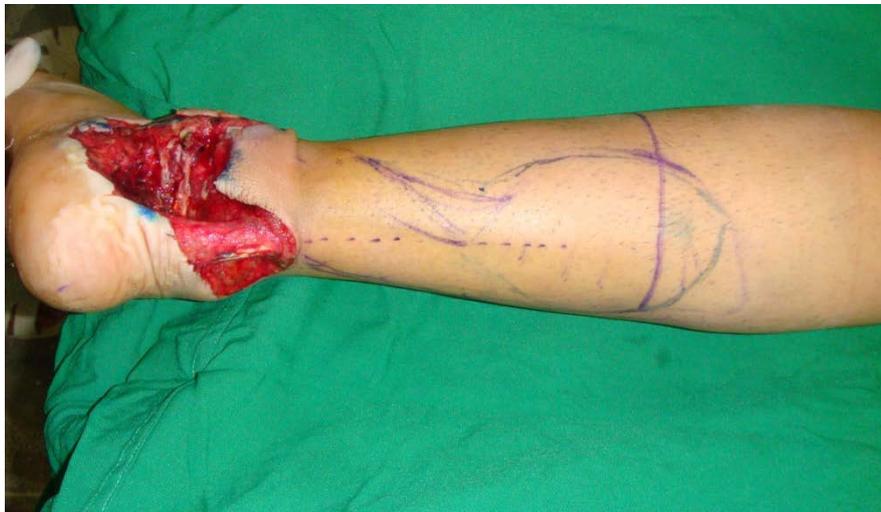


Figure (8): Patient one with bullet injuries, surgical delay applied to the sural flap after noticing vein congestion.



Figure (9): Patient one with bullet injuries, surgical delay applied to the sural flap after noticing vein congestion.

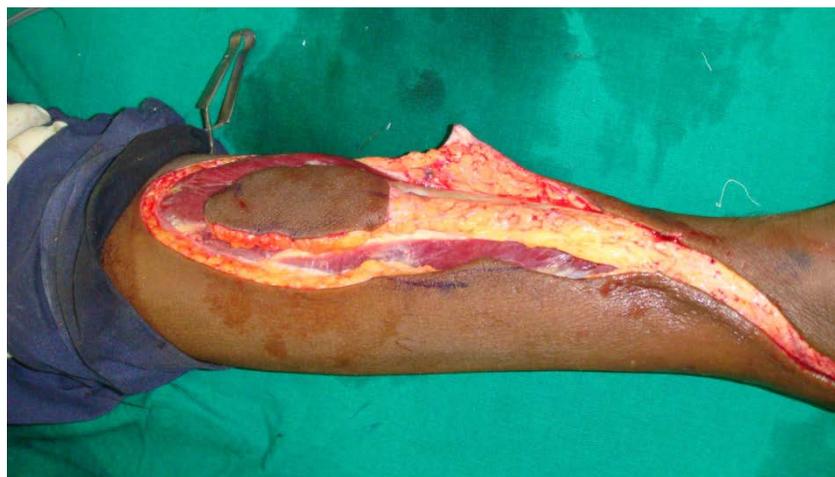


Figure (10): Patient two Sural flap used for anterior aspect of the proximal foot

