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Original article:

Outcome of reverse sural artery flap in lower limb reconstruction: Our experience

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Abstract:

Context: Lower extremity reconstruction is an important domain of plastic surgery. Treatment of lower third defects and heel pad defects are especially challenging due to decreased vascularity and lack of adequate subcutaneous fatty tissue. We aimed to study the outcome of patients undergoing reverse sural artery flaps in our institute.

Settings and Design: This was a retrospective study conducted on thirty two patients who underwent reverse sural artery flap surgery between January 1, 2016 to May 31, 2020 in our institute.

Methods and Material: The records of the patients were reviewed and clinical data –etiology, site of defect, outcome of surgery and duration of hospital stay, was collected. The data was categorized based on demographic variables.

Statistical analysis used: The data was subjected to descriptive statistical analysis to yield frequencies, percentages and means.

Results: The mean age of the studied population was 45.06 ± 13.69 years. Twenty seven subjects were males whereas five subjects were females. The major causative factor for lower limb defect was trauma accounting for 50 % of total cases followed by diabetes mellitus (25%). Majority of defects (65.62%) were in the lower third of lower limb. Twenty seven patients had uneventful post-operative outcome, whereas two patients had marginal necrosis of flap, two had tip necrosis of flap and one had partial necrosis.

Conclusions: In conclusion, we recommend the versatile reverse sural artery flap for coverage of lower third and heel pad defects because of favourable post-operative outcome.

Key-words: Reverse sural artery flap, lower limb defects, pedicle flap

Introduction:

The loss of soft tissue at the level of the lower third of the leg, ankle and heel with the exposure of tendon or bone, represents a reconstructive challenge because of lack of locally available tissue, relatively poor circulation of the skin and weight – bearing requirements of the region. The reverse sural artery flap is a distally based fasciocutaneous flap that is being widely used for coverage of defects that involve the distal third of the leg, ankle, and heel. This flap is based on perforators of the peroneal artery system. The flap consists of superficial and deep fascia, the sural nerve, lesser saphenous vein, and superficial sural artery.[1]

The superficial sural artery, which branches off of the posterior tibial artery, connects with the sural nerve in the proximal leg. The artery gives off branches to the tissue and skin along the course of the nerve as it continues distally to the foot. Peroneal artery septocutaneous perforators anastomose with the superficial sural arterial network within the distal two-

thirds of the leg[2-4]. Masquelet et al found that the close proximity between the deep vessel axis of the sural nerve and its corresponding peroneal and sural arteries accounts for the logic behind the transfer and subsequent survival of the flap[2]. In more understandable terms, one can assume that the flap should maintain its viability due to the close proximity of the arterial and nervous supply to the flap. The venous network of the superficial sural vein, the short saphenous vein, and the associated veins of the peroneal artery provide the venous return for the flap.[5]

According to various classification criteria, but mostly determined by the surgical technique for harvesting and using this flap in various defects reconstruction, the sural flap has been referred to as reverse sural artery flap[6,7], delayed sural flap[8], supercharged reverse sural flap[9], sural fasciomusculocutaneous flap[10], distally based sural flap[11,12], cross-leg distally based sural flap[13], distally based sural neurocutaneous flap[14], distally based sural neuro-fasciomyocutaneous flap[15], distally based sural neuro-lesser saphenous veno-fasciocutaneous compound flap[16], nerve sparing distally based sural fasciocutaneous flap[17,18]

Subjects and Methods:

A retrospective study was conducted in a tertiary care medical College of Malwa region, Punjab. Research and ethical clearance was obtained from Institutional research and ethical committee. The demographic and clinical data of thirty two patients who had undergone reverse sural artery flap surgery for lower third and heel pad defects was collected. In this study we included the patients who underwent the surgery from January 1, 2016 till May 31, 2020. Patients with history of trauma or surgery in the median sural artery territory were excluded from the study. Also excluded from the study were patients with history of burns in the local area.

Detailed history regarding etiology of defects and any other associated co morbid conditions was elicited. All cases underwent detailed general and local examination. Local examination included size, site and depth of defect, condition of surrounding skin.

Reverse sural artey flap was planned and flap markings were done preoperatively (figure 1, figure 2). The patient was placed in the prone position. A line was drawn from the centre of popliteal fossa to a point in between the posterior border of lateral malleolus and anterior margin of Achilles tendon. This line marks the vascular pedicle. Upper border of flap was marked 8 cm from the popliteal fossa which represents the first fasciocutaneous perforator from the sural artery. In all the patients, the flap was harvested as an island flap and was raised along the course of sural nerve. Lesser saphenous vein was included in the pedicle. The modification done at our end in raising the flap was that we opted for a wider, 4.5 -5 cm, adipofascial cuff along the pedicle, instead of a usual narrow pedicle (figure 3). After raising the pedicle, a subcutaneous tunnel was made upto the defect through which flap and pedicle was passed and made to reach the defect and inset was given. Donor area of the islanded part of flap was either grafted or primarily closed (figure 4, figure 5). Regular monitoring of the flap was done to look for skin colour, capillary refill, and local skin temperature.

