The distally based sural flap for lower leg reconstruction: Versatility in patients with associated morbidity

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Domenico Mileto, Stefano Cotrufo, Giuseppe Cuccia, Gabriele Delia, Giovanni Risitano, Michele R. Colonna, Francesco Stagno d'Alcontres,

From the Plastic and Reconstructive Surgery Unit of Messina University. Messina, Italy.

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INTRODUCTION: *Coverage of soft tissue defects in the lower leg is often made by use of free flap, also because of the improving of anaesthesiology techniques in the last decades. However, there are disadvantages in the use of free flaps like the need for a remote donor site, increased operative time, use of a major vessel to the leg, and microsurgical skills. Besides these, trauma in the lower limb are often cause of damage for a major vessels of the leg, so the use of free flaps in these patients may be related to an higher incidence of complications; also associated pathologies, like diabetes and vascular pathology, can increase the incidence of complications when a free flap is utilized. In all these cases local fascio-cutaneous flaps, like the sural reverse flap, because of their easy and short time harvesting, can be a very good alternative to free flaps. Superficial sural artery flap is a adipofasciocutaneous flap based on the vascular axis of the sural nerve, which gets reverse blood flow through communication with the perforating branch of the peroneal artery, situated in the region of lateral malleolar gutter.*

PATIENTS AND METHODS: *Between 2000 and 2005, 11 patients, mean age 68 (range 58-78 years), were treated at the Plastic and Reconstructive Surgery Unit of Messina University, for soft tissue defects of lower limb and foot, using the distally based sural artery flap. The defects were related to post-traumatic damage of soft tissue, diabetic and vascular ulcers, osteomyelitis and oncological resection.*

Mean follow-up time was 20 months (range 6-55 months). All patients were pre-operatively assessed for vascular patency of peroneal axis and associated morbidity that could increase risk of flap necrosis. This included diabetes mellitus type II, osteomyelitis and peripheral arterial diseases.

RESULTS: *All flaps survived with the exception of one that sustained partial skin necrosis, in the ratio of 25% of the skin island. All defects were covered with no major complications and none of the patients required a blood transfusion. Moreover aesthetic results were good with satisfaction of all the patients.*

CONCLUSION: *In our cases we found the sural reverse flap to have a good reliability with low incidence of complication and surgical outcomes. This flap is an excellent option for covering defects of minor deficiency of skin in the third distally of lower limb, ankle and heel. It allows rapid, reliable coverage of defects extending as far distally as the forefoot. Because of the sparing of major vessels, the short surgery time in harvesting the flap, and the good vascular pattern of the flap, we retain the flap a first choose technique for reconstruction in lower leg, especially in politrauma and in patients with associated pathology as vascular diseases or diabetes.*

PAROLE CHIAVE: Associated morbidity, Fasciocutaneous flap, Lower limb, Softh tissue, Sural flap.

Introduction

Coverage of soft tissue defects in the lower leg is often made by use of free flaps, also because of the improving of anaesthesiology techniques in the last decades. However, there are disadvantages in the use of free flaps like the need for a remote donor site, increased operative time, use of a major vessel of the leg, and microsurgical skills [1].

Besides these, trauma in the lower limb are often cause of damage for a major vessel of the leg, so the use of free flaps in these patients may be related to an higher incidence of complications; [2] also associated pathologies, like diabetes and vascular pathology, can increase the

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Per la corrispondenza: Domenico Mileto, M.D, Via Vittorio Emanuele II° 49, 89010 Cannitello di Villa San Giovanni (R.C.), (e-mail: d_mileto@virgilio.it).

incidence of complications when a free flap is utilized. In all these cases local fascio-cutaneous flaps, like the sural reverse flap, because of their easy and short time harvesting, can be a very good alternative to free flaps. The reverse sural flap is a fasciocutaneous flap based on the vascular axis of the sural nerve, which gets reverse blood flow through communication with the perforating brancheg of the peroneal artery, situated in the region of the lateral malleolar gutter [3].
Authors present their experience with the reverse sural flap for coverage of soft tissue defects in the lower limb, in patients with associated pathology such as diabetes mellitus and peripheral vascular diseases.

