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DISTALLY BASED SUPERFICIAL SURAL ARTERY FLAP

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SUMMARY: We describe our experience with the use of distally based superficial sural artery flap for coverage of defects in lower third of leg and foot in 12 patients. In 9 patients the flap was successfully transferred and in 3 cases marginal necrosis of flap occurred. This flap has a constant and reliable blood supply and does not sacrifice a major artery. Other advantages of this flap are easy dissection and is a one stage procedure. In most patients the skin graft site is cosmetically unacceptable.

INTRODUCTION

Soft tissue defects of the lower third of leg, ankle and heel regions are considered a major reconstructive problem. There are many possible reconstructive options which include skin grafting, local flaps, distant flaps and free flaps. Previously described flaps have a limited arc of rotation, are unreliable or sacrifice an important artery. This is the reason why a free flap is usually chosen for small to moderate defects.

In 1983, Donski and Fogdestam[1] described a distally based flap from the sural region to cover defects in the middle and lower third of leg. In 1992, Masquelet et al[2] reported a distally based flap dependent on reverse flow of the median superficial sural artery which accompanies the sural nerve. Hasegwa et al [3] in 1994 reported the first major series of 21 flaps and also named them distally based superficial sural artery flap. We have used this flap to twelve lower third leg and foot defects which form the basis of this paper.

ANATOMY & VASCULAR SUPPLY

The median sural nerve penetrates the deep fascia at the junction of the heads of the gastrocnemius muscle to become suprafascial in the lower two thirds of the leg. Proximal to this point the nerve and its accompanying vessels follow a subfascial course after their origin in popliteal fossa.

Distally based sural artery flap is based on a reverse flow through anastomosis between the septocutaneous perforators from the peroneal artery and the communicating vascular network of the median sural artery that continues upto the lateral retromalleolar region. During its suprafascial course, the artery gives off several cutaneous branches to the overlying skin. In its distal part the artery anastomoses with septocutaenous perforators either directly or through the interlacing suprafascial network. A constant pivot point is a must for the distally based flap. This pivot point consists of one of the three to five septocutaneous perforators in the posterolateral septum. The most important perforator is situated 5 cm proximal to the tip of the lateral malleolus. Venous drainage is ensured by a network that is included in the pedicle even when it is not possible to include the short saphenous vein

FLAP DESIGN & OPERATIVE TECHNIQUE

Preoperatively a line is drawn connecting the mid point of junction between upper third and lower two third of posterior surface of leg to the lateral malleolus. Short saphenous vein is marked with the patient standing. In the lower third of the leg, this line approximately represents septocutaneous perforators from peroneal artery.

Flap dissection is done under pneumatic tourniquet with the patient in prone position. The flap can be located any where in the lower two thirds of the posterior aspect of leg according to the required pedicle length. The flap is then marked and centred over short saphenous vein according to the defect size.

An incision is made along the superior border of the flap. At mid calf, medial sural nerve and short

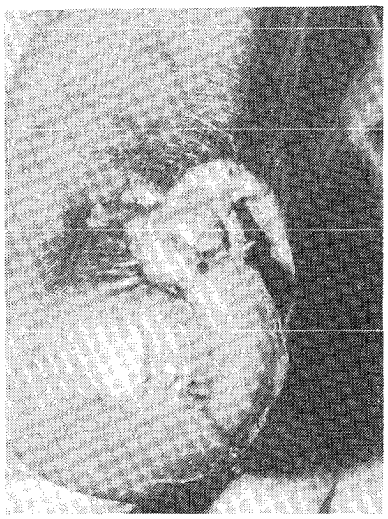
saphenous are identified suprafascially. The median sural nerve, median sural artery and short saphenous vein are ligated, divided and included with the flap. The fascia is incised superiorly and flap dissection is continued inferiorly below the deep fascia. Distally an extension of the flap skin paddle is left over the pedicle (Racquet shaped flap). A longitudinal strip of fascia containing the sural nerve and short saphenous vein is included in the pedicle. The width of pedicle must be between 2 to 4 cm.

Pedicle dissection continues towards the pivot point of the flap. Flap is transferred to the defect by incising the skin bridge between the flap pedicle and recipient defect. Flap donor site was always skin grafted in all our cases.

