

Reliability and versatility of superficial sural artery flap

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Abstract

Objectives: To determine the reliability and versatility of Superficial Sural Artery Flap (SSAF) for lower limb reconstruction in terms of flap survival and frequency of complications.

Material and Method: This cross-sectional study was conducted in the department of Plastic and Burns Surgery, Khyber Teaching Hospital Peshawar from June 2014 to October 2016. All patients with leg defects, reconstructed with SSAF were included in the study. The data was acquired from the Hospital's record and analyzed with statistical package for social sciences (SPSS) to determine the frequency of different type and design of SSAF used and its complications of venous congestions and flap necrosis.

Results: During the study duration, 16 male patients were included with age ranging from 12 years to 60 years with a mean of 36.18 years +SD. Road traffic accident was the most common etiology of the soft tissue defects (68.8%). Six (37.5%) patients had distal leg defects as the most common site of soft tissue loss. Reverse Superficial Sural Artery Flap (RSSAF) was performed in 10 (62.5%) followed by Proximally Based Superficial Sural Artery Flap (PSSAF) in 6 (37.5%). Flap congestion was observed in 5 (31.2%) patients. We did not observe any complete flap loss. In one case (6.2%) case, partial significant flap necrosis was noted.

Conclusions: Superficial Sural Artery Flap is reliable source of reconstruction which can be used for the soft tissue defects of distal thigh, knee, leg, heel and proximal foot due to its versatile blood supply.

Key words: Sural artery flaps, reconstructive surgery, leg, trauma, malignancy

Introduction:

Tissue paucity and unreliable blood supply makes leg defects reconstruction a challenging job with few local tissue coverage options, making free tissue transfer more favorable option in most of the situations. Free tissue transfer provides the tissue of choice with the drawbacks of longer operation time, requirement of micro-vascular surgical skills and donor site morbidities.¹ Local tissue coverage option are the desired options for patients with systemic morbidities or to reduce the operation time In the current scenario of long waiting list of reconstructive surgery patients. SSAF is a faciocutaneous flap which can be raised both proximally and distally based.²⁻⁴

Ponten⁵ described the proximally based sural flap in 1981 in his series of 23 patients. Taylor and Pan's work showed that proximally based sural flap is supplied by Median, Lateral and Medial Superficial Sural Arteries present in 83-97%, 81% and 17% cases respectively with a variable number of source vessels as popliteal, medial and lateral sural, Inferior Medial genicular, Median genicular arteries. These source vessels are also supplied by 2-3 musculocutaneous perforators of medial and lateral sural arteries through medial and lateral bellies Gastrocnemius with the more consistent anatomy of the former.⁶⁻¹⁶ The proximally based (standard) design of sural artery flap extends the usefulness of the flap for reconstruction of the distal thigh, knee and proximal leg defects with sensate tissue. The

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proximally based can be designed either pedicles or islanded.¹⁷

After initial description by Donski and Fogdestam¹⁸ in 1983, the anatomy of the RSSAF was elaborated by Masquelet et al¹⁹ in 1992. The RSSAF became a popular option for the lower leg, ankle and proximal foot defects due to its reliable vascular anatomy without compromising any major vessel of the lower limb.²⁰ In the Reverse RSSAF design when the proximal blood supply is divides, the flap is supplied by 4-6 septocutaneous perforators of peroneal artery between the soleus and peroneus longus muscles with the distal most located 4-7 cm proximal to the lateral malleolus. The terminal branches of peroneal artery i.e lateral maleolar artery and lateral calcaneal artery has communication with the superficial sural arteries at 3cm and 1cm proximal to the lateral malleolus. Four to five Posterior tibial artery perforators join the sural-angiosome between the soleus and flexor digitorumlongus muscles. The most distal perforator location is 4-10cm proximal to the medial malleolus.²¹ Later, Nak-ajima^{22,23} demonstrated a secondary source of blood supply to through neurocutaneous and venocutaneous perforators from the vasa-nervosa and vasa-vesora accompanying sural nerve and small saphenous vein respectively.