Patients and methods

Between 2000 and 2005, 11 patients, mean age 68 (range 58-78 years), were treated at the Plastic and Reconstructive Surgery Unit of Messina University, for soft tissue defects of lower limb and foot, using the distally based sural artery flap.
The defects were related to post-traumatic damage of soft tissue, diabetic and vascular ulcers, osteomyelitis and oncological resection (Figg 1-3-5).
The site of soft tissue defect was at the lower third of the antero-lateral aspect of leg in four cases, dorsal face of the foot in two cases, lower third of the posterior aspect of the leg in four cases, medial malleolar region in 1 case (Tab. I).
Mean follow-up time was 20 months (range 6-55 months). All patients were pre-operatively assessed for vascular patency of peroneal axis and associated morbidity that could increase risk of flap necrosis. This included diabetes mellitus type II (six cases), osteomyelitis (two cases) and peripheral arterial diseases (three cases) (Tab I). Before the operation, the lesser saphenous vein and the perforators of the peroneal artery on the lateral aspect of the distal leg were detected using a Doppler ultrasound probe.

Surgical Technique

A line was marked from a point halfway between the Achilles tendon and the lateral malleolus at the ankle

Fig. 1: Pre-operatory aspect in a 73-year-old patient with vascular ulcer in calcaneal region.

Fig. 3: A 59-year-old man who reported lost of soft tissue after a car accident. The defect with lesion of the extensor tendons.

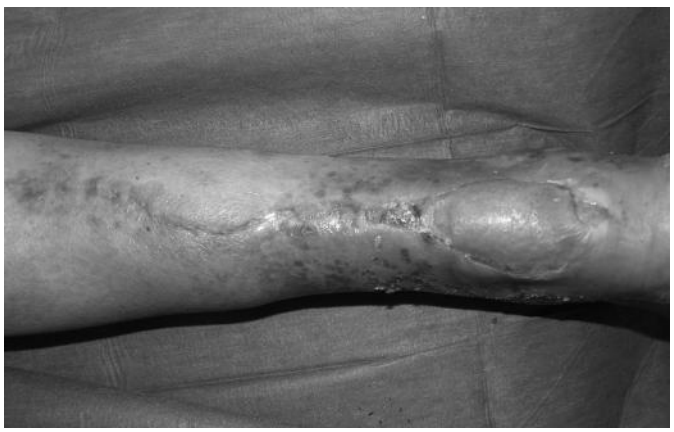

Fig. 2: Post-operatory aspect at 6-mounths follow-up.

Fig. 4: Coverage of the defect with a reverse sural flap.

TABELLA I – *Use of Reverse Sural Flap in reconstruction of lower leg in patients with associated pathology.*

Age	Sex	Comorbidity	Location of soft tissue defect	Complications
58	M	Peripheral Vascular Disease	Posterior lower third	
59	M	Hypertension	Antero-lateral lower third	
61	M	Peripheral Vascular Disease	Antero-lateral lower third	
67	M	Peripheral Vascular Disease	Dorsum of the foot	
68	F	Diabetes Mellitus Tipe II; Hypertension	Heel	
59	F	Hypertension	Medial malleolar region	
71	M	Diabetes Mellitus Tipe II; Atherosclerosis	Posterior lower third	
73	M	Diabetes Mellitus Tipe II;	Posterior lower third	Venous Congestion; Partial Necrosis
75	M	Diabetes Mellitus Tipe II; Osteomyelitis	Antero-lateral lower third	
79	M	Diabetes Mellitus Tipe II;	Antero-lateral lower third	
78	F	Diabetes Mellitus Tipe II; Hypertension; Osteomyelitis	Dorsum of the foot	

extending to the midline between the two heads of the gastrocnemius muscle. This roughly describes the course of the medial sural cutaneous nerve and lesser saphenous vein (Fig. 6).
The skin incision started distally along the line of the pedicle so that lesser saphenous vein was first localized. The skin island was then marked, with its centre along the line of the lesser saphenous vein.
Pedicle included fascial and subcutaneous tissue and ranged 3-5 cm wide. After incision of the skin island, sural nerve was detected in the subfascial plane and harvested with the flap.
In ten patients subcutaneous tunnel for pedicle transposition was used, in one patient division of skin bridge of the tunnel was utilized.
The skin island dimensions ranged from 3x5 to 8x5 cm; in one case adipo-fascial variant of the flap was performed in a female patient (Fig 7), and in this case we closed the donor site primary, with better aesthetic results (Figg. 8-9). All the surgical procedures were performed by a senior author.