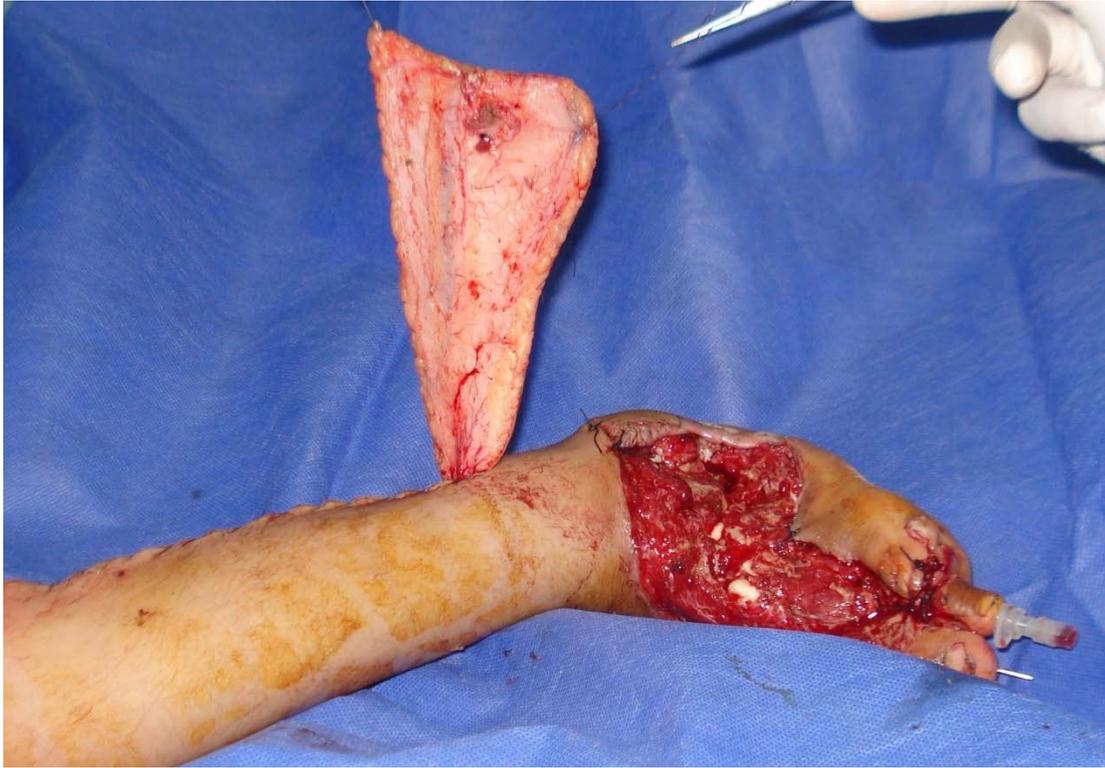


Figure (11- 12): Patient three suralfasciocutaneous flap used to cover the dorsum of the foot



Figure (13): Patient four sural fasciocutaneous flap used to cover the heel ulcer

Discussion:

Fasciocutaneous flaps first introduced by Ponten in 1981, are in use for the reconstruction of soft tissue defects of lower 1/3 leg and foot⁽⁸⁾. Reversed island flap e.g., peroneal artery flap, anterior tibial artery flap and posterior tibial artery flap can be transferred to the ankle or foot. However, it needs sacrifice of a major artery which constitutes a potentially serious disadvantage⁽⁹⁾. Masquelet et-al in 1992 first described distally based sural artery flap.

The distally based superficial sural artery flap is vascularized by a median superficial artery with reverse flow as this artery has septocutaneous perforators from peroneal artery⁽¹⁰⁾.

The advantages of the flaps are that relatively large size flap can be harvested with little donor site deformity. Dissection is easy, blood loss is minimal and preservation of the major vascular structure of the lower limbs is possible. It also avoids the need for more sophisticated equipment and expertise. This flap has a wide arc of rotation on its pedicle at approximately 5cm superior to the lateral malleolus. There is no simple rule for when a defect can and cannot be covered⁽¹¹⁾.

The sural fasciocutaneous flap can generally be used to cover any soft-tissue defect of the proximal third of the foot and the lower leg⁽¹²⁾. The flap can be used to cover exposed vessels, bones, tendons, and internal fixation hardware⁽¹³⁾. As always, adequate debridement of the recipient site is the single most important step for ensuring success, the flap has been shown to be successful in diabetic patients⁽¹⁴⁾, in medically compromised patient groups⁽¹⁵⁾, and in the pediatric population⁽¹⁶⁾.

Good planning and precise execution is required to ensure minimal local morbidity and decrease the incidence of partial or total flap loss. The reconstruction of soft parts after loss of substance in the distal third of the leg, ankle, and heel—especially when associated with fractures—poses a continued challenge to plastic surgery.

Relatively few procedures for cutaneous coverage of these regions have really shown effectiveness and low morbidity⁽¹⁷⁾. Muscle flaps for those regions are of restricted use, as they are not as safe there as when executed in the middle and superior thirds of the leg⁽¹⁸⁾. The cross-leg flaps are still more limited or even rendered by the presence of external fixation to

treat bone fracture. They require a long internment period and the adoption of uncomfortable postoperative positions, and may further give rise to articular restrictions because of long immobilization⁽¹⁹⁾. Microsurgical flaps are a good alternative, despite being of laborious execution, as they need skilled personnel and sophisticated equipment. Fasciocutaneous flaps of the proximal pedicle have little application in the distal third of the leg. The lateral calcaneal flap may be used, but it presents limitations relative to its dimensions⁽²⁰⁾. Fascial and fasciocutaneous flaps of the distal pedicle have been intensively researched and constitute another important alternative⁽²¹⁾.

Different modifications were used in this study regarding the flap, including surgical delay, island fasciocutaneous flap, and supercharged flap, it was found that surgical delay might help in the prevention of the venous congestion, as we used in one case in which there was venous congestion as well as the pivot perforator was just 2cm from the defect area⁽²²⁾.

Congestive necrosis of the flap may be a complication but in most cases the deep adipofascial tissue is alive, and can be resurfaced with skin graft. When large flaps were raised and rotated through 180 degree, the bulkiness of the tissue at the recipient site with dog-ear formation was noted.

The flap can be debulked at a later stage with correction of dog-ear. But the long-term use of pressure garment has eliminated the need for further surgical procedure in these patients. Sensory loss over the posterior sural nerve area may be a problem^(23, 24), but rarely affects the life style of the patient⁽²⁵⁾.

Conclusion and Recommendations:

1. The flap has good color match, excellent texture and contours easily for leg and proximal foot coverage. It offers the benefits of being single-stage, reliable with acceptable donor site morbidity.
2. Relatively easy to dissection, no bleeding and no major vessel will be sacrificed.
3. Injury to sural cutaneous nerve is a reason for patients' objection for a while.
4. The distally-based sural flap has proven to be reliable and useful for reconstruction of the distal third leg and various aspects of the proximal ankle.
5. The flap may require delay if venous congestion occurs.
6. The long-term use of pressure garment has eliminated the need for further surgical procedure in these patients.

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