

DISTALLY BASED SURAL FASCIOCUTANEOUS FLAP FOR SOFT TISSUE RECONSTRUCTION OF THE DISTAL LEG, ANKLE AND FOOT DEFECTS

Ali A. Maazil MBCHB. FIBMS. (Plastic and reconstructive surgery)

ما زال فقدان الانسجة الرخوة والجلد في منطقة اسفل الساق والقدم تمثل تحديا لجراحي التجميل والتقويم، حيث تتطلب تقويم هكذا مناطق سدله عالية المقاومة لذلك فان الخيارات الموجودة لهذا الغرض محدوده. ان هذه الدراسه اجريت على مدار ثلاث سنوات في مدينة الصدر الطبيه في النجف الاشراف في وحدة الجراحه التجميليه والتقويميه، وذلك بعلاج اثنان وعشرون مريضا كانوا مصابين بفقدان الانسجه الرخوه في منطقة اسفل الساق والقدم وذلك بنقل سدلة العصب الربلي العكسيه ذات القاعده البعيده، وكانت اصابات الشده الخارجيه من اهم الاسباب لهذه الاصابات، اما اعمار المرضى فقد كانت تتراوح بين خمس الى اثنين واربعين عاما، وقد حددنا امتداد السدله الداني حيث تكون مرتبطه بنهاية المسار فوق اللفافي للعصب الربلي، وتمكنا من التغلب على القصور الناتج في تطبيقات هذه السدلات من هذا التحديد باستخدام سدلة العصب الربلي من الساق المقابله للساق او القدم المصابه وتم ذلك بسبعة مرضى، ام الخمسة عشره مريضا الباقين فقد تم نقل السدله من نفس الساق المصابه. وكانت النتائج جيده جدا، تمثلت ببقاء جميع السدلات على قيد الحياة بشكل كامل، وبدون مشاكل رئيسيه عدا حصول احتقان وريدي في سدلتين وقد عادتا الى الحاله الطبيعيه بعد عدة ايام. وقد وجدنا في هذه الدراسه ان استخدام سدلة العصب الربلي العكسيه ذات القاعده البعيده خيار جيد لتقويم فقدان الانسجه الرخوه في اسفل الساق والقدم وكذلك وجدنا انه من الاسلم استخدام السدله من الساق المقابله للساق او القدم المصابه بدلا من زياده البعد الداني للسدله وخاصة بعدم وجود معدات وخبرة الجراحه المجهريه التي قد تكون منقذه للسدله في حال حصول قصور وريدي او شرياني نتيجة الامتداد الداني للسدله.

Abstract:

Background: Soft tissue management around the lower third of the leg and foot presents a Considerable challenge to the reconstructive plastic surgeon. The options in this region are limited. Durable flap is the preferred option for coverage of such defects. This study was conducted in Alsadder medical city in Alnajaf city over a period of 3 years to evaluate the efficacy of distally based Sural flap in the coverage of the lower third of leg, and foot defects, in 22 patients.

Methods: A study was conducted in the department of Plastic and Reconstructive Surgery in alsadder medical city in Alnajaf. Twenty two patients with soft tissue defects over the distal leg and foot were included in this study. Distally based sural fasciocutaneous flap was used for defect coverage in all patients. In this study we did not extend the flap proximally on a random pattern, instead of this, we extend the flap only to that part of leg that coincide with the supra fascial course of sural nerve. the limitation of flap size in such manner was restricted flap applicability for larger and more distal type, but we over come this by using contra lateral reverse sural flap for covering a more distal defect that couldn't covered by ipsilateral flap or when proximal calf tissue of ipsilateral limb was unsuitable for flap harvesting . Ipsilateral reverse sural flaps were used in 15 cases, and 7 cases the flap used in contra lateral limb (cross leg flap).

Results: from January 2008 to March 2011, 22 patients, their ages ranged between 5-42 years. (Average age was 17 years), with soft tissue defect in the distal leg and foot, (45.5 % in distal leg), trauma was the cause in 68.2%. Reverse sural flap from ipsilateral limb have been used in 68.2%, and from the conteralateral limb in 31.8 %, complete flap survival in 100 % of cases with no major complication in the donor or recipient site apart of flap venous congestion in 9.1 % which resolve with few days.

Conclusions:

The distally based sural flap is a versatile and reliable flap for the coverage of soft tissue defects of the distal third of the leg and foot. It is safer to apply the flap from contra lateral limb rather than its extension proximally, if micro vascular surgical facilities are not available.