The data collected included the demographic variables like age, gender and place of residence. Clinical data pertaining to the etiology, site of defect, complications of surgery and duration of hospital stay was retrieved. The data was compiled in Microsoft Excel Spreadsheets. It was then subjected to descriptive statistical analysis to yield percentages, means and range.

Results:

A total of thirty two patients who underwent reverse sural artery flaps in our institute were studied. The mean age of the studied population was 45.06 ± 13.69 years (range 18-68 years). There were 27 (84.37%) males and 5 (15.62%) females in our study.

The site of defect was the lower third of limb in 21(65.62%) patients and heel in 11(34.38%) subjects. Right limb was affected in 15 subjects and left limb was affected in 17 subjects.

Of the population studied, the etiology of defect was trauma in 50% subjects (n=16). 25% (n=8) had defects due to diabetes, 9.37% (n=3) had post cellulitis, 9.37% (n=3) had postoperative defect following Achilles tendon repair. One case each had defect following squamous cell carcinoma excision and long standing discharging sinus over heel pad respectively.

Data on postoperative outcome revealed nil postoperative complications and healthy, viable flap in 27 patients (84.37%). None of the cases had venous congestion of flap. Postoperative marginal necrosis and tip necrosis was present in two cases each. One patient had postoperative partial necrosis of flap. Average duration of hospital stay of patients was 7.62 ± 2.89 days (range 3-15 days).

Discussion:

Reverse sural artery flap, first described by Donski and Fogdestam[19] and later modified by Masquelet et al[2], is a work horse flap for lower third limb defects and heel pad defects. The reason for this is embodied in the fact that this flap does not lead to any manipulation or sacrifice of any major lower limb artery. This results in uncompromised blood flow[20]. Apart from this, it confers relative surgical ease due to its ease of dissection. As a result, favourable outcomes far outnumber flap related complications. A metaanalysis[24] has reported 82% favourable outcomes in reverse sural artery flap surgery. This flap is less bulky as compared to other options of coverage like free flap (anterolateral thigh flap , latissimus dorsi muscle flap). This in turn is beneficial to the patient in terms of better contouring in heel pad defects and uniformity in the size of shoes of both feet that can be worn postoperatively. Moreover, discomforts associated with long periods of immbobilization and difficult positioning as in cross-leg flap can be circumvented with RSAF surgery.[21-23]

Ours was a study conducted in a tertiary care medical college of North India which analyses the outcomes of reverse sural artery flap surgery in the institute. This study will help in identifying the major etiology of the defects as well as analyze the outcomes of RSAF surgery in our centre which shall go a long way in considering this surgery as a routine modality of treatment for lower limb defects.

Our study included thirty two patients with mean age of 45.06 ± 13.69 years, which corresponds well to a metaanalysis[24] which reported age group 46.9 ± 16.7 years. However, a study by Justin Orr et al[25] on ten subjects had much younger study subjects with mean age of 27.2 years. His study was conducted on patients with severe war related blast injuries and did not include other etiologies like diabetes and cellulitis which are associated with advanced age. A case series on ten subjects done by Ahmed et al [26] had mean age of 59.8 years. In a study conducted by Parrett et al[27], patients had a mean age of 53 years. Twenty six patients studied by Mahipathy etal[28] had average age of 37.8 years. This variation for mean age among studies could be attributed to the differences in etiology, regional influences and difference in sample size. The number of males(n=27) were far more than the number of females (n=5) in our study. In a similar study done on 84 patients by **Akhtar Set al[29]**, 54 were males and 30 females.

In our study, the major causative factor for lower limb defects was trauma (50%), followed by diabetes mellitus (25%), post cellulitis (9.37%) and defects due to wound dehiscence following Achilles tendon repair (9.37%). One case each had defect following squamous cell carcinoma excision and long standing discharging sinus (secondary to osteomyelitis) over heel pad respectively. Out of 16 post-trauma cases, 15 were males and only one was female. In these post trauma cases, left limb was affected in 12 patients and right limb in 4 patients.

Male preponderance in our study is because the main causative factor is trauma due to road side accidents. Males, being the main outgoing population in Indian scenario, are more prone to trauma related lower limb defects.

Higher risk of infection coupled with diabetic neuropathy and poor immunity predisposes a diabetic patient to defects in lower limb. In our patients with defects secondary to diabetes, RSAF surgery was preceded by vacuum assisted closure (VAC) dressing to reduce the bacterial load and increase the local vascularity. Severe cases of lower limb cellulitis, on the other hand, often leads to exposed tendons or bone after serial debridements which mandates use of flap for coverage.