The venous outflow of the flap is through small saphenous vein into popliteal vein with valves preventing retrograde flow. The venous return of RSSAF flap is through one or more small collateral veins accompanying small saphenous vein which has communication with the later and the perforators' concomitant veins of peroneal and posterior tibial vessels.²¹

This study is aimed to determine the demographics, analyze the reliability and versatility and frequency of complications of patients reconstructed with Sural flap in our setup with the rational to explore different clinical scenarios in which the flap can be a useful reconstructive option.

Material and Methods:

This descriptive cross-sectional study was performed in our department from June 2014 to October 2016, including all patients reconstructed with SSAF irrespective of age, gender and etiology of the defect. Those patients were excluded who did not consent the study protocol. The preoperative clinical data, procedure details and post-operative course was acquired from the hospital records. Procedures were performed in spinal or general anesthesia, either in prone or lateral decubitus position under tourniquet control. For distal leg, heel or proximal foot defects, RSSAF was designed while distal thigh, knee or proximal leg defects were reconstructed with PSSAF. Flaps were delayed in patients who required large flaps, sustained high velocity trauma, scars in the suralangiosome, multiple orthopedic surgeries were performed, patients of extreme ages or with comorbidities. Flap congestion was treated with delay phenomenon, or scoring and topical heparin application or leeches. Postoperatively the necrosis was classified into three groups; non-significant partial necrosis (which are treated conservatively without additional procedure), significant partial necrosis (which required an additional procedure for coverage) and complete necrosis(which required complete coverage in a secondary procedure). Data was organized, analyzed and stratified for different variables with the help of statistical package for social sciences (SPSS).

Results:

Sixteen patients qualified the study criteria. The age ranged from 12 years to 60 years with a mean of 36.18 years 16.31+SD. All of the patients were males. Eleven patients (68.8%) presented with the history of road traffic accident as the etiology of their defect (Figure 1). Distal leg defects followed by heel defects were the most common with the frequency of 6 (37.5%) and 4 (25%) patients respectively(table 1). RSSAF was performed in 10 (62.5%) followed by PSSAF in 6 (37.5%). In 13 (81.2%) cases pedicled flaps were designed while in 3 (18.8%) cases islanded flap design was adopted mostly for PSSAF. Six flaps were performed in three stages with flap

Table 1: Location wise distribution of soft tissue defects of the study population

S/No.	Soft tissue defect location	Frequency
1	Distal Thigh	2 (12.5%)
2	Knee	1(6.2%)
3	Proximal Leg	3(18.8%)
4	Distal Leg	6(37.5%)
5	Heel	4(25.0%)
Total		16

Table 2: Number of stages in which the reconstructive procedures were performed

S/No.	Number of stages	Frequency
1	Single Stage	4 (25.0%)
2	Two Stage	6 (37.5%)
3	Three Stage	6 (37.5%)
Total		16

Table 3: Venous congestion for different type of Superficial Sural Artery Flaps

Flap Type	Flap Congestion		Total
	Nil	Yes	
Reverse Superficial Sural Artery Flap	7 (70%)	3 (30%)	10
Proximally Based Superficial Sural Artery Flap	4 (66.7%)	2 (33.3%)	6
Total	11	5	16