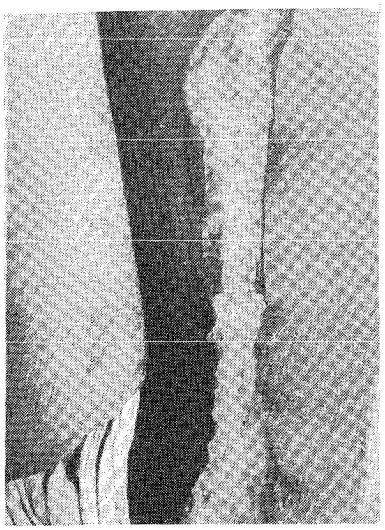
RESULTS

Nine flaps survived completely. In three cases necrosis of the distal part of skin occurred. The necrotic part of the skin was debrided and fascia covered with skin graft.

Case 4 : A 50 year old man sustained closed fracture of left femur with loss of soft tissue over left heel in a motor vehicle accident. On admission, debridement of the heel wound and internal fixation of the femur was performed by an orthopaedic surgeon and the patient was referred to us for the cover of exposed tendo achilles. To cover the defect a 7cm x 6 cm distally based superficial sural artery flap was used. The flap healed uneventfully (Fig. 1-a, b,c,d).

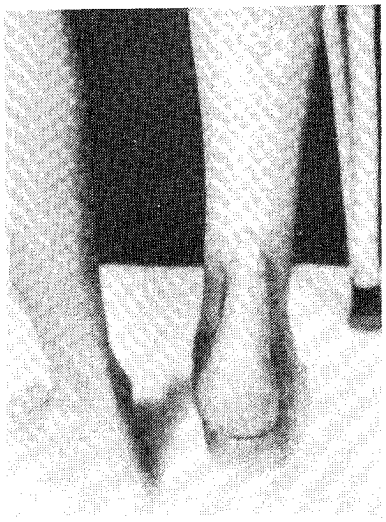


(Fig-1a) Post traumatic skin defect over achilles tendon area



(Fig-1b) Elevation of flap completed

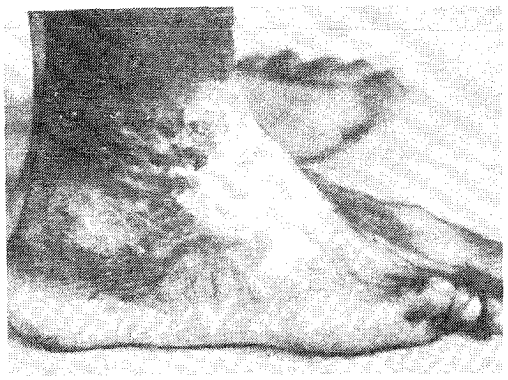
(Fig-1c) Transposed flap



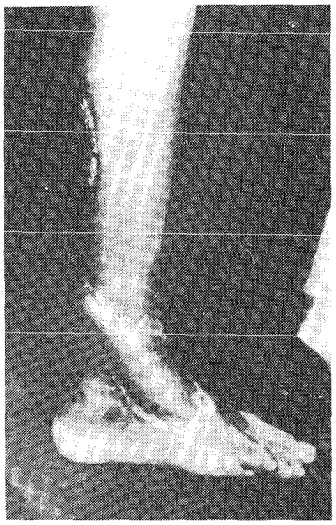
(Fig-1d) Six months post-operative picture

Case 6 : A 35 year old man presented with chronic unstable scar and non healing ulcer over the lateral side of foot. Repeated excision with split thickness skin graft had been performed without success. After excision of ulcer and unstable scar the defect was closed with 8cm x 6 cm distally based sural artery flap (Fig. 2-a,b,c).

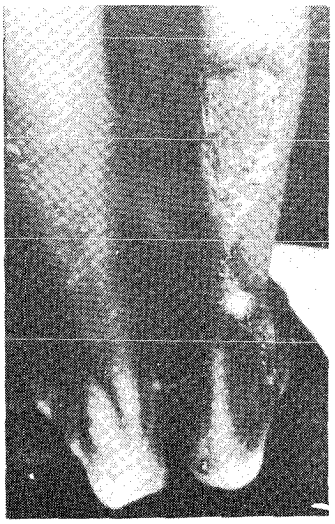
Case 10 : A 22 year old female suffered from a neurotrophic ulcer of the lateral malleolar region with osteomyelitis of the underlying bone. After debridement of the ulcer, a 8cm x 8 cm distally based sural artery flap was raised and was transferred to cover the defect. The donor site was skin grafted. The flap healed uneventfully (Fig.3-a,b).



