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# Results of reverse sural artery (RSA) fasciocutaneous flapsperformed by an plastic surgeon at a local tertiary care facility innorthern India ondistal lower limb soft tissue anomalies brought on bytraumatic injuries

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**Abstract**

Small soft tissue defects of the distal tibia and hindfoot resulting from traumatic, operative, or neoplastic conditions and chronic ulcers can be successfully dealt with the use of the reverse sural artery flap (RSAF). This study aimed to know the association between the successful outcome of the flap and the selected factors.Our retrospective study included 40 patients who had soft tissue defect in the distal third of the leg, heel, ankle and dorsum of the foot. Detailed history was obtained, thorough clinical examination performed, necessary preoperative investigations done and reverse sural artery fasciocutaneous flap cover performed.All the patients selected in the study group underwent reverse sural artery flap cover in a satisfactory way. Majority of the patients were discharged with no complications and a minor group of them with minimal complications.Reverse sural artery flap is a versatile and reliable flap for the coverage of soft tissue defects of distal lower extremity. The leading independent factors which contribute to the success of the flap are trauma as the aetiology, distal third of the leg, and dorsum of the foot being the site of the defect and flap size of 24 sq. cm in comparison to the rest of the factors in the study.

**Keywords:** soft tissue defect, reconstruction, complication, diabetic foot ulcers, cutaneous nerve, artery, pedicled flap

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## Introduction

The management of distal lower limb defects, particularly those requiring vascular support for tissue, has posed a persistent challenge for orthopaedic and plastic surgeons over an extended period of time. The presence of osseous tissue, fractured segments, and tendons necessitates prompt closure in order to mitigate the likelihood of infection [1, 2]. Due to the relatively thin subcutaneous tissue in the distal third of the lower limb, it is common for tendons, bones, and implants to become exposed in this anatomical region following trauma [3]. Despite the limited availability of flaps for soft tissue coverage in the distal third of the lower limb, several of these techniques have not gained popularity or been widely practised due to the surgical challenges involved in raising the flap, restricted range of rotational movement, and a high level of unreliability [4, 5, 6]. Fasciocutaneous flaps have proven to be highly beneficial in addressing the challenges associated with the distal third of the leg, ankle, and hind foot [7]. The utilisation of free flap is presently considered the preferred therapeutic intervention for substantial soft tissue deficiencies affecting the distal extremity. However, the absence of microsurgical expertise and infrastructure at peripheral medical facilities, the financial implications, and occasionally patient-related considerations may limit the feasibility of utilising free flap procedures [8].

The Reverse Sural Artery Flap (RSAF) is one of several flaps that have been suggested for the purpose of reconstructing defects in the distal leg, ankle, and foot. Other flaps that have been proposed include the lateral supra malleolar flap, peroneus brevis and extensor digitorum brevis muscle flaps, and crossed leg flaps. The RSAF (Reverse Sural Artery Flap) is a dependable and anatomically-based surgical technique used for reconstructing heel and hindfoot defects. This procedure involves utilising a segment of skin and underlying fascia from the sural angiosome, which is located in the posterior calf region between the popliteal fossa and midportion of the leg [9]. The observed anatomical location is situated precisely

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along the middle raphe, positioned between the medial and lateral heads of the gastrocnemius muscle. It is noteworthy that this location can be elevated through various surgical techniques, including fasciocutaneous, adipofascial, and myocutaneous approaches. It can be utilised for the purpose of providing coverage to exposed vasculature, osseous structures, tendons, as well as internal fixation devices [2, 10]. The observed object exhibits a substantial range of rotation, facilitating comprehensive examination of the distal portion of the lower extremity, encompassing the metatarsophalangeal joints on the dorsal aspect and the base of the metatarsal bones on the plantar aspect of the foot [3, 4]. When considering the distally based peroneus brevis and extensor digitorum brevis muscle flaps in comparison, it has been observed that the reverse sural artery flap (RSAF) is suitable for application in cases involving larger defects [11]. The option under consideration exhibits remarkable versatility, both in its proximal and distal applications, and has demonstrated efficacy in addressing even substantial defects (ranging from approximately 17 × 16 $cm^2$ to 20 × 15 $cm^2$) [3,4]. Immobilisation and challenging positioning techniques are actively circumvented, in contrast to the utilisation of cross-leg flaps [12]. The lateral supra malleolar flap, despite its technical simplicity, presents limited indications in terms of size and leads to a larger area of foot insensitivity [13]. Hence, the Reversed Saphenous Artery Flap (RSAF) has gained significant popularity