Fig. 5: A 59-year-old female patient, affected by hypertension. Soft tissue defect after oncological ablation of a giant-cells tumor of the medial malleolar region.

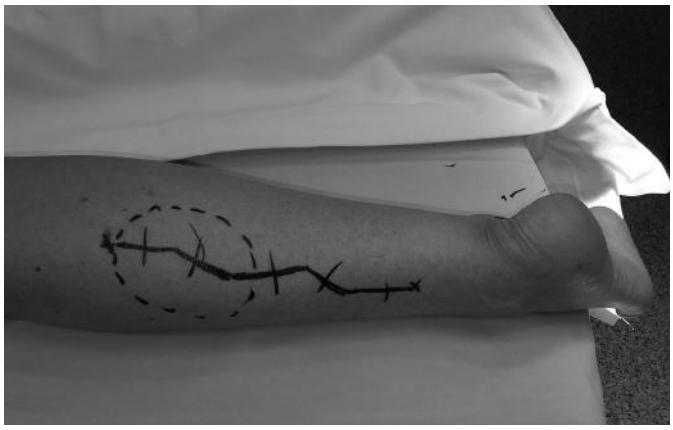

Fig. 6: The pre-operative flap design.

Results

All flaps survived with the exception of one that sustained partial skin necrosis, in the ratio of 25% of the skin island (Tab. I).
All defects were covered with no major complications and none of the patients required a blood transfusion [4]. Moreover aesthetic results were good with satisfaction of all the patients (Fig. 2-8-9).

Surgical Anatomy

The neurovascular axial pattern of the sural flap is represented by the lesser saphenous vein, the sural nerve and the median superficial sural artery. However there are some anatomical variations.
Therefore the vascular axial of the sural nerve has com-

Fig. 7: An adipo-fascial reverse sural flap is harvested.

munication in the region above the lateral malleolous with multiple fascio-cutaneous perforators from the peroneal vessels [5].

These fascio-cutaneous perforators are the vascular supply of the fibula osteo-cutaneous flap skin island. They also form intercommunications with the axial pattern arteries that accompany the medial sural cutaneous nerve. These vessels typically are located in the posterior crural septum, starting at a point 5 cm above the tip of the lateral malleolus and extending proximally to a distance of approximately 13 cm above the lateral malleolus [5].

The skin overlying the gastrocnemius muscles can be elevated based distally on these perforators, as they supply the sural artery in retrograde fashion.

Sladjana et al. [6] studied the neurovascular stalk of the sural flap in 42 fetal lower extremities: the nerve is accompanied by one to three arteries; the median superficial artery was detected in 83.3 percent of the cases, while the sural nerve and the lesser saphenous nerve were detected in all cases.

The median superficial sural artery arises at the level of the intercondylar line, mostly as a branch of the popliteal artery, and travels downwards between the heads of the gastrocnemius muscle as far as the Achilles tendon. This artery has constant relationship with the sural nerve and the lesser saphenous vein: usually the artery is located lateral to the sural nerve, while the lesser saphenous vein is located medially.

The other two arteries, the medial and lateral, when detected, are usually short and tiny blood vessels extending to the level of the heads of the gastrocnemius muscle [6].

Discussion

Coverage of wounds of the lower one-third of the leg

Fig. 8-9: Three months follow-up with good aesthetical results at the donor site, that was primary closed and at the reconstructed region.

are usually best treated using microvascular free-tissue transfer. These flaps provide for reliable single-stage coverage of these wounds.

There are, however, disadvantages to use free flaps. Among these are the need for a remote donor site, increased operative time, use of a major vessel to the leg, and microsurgical skills.

The alternative for coverage of these areas has historically been pedicled fascio-cutaneous flaps [7].

Masquelet et al. [3] in 1992 introduced the neuroskin flap concept, referring that skin island flaps can be supplied by the vascular axis of sensitive superficial nerves in the legs, and they made description of a skin island flap based on the neurovascular pattern of the sural nerve.