P-value = 0.654, calculated with Fisher's Exact Test <0.05=significant

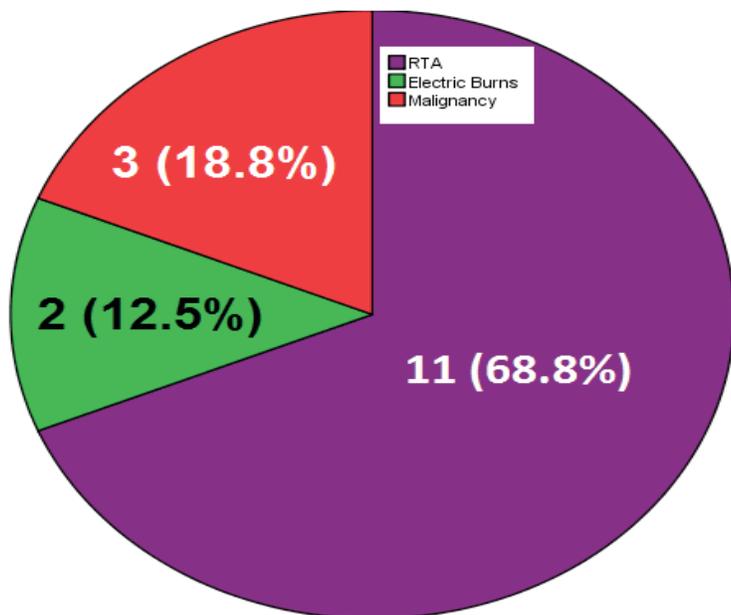


Figure 1: Etiological distribution of study population

delay as the first stage to prevent or treat the flap venous congestion (table 2). Over all flap congestion was observed in 5 (31.2%) patients, out of which 3 were treated with flap delay and rest conservatively either with scoring and topical

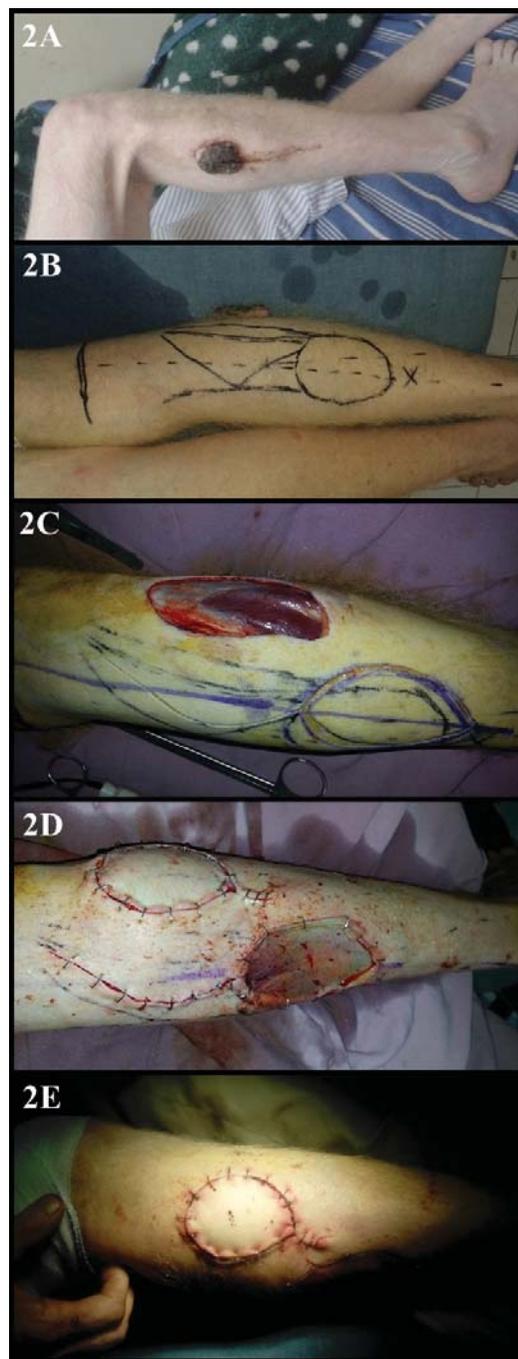


Figure 2: Squamous cell Carcinoma of proximal half of right leg reconstruction with Proximally Based Islanded Superficial Sural Artery Flap (PSSAF), 2A; Squamous Cell Carcinoma right leg, 2B; Preoperative marking for Islanded PSSAF, 2C; Defect after excision of Tumour, 2D; Flap inseting and donor site Skin graft coverage, 2E; One postoperative with healthy flap.