Introduction

Skin and soft tissue defect of lower third of leg and foot has always posed challenge. This because the tibia is subcutaneous bone with almost no muscles around its lower third with tight skin and poor circulation, heel is another problem site because of weight bearing properties (1).

There are many methods for covering soft tissue defect, although free flaps have been used to manage these defects, with good result, but their greater complexity requires, specially trained surgeons who are not always available at hospital, and have a higher complication rate than loco regional flap (2). There has been a great deal of interest in the use of local tissue to cover lower limb defects, beginning with their description by ponten, fasciocutaneous flap have been attempted for defect of the lower third of the leg based on the axis of major vessels of the leg, subsequently, however it was discovered that there existed vascular axis along the path of cutaneous nerves of the body (3).

This allows elevation of the skin supplied by this neurovascular axis as a flap for coverage of leg wounds, this perhaps best exemplified by the sural nerve flap described by Masquelet et al. (4). The sural nerve as it pierces the fascial plane to run subcutaneously between the two heads of gastrocnemius muscle, is generally accompanied by one to three arteries, these run inferiorly to a region just above the lateral malleolus, where communicate with multiple perforators from the peroneal artery. Also running along this same axis is the lesser saphenous vein; as such the skin overlying gastrocnemius muscle can be elevated based distally on these perforators (5). Although cross leg fasciocutaneous flap are less frequently indicated for distal leg and foot defect due to the availability of other alternative it still useful as they continue to prove to be the flap of choice in demanding situation (6). (free flap failure, non availability of ipsilateral proximal calf tissue, damaged distal perforators following trauma, burn, radiation, ect).

Patients and methods

The reverse flow sural flap used in 22 patients with lower limb defects in the period from January 2008 to March 2011, in Al-Sadder teaching hospital, in department of plastic and reconstructive surgery, sixteen patients were males and six were female, their ages ranged between 5-42 years (average age was 17 years). All the patients had no associated disease apart from one who had history of epilepsy, there is no associated fracture apart from three patients who had exposed bone at site of injury, the defects were in distal leg in ten patients, in the heel in five patients, ankle joint and tendoachilles in three patients, sole of foot in two patients and in dorsum of the foot in two patients. The aetiology of the defect was trauma in 15 patients, post surgical excision in 2 patients and unstable scar and burn in 5 patients. The procedure was done under general anesthesia, the recipient wounds were prepared by refreshing its edges, removal of granulation tissue and thorough washes with normal saline, in cases where chronic exposure of bone had resulted in drying and desiccation of bone it was debrided until healthy bleeding from the bone started. The flap is outlined at the junction of relief

of two heads of gastrocnemius, under tourniquet, a line of incision is traced over the presumed course of sural nerve and vein; the pivotal point of the pedicle is three fingers breadth proximal to the tip of lateral malleolus. Distant transverse short debridement allows the raising of two skin flaps in order to isolate the subcutaneous fascial pedicle. The flap and pedicle are raised; fascia included small arteries arising from the peroneal artery, should be ligated and divided in the depth of the pedicle. All the flaps were fasciocutaneous flap, the flap size range from 6-3cm to 10 -7cm. after the elevation of the flap release of tourniquet was done for assessment of flap vascularity, and all flaps have been transfer without delay.

In fifteen cases of ipsilateral reverse flow sural artery flap (figure I), the subcutaneous fascial pedicle is elevated with a width of 2-3 cm to include the nerve and accompanying vessels. The flap rotated in a manner that with less comprise of the pedicle, the interposing skin between the donor site and recipient are open to minimise the compression on the pedicle, the donor site closed primarily if it less than four cm in width, if it wider than this it closed by skin graft.

Conteralateral reverse sural flap used in seven cases (figure II), the indication for these cross leg flap were

- 1-unsuitable proximal calf tissues for ipsilateral retrograde fasciocutaneous flap.
- 2-damaged ipsilateral distal perforator following trauma, burn.
- 3-very distal defects where ipsilateral retrograde flap could not reach.

Before planning these flaps prior counselling of patients and their attendants is essential, regarding available option, position of limbs, required nursing care, and period of hospitalization and morbidity of donor site.

After harvesting the flap, the reach was confirmed by bringing the donor limb along with the defect keeping the limbs in comfortable position. Donor area and under surface of the bridge segment of the flap were covered with split thickness skin graft. The limbs were immobilized both proximally and distally, the fixation achieved by few layers of plaster of Paris bandage in the form of figure of eight around two light smooth wooden pieces of half inch diameter and eighteen inches long, these were kept with adequate cotton padding across ankle and knee joint. Since the primary inseting was more than 70%, single stage flap detachment was done after three weeks, in most of the cases bridges segment of the flap was utilized to resurface rest of recipient area and the remaining cases it was brought back to donor limb. Active and passive movement of limbs were encouraged soon after detachment.