Since then, popularity of the sural flap has increased throughout the years, with favourable results reported by most of the Authors and several anatomical study decribing the anatomy of the neurovascular axis of the sural flap.

In our cases we found the sural reverse flap to have a good reliability with an easy dissection and low incidence of complications and surgical outcomes, this according with many Authors [4-8-9].

Conclusion

The distally based sural nerve flap is an excellent option for covering defects of minor deficiency of skin in the third distally of lower limb, ankle and heel [10-11-12-13-14].
It allows rapid, reliable coverage of defects extending as far distally as the forefoot.
The flap can be elevated under a tourniquet in relatively bloodless fashion without sacrificing a major vessel of the lower limb.
Therefore harvesting the flap is easy and the vascular pattern of the sural nerve is quite constant.
Because of the sparing of major vessels, the short surgery time in harvesting the flap, and the good vascular pattern of the flap, we retain the flap a first choose technique for reconstruction in lower leg, especially in politrauma and in patients with associated pathology as vascular diseases or diabetes.
The scar resulting from the skin graft in the donor site is a disadvantage of this flap, especially in women, where as alternative, an adipo-fascial flap can be successfully be harvested
Tendency of venous congestions is an other problems of this flap, so that rotation of the pedicle and his "tunnellization", where possible, must be carefully valued [4].

Riassunto

La copertura della perdite di tessuti molli a livello dell'arto inferiore è molto spesso realizzata mediante l'utilizzo di lembi microchirurgici. Tuttavia l'utilizzo di lembi a distanza comporta degli svantaggi, come tempi operatori più lunghi, utilizzo degli assi vascolari maggiori dell'arto inferiore e necessità di competenze microchirurgiche. Inoltre molto spesso i traumi a livello della gamba comportano danni agli assi vascolari maggiori, rendendo l'utilizzo di lembi liberi più soggetto a complicanze. Altri fattori che possono aumentare i rischi di complicanze maggiori e minori nei pazienti sottoposti a ricostruzioni con lembi microchirurgici sono le patologie associate come diabete mellito e malattie vascolari. In questi casi lembi locali fascio cutanei, come il lembo "reverse" surale, possono rappresentare una valida alternativa all'utilizzo di lembi a distanza. Il lembo surale "reverse" è un lembo fascio-cutaneo basato su un peduncolo distale nutrito da vasi perforanti provenienti dall'asse vascolare peroniero, localizzati a livello del malleolo laterale.
PAZIENTI E METODI: Tra il 2000 ed il 2005, 11 pazienti, età media 68 anni (range 58-78 anni), sono stati trattati presso il Dipartimento delle Specialità Chirurgiche dell'Università degli Studi di Messina, per perdite di sostanza che riguardavano la gamba ed il piede, utilizzando il lembo fascio-cutaneo, "reverse" surale. Le perdite di sostanza erano dovute a traumi, osteomieliti, ulcere diabetiche e vascolari, asportazione di tumori. Il tempo medio di follow-up è stato 20 mesi (range 6-55 mesi). Tutti i pazienti sono stati studiati pre-operatoriamente, mediante l'utilizzo di una sonda doppler, per la pervietà delle perforanti peroneali su cui si basa il lembo reverse surale. Le malattie associate erano il diabete mellito, osteomieliti, e arteriopatie periferiche.
RISULTATI: *T*utti i lembi sono sopravvissuti a distanza, tranne uno, che ha avuto una necrosi parziale (25% dell'isola cutanea), in un paziente diabetico in cui il lembo era stato utilizzato per la ricostruzione della regione achillea. Nessun paziente è andato incontro a complicanze maggiori. Buono il risultato estetico a distanza di 6 mesi dall'intervento.
CONCLUSIONI: Il lembo surale a peduncolo distale rappresenta una valida opzione ricostruttiva per le perdite di sostanza minori a livello del terzo distale della gamba, caviglia, tallone e dorso del piede. Nella nostra esperienza il lembo surale reverse si è dimostrato un lembo affidabile, con una bassa incidenza di complicanze maggiori e minori. Il lembo presenta versatilità nel design e nelle sue applicazioni cliniche, potendo risolvere complesse situazioni ricostruttive in pazienti, le cui condizioni generali e locali dell'arto inferiore, non avrebbero permesso l'uso di altri lembi.

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