(Fig-2a) Non healing ulcer and unstable scar over dorsum of foot

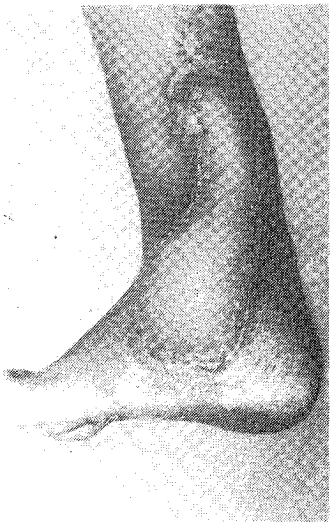


(Fig-2b) Two months after the operation



(Fig-2c) Skin grafted flap donor site

(Fig-3a) Neurotrophic ulcer over lateral malleolus



(Fig-3b) Six months post-operative picture

TABLE I

S.NO	AGE	CAUSE	SITE OF SKIN DEFECT	SIZE OF FLAP (cm)	COMPLICATION
1	49/M	Industrial accident	Posterior aspect of heel	5 x 4	Nil
2	38/M	Open Fracture	Lower third of leg	6 x 6	Nil
3	19/ M	Motor vehicle accident	Lateral malleolus	5x4	Nil
4	50/M	Motor vehicle accident	Achilles tendon area	7x6	Nil
5	19/M	Motor vehicle accident	All of the heel	10x8	Marginal necrosis
6	35/F	Motor vehicle accident	Dorsum of foot, lateral side	8x6	Nil
7	45/M	Neurotrophic ulcer	Posterior aspect of the heel	9x6	Nil
8	30/M	Electrical Burn	Lower third of leg, anterior aspect	10 x 7	Nil
9	10/ F	Motor vehicle accident	Dorsum of foot, proximal half	8 x 6	Nil
10	22/ F	Neurotrophic ulcer	Lateral malleolus	8 x 8	Nil
11	35/ M	Osteomyelitis	Dorsum of foot, proximal half	10 x 8	Marginal necrosis
12	40/ M	Old blast injury with osteomyelitis	Lower third of leg	10 x 10	Marginal necrosis

DISCUSSION

Reconstruction of defect on ankle, malleoli and heel remains a difficult task for plastic surgeons. There are many possibilities for coverage of defects in these regions, such as skin graft, cross leg flap, reversed muscle flap with skin graft, reversed fascial or adipofascial flap with skin graft, and reversed flaps using a major artery. The ideal flap should be one stage, reliable and preferably should not depend on microsurgery. It should not sacrifice a major artery or nerve.

In 1992 Masquelet et al[2] reported the blood supply to leg skin from the arteries accompanying the superficial peroneal, sural, saphenous nerves. These arteries give off several cutaneous branches in the supra fascial course. They described the concept of neurocutaneous flap. From a practical point of view neurocutaneous arteries are similar to direct cutaneous arteries, and the flap designed on such a blood supply can be considered an axial pattern flap. The anastomoses with septocutaneous perforators from the deep artery constitute the pivot point for a pedicle. In our series of 12 patients, 9 flaps survived completely. In three cases marginal necrosis of skin only occurred. In two cases flap was extended to proximal third of leg in order to reach the defect. Marginal flap necrosis confirm the opinion of Masquelet that flap is safe only if taken in the lower two thirds of the posterior leg along the suprafascial course of the median sural artery. The third case of the partial necrosis was due to persistent infection following previous blast injury in ankle region. As the skin around the ankle region is tight due to previous fibrosis we never tunnel the flap. Our racquet shaped flap design is similar to Hyakusoku[4] and Yilmaz[5]. This modification has obviated the tension on the pedicle as could be caused by a subcutaneous tunnel.

The sensibility of the lateral foot and leg is lost as a result of sacrificing the sural nerve. Hasegawa[3], Hyakusoku[4] and Jeng[6] described the dissection by which the sural nerve is spared. Yilmaz[5] noticed partial necrosis of flap in two cases, when sural nerve was not included with the flap. In our series sural nerve was always included with the flap. All flaps were insensate in this series. In two patients this flap was used to cover heel defects. Both these patients support their weight on their soles but develop pressure ulcers frequently. The main

disadvantage of this flap is unacceptable donor site scar. The distally based sural artery flap is our flap of choice for reconstructive surgery of lower one third of leg, calcaneal area and malleoli. The sural artery flap has the widest arc of rotation of all flaps described in this region. It fulfils all the criteria for an ideal flap except for the sacrifice of the sural nerve and an unsightly donor site scar.

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