Statistical Analysis:

Statistical analyses were performed using SPSS 12.0 for windows.Inc. Student-Ttest was used for the multiple comparisons among all. In all tests, $P < 0.05$ was considered statistically significant.

Result

Over a period of 3 years (January 2008 to march 2011) a 22 patients were treated by reverse sural flap. The age and sex distribution of the patients were shown in the following table -1

Age / years	Male	female	Total	percentage
Less than 15	7	3	10	45.5%
15 -30	6	1	7	31.8 %
More than 30	3	2	5	22.7 %

The causes of the defects in the patients treated in our study were shown in the following table -2

The cause	No. of patients	Percentage
Trauma	15	68.2%
Un stable scar and burn	5	22.7%
Post surgical excision	2	9.1 %

The distribution of cases with respect to the defect site (wound) was shown in the following table -3

Site of the defect	No. of patients	Percentage
Distal leg	10	45.5%
Ankle and tendoachilles	3	13,6 %
Sole of foot	2	9.1 %
Dorsum of foot	2	9.1 %
Heal	5	22.7 %

Distribution of patients with respect to the size of the defect was shown in the following table-4

Size of the defect /cm	No. of patients	percentage
Less than 5	8	36.4 %
5-10	10	45.5 %
More than 10	4	18.9 %

The size of flap range between 6-3 cm to 10 – 7cm with average of 8.5 -4.6 cm.

The distribution of patients in respect to type of reverse sural flap used in defect reconstruction as shown in following table-5:

Type of flap	No. of patients	percentage
Ipsilateral reverse sural flap	15	68.2
Conteralateral (cross leg) flap	7	31.8

All flaps survived. Only two flaps showed slight venous congestion which cleared within a few days. There was no loss of split skin graft; direct closure of donor site was done in 6 patients. No complaints related to the sacrifice of the sural nerve. Paresthesia on the lateral border of the foot was not a problem and disappeared with in two months. In those patients with cross leg flap there is no incidence of development of joint stiffness and sore.



Figure I		figure II	
Ipsilateral reverse sural flap		contralateral reverse sural flap	
a) Preoperative	b) flap design	c) flap elevation	d) post operative

Discussion

The challenge of distal leg and foot reconstruction have been a matter of increasing interest to the reconstructive surgeons and stimulated the continued search , innovation and modification of various reconstructive modalities in a trial to reach an algorithm to achieve the ideal reconstructive goals for such defects, various flaps have been described to solve this problem ,each has its own indications, advantages and disadvantages with relatively few procedure showing effectiveness and low morbidity (7) The anatomical arrangement of the leg structures made most of described regional flaps in - amenable to applied in such situation, therefore, the option for ankle reconstruction is more prone to the usage of microsurgical free flaps (8). There are still some clinical situations in which the patients not suitable for microsurgical procedures (like in our hospital when there is no microsurgical free flaps surgery).

One of these modalities is the concept of neuroskin island flaps which is first proposed by Masquelet et al. (9). They described a flap utilizing the median superficial artery (which run along sural nerve) as its vascular axis with a distal base nourished through the distal peroneal perforators. In our series of patient the major cause of soft tissue defect is trauma (68.2 % , P value 0.05) which is compatible with other studies, Ferreira et al (70%) 9, Almeida et al (75 %) 10. Bocchi et al (11) used a reverse sural flap in 14 patients to cover larger defects of the leg and ankle and a reverse adipofascial sural flap in 11 patients to cover moderate-size wounds in heel areas; they reported complete flap loss in three patients and partial loss in two patients. Ferreira et al (9) reported partial necrosis in six flaps of 36 distally based superficial sural artery flaps, and no other major complications occurred. We successfully elevated twenty two distally based sural artery flaps, only two flaps (9.1 % P value 0.05) show venous congestion , they resolved spontaneously within few days, There was no other major complications in rest of the cases with flap survival in all of them. The low incidence of complications in our series mainly because of the selection of our patients, as they were of younger age group and have no co morbid conditions (like diabetes mellitus or other diseases apart of one of them had a history of epilepsy) if compared with above mentioned studies. Also we based on original clinical experiences, that based on Masquelet anatomical report, stressed on the importance of limiting the flap extent only to that part of leg that coincide with the supra fascial course of sural nerve; we based on this principle because we don't have micro vascular facility and experiences in near by of our hospital , because some author when try to extend the flap proximally on random pattern basis and described their flap as being un predictable with high percentage of loss of distal portion of flap (12).