Heparin application or leeches (table 3). We did not observe any complete flap loss. In one case (6.2%) of high voltage electric burns patient re-



Figure 3: Heel defect reconstruction with RSSAF, 3A; Defect location on the heel and flap markings with exposed Small Saphenous Vein and Nerve in the superior incision, 3B; Flap inset and donor site coverage with Split Thickness Skin Graft, 3C; Final result after flap division after one month with good contour.

constructed with a large PSSAF, partial significant flap necrosis was observed who required a secondary reconstructive procedure.

Discussion:

Superficial Sural Artery Flap is one of the most important regional flaps for reconstruction of the leg with good success rates. In our series, most of the patients were young males affected



Figure 4: Venous congestion of RSSAF coverage for a wheel spoke heel and distal leg defects, 4A; Second postoperative day of flap in-setting on heel defect and utilizing the extra skin paddle for the reconstruction of distal tibial defect in islanded fashion with some venous congestion, 4B; Planter view of the heel with good contour

most commonly with Road Traffic Accidents. Chen SL et al.²⁴ published their series of similar demographics except for inclusion of female patients which makes almost half of their study population. Yusof NM et al.²⁵ noted similar age group, mostly male patients reconstructed with Superficial SSAF. In contrast with our study, defects around the ankle were the most common in Yusof NM et al.²⁵ observations. Similar to our results, Masood T et al.²⁶ also observed Road Traffic Accidents as the most cause of leg defects reconstructed with this flap. In contrast to our Pedicled RSSAFs in two or three stages, Yusof NM et al.²⁵ performed islanded RSSAFs in two stages in their series with flap delay as the 1st stage with a very high frequency of partial and complete flap necrosis which increased the requirement for secondary reconstructive procedures. Li-You W et al.²⁷ observed no necrosis in their study of RSSAF for heel defects in children. Ilyas Tahirkheli MU et al.²⁸ reported good results for both RTA and war injuries using islanded RSSAF but the complication rates as partial or complete necrosis is still higher than our series. In our series half of the PSSAFs were islanded in which one flap developed partial significant flap necrosis. Suri MP et al.²⁹ performed the Proximally based Superficial Artery Flap in their series with one partial flap necrosis for secondary reconstructive procedure was performed. Cheon SJ et al.³⁰ also reported one partial necrosis in their series of ten patients of PSSAF. The venous congestion, in our series was noted

in 31.2% cases which is similar to Masood T et al²⁶ observations. Lee H et al³¹ reported 16% flap congestion frequency which is lower than what we observed in our series. We observed significant partial necrosis in one case, which was performed in electric burns patient with a very large defect having exposed anterior aspect of tibia at the junction of middle and proximal third of the leg. We believe the cause was of this partial necrosis was two folds. Firstly, the electric burns affect the surrounding vasculature and decreases the loco-regional flaps reliability, secondly this patient requires a larger flap which an extended flap was used. Multiple studies observes similar partial necrosis frequencies without any complete flap loss.^{26,30,31}

Small sample size and study design are the weak points of our study. Multi-center Randomized controlled Trials are suggested to study the various risk factors for complications and the reliability of multiple designs of SSAF.

Conclusion:

Superficial Sural Artery Flap is reliable flap with acceptable complication rates and can be safely used for the reconstruction of defects of the lower thigh, knee, upper/lower leg, ankle and proximal foot due to the versatility of its blood supply without compromising the major leg vessels.

Conflict of Interest: None

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Role and contribution of authors:

Dr Amir Taimur Khan did the procedures and provided data

Dr Mansoor Khan did Idea conception, co-ordination, methodology, data collection and research, performed surgeries.

Dr Syed Mohammad Haider did surgeries and compiled results

Dr HidayatUllah did data analysis and review

Dr Asif Aziz did bibliography, helped in data analysis

Dr Muhammad Tahir did performed the procedures, provided data and supervision.

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