Our finding of trauma being the main causative factor collaborates well with many other similar studies. A study by Akhtar S et al[29] on 84 patients found road traffic accidents as the cause of the defects in 53 patients, wheel spoke injury in 12 patients, trophic ulcer in five patients, osteomyelitis in five patients, marjolin ulcer in seven patients and diabetic ulcer in two patients. In a metaanalysis [24], 60.4% defect etiologies were traumatic. Case series on ten patients done by Ahmed et al[26] had the defects as a result of trauma in five patients (50%), diabetic ulcers in four (40%) and decubitus ulcer in one (10%) paraplegic patient. In study by Mahipathy et al[28] trauma was the major cause of the defects in 22 (84.6%) patients. Trauma was described as major etiological factor in 84% by Almeida MF et al[30] and 88% by Fraccalvieri M et al[31]. However, contrary to our study, Touam C et al[32] reported pressure sores in 45% cases. Baumeister SP et al[33] reported unstable or chronic ulcers in 75% of patients as the authors had specifically included high risk, critically multimorbid and older patient population.

Different selection criteria in studies and different rates of prevalence of each etiology in various geographical areas has led to a variation in the etiologies amongst these studies.

The site of defect was heel in 11(34.38%) subjects, malleolus in 9 (28.12%), lower third of leg in 5 (15.62%), anterior ankle in 4 (12.5%) and tendoachilles region in 3 (9.37%) subjects in the present study. This collaborates well with the metaanalysis[24]wherein the most common defect location was the heel (40.8%). Although in a study by Sokol isaraj et al[34] on 15 cases, the defect was located on medial malleolus in 6 cases, dorsum of the foot in 3 cases, distal third of the leg in 2 cases, calcanear region in 3 cases, and anterior ankle in one. Akhtar S et al[29] reported the site of defects in 84 study subjects as distal tibia in 52; 20 tendo-Achillis and posterior heel defects; seven-malleolar region; three-anterior ankle and two-foot amputation stumps. This variation amongst the studies can be due to difference in distribution of etiologies and study population. Trauma, a major etiology in many studies, leads to injuries to different parts of lower limb depending upon type and intensity of trauma.

We encountered necrosis in flap in 15.62% (n=5) study subjects. Out of these, tip necrosis of flap was seen in two cases, marginal flap necrosis in two cases and partial necrosis in one case. We didn't come across venous congestion in any of the flaps. This was probably because we chose a wider 5 cm pedicle. This ensured better vascular flow in and out of the flap. 84.37% (n=27) cases had nil postoperative complications with a healthy, viable flap. In a 2018 metaanalysis [24] the partial and total flap loss rates were 15.4% and 3.1%, respectively. Study by Parrett et al[27] on 58 flap surgeries reported complication rate of 16%. Another study by Mahipathy etal[28] five of 26 (19.3%) of the flaps showed marginal or partial necrosis.

However, success rate in studies by Baumeister SP et al[33], Almeida MF et al.,[30] and Fraccalvieri M et al.,[31] were 64%, 73.6% and 78% respectively. Higher rates of necrosis in these studies were due to inclusion of large number of high risk elderly patients with associated comorbities.

The favourable outcomes in the present study were largely because we could avoid venous congestion. This was because we chose a wider 5 cm pedicle, which ensured better vascular flow in and out of the flap. This is supported by the study done by Hollier L et al.,[35] and Ajmal S et al,[36] . Another contributing factor was less of associated comorbid conditions in our study population (half of the patients in our study had defects secondary to trauma with no associated comorbid conditions).

In the present study, average duration of hospital stay of patients was 7.62 ± 2.89 days, ranging between 3 and 15 days. There is large variation in number of days of hospital stay. This was because one patient had an unexpected event back home just three days after surgery and took discharge against medical advice. There was another patient who was admitted for 15 days as the wound was prepared by vacuum assisted closure (VAC) dressing for the initial seven days. This is in contrast to the findings of study by Sokol Isaraj[34] where the reported mean hospital stay of the patients was 32 days.

The variation of results between studies on Indian population and foreign population and even between different regions of India can be attributed to various factors including difference of sample sizes, geographical and ethical distribution of populations. Variations in selection criterion in different studies and individual modifications in surgical technique are also important factors leading to differences in results amongst different studies.

Conclusions

Lower third limb and heel pad reconstruction is a wide subject, which encompasses various types of flap surgeries. But due to less complications by increasing the width of adipofascial pedicle desirable results can be obtained with reverse sural artery flaps. Moreover, RSAF provides good coverage to less accessible and far off areas because of the long pedicle and greater arc of rotation.

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