Usage of flap delay , arterial supercharge and venous super drainage are the possible modes for vascular augmentation ,in Tarek Mahboub MD et al (13) , vascular augmentation was needed in 5 out of 17 patients (29.4 %)that achieved flap survival in all except in two patients with partial flap necrosis (11.8 %). So for all of this we didn't extend flap proximally on random pattern , the limitation of flap size in such manner was restricted flap applicability for larger and more distal type , but we over come this by using contra lateral reverse sural flap for covering a more distal defect that couldn't covered by ipsilateral flap in two cases. Other five cases in which we used conteralateral flap, four because un suitable proximal calf tissue of ipsilateral limb for reverse flap (figure II), and one because of damage of distal peroneal perforator by trauma as shown by Doppler study as was shown preoperatively. In compare to other study (Bocchi et al (11) venous congestion in 32%) we had venous congestion only in two case (9.1 %)

this is mainly because we opened the interposing flap between donor and recipient area to avoid compression on the pedicle, that might result when using tunnelling of the interposing flap, because of oedema. in

Conclusions:

The distally based sural flap is a versatile and reliable flap for the coverage of soft tissue defects of the distal third of the leg and foot. It is safer to apply the flap from contra lateral limb rather than its extension proximally, if micro vascular surgical facilities are not available.

References

- 1- Jeng SF, Wei FC, Kuo YR, salvage of distal foot using the distally based sural island flap. *Ann plast surg* 1999; 43:499-505.
- 2-Pisolle V, Reau AF, Pelissier P, Martin D, Baudet D. Soft tissue reconstruction of distal lower leg and foot: are free flaps the only choice ?review of 215 cases .*g plast reconstr aesthet surg* ,2006;59:912-7.
- 3- Hollier ,Llarry MD, Sharma, versatility of sural fasciocutaneous flap in the coverage of lower extremity wound .*plast .reconstr. surg.*; 2002; 110:1673-1679.
- 4 –Masquelet AC. Romana MC, Wolf G. skin island flap supplied by the vascular axis of sensitive superficial nerve : Anatomic study and clinical applications . *plast reconstr. Surg.* 2000; 120:100- 14.
- 5 – Le Fourn B,Caye N , Pannier M , distally based fasciocutaneous flap :anatomic study and its clinical applications , *plast reconstr surge* .1999;103:104 – 20.
- 6-Barday TL,Cardos E,Sharpe DT. Cross leg fasciocutaneous flaps ; *plast reconstru surg* .1983;72:847.
- 7-Maruyama Y., Iwahia Y. and Ebihara H.; V-Y-advancement flap in reconstruction of skin defects of posterior heel and ankle. *Plast.reconstr.surg.* 5:759-64, 1985.
- 8-Levin L.S.; Soft tissue coverage options for ankle wounds. *Foot ankle clin.* 4:853-66, 2001.
- 9-Masquelet A.C., Romana M. C. and Wolf G.: skin island flaps supplied by the vascular axis of the sensitive superficial nerves. Anatomic study and clinical experience in the leg. *Plast. Reconstr. Surg.*, 89; 1115-21, 1992.
- 9-Ferreira AC, Reis J, Pinho C, Martins A, Amarante J.The distally based island superficial sural artery flap: clinical experience with 36 flaps. *Ann Plast Surg* 2001; 46:308-13.
- 10 - Almeida MF, Robero da Costa P, Okawa RY. Reverse flow island sural flap. *Plast Reconstr Surg* 2002; 109:583-91.
- 11- Bocchi A, Merelli S, Morellini A, Baldassarre S, Caleffi E, Papadia F. Reverse fasciosubcutaneous flap versus distally pedicled sural island flap: two elective methods for distal-third leg reconstruction. *Ann Plast Surg* 2000; 45:284-91.
- 12- De Almeda OM, Monterio AA,DR, Neves RI,De Lemos RGBraz, DC, Brechtbuhl ER, distally based fasciocutaneous flap of calf for cutaneous coverage of lower leg and dorsum of foot, *ann. Plast. Surg.*, 2:260-24, 2001.
- 13-Tarek Mahboub MD. And Mostafa Gad, MD, increasing versatility of reverse sural flap in distal leg and foot reconstruction, *J. plast .reconstr.surg.* vol.28, no.2Jully:99-112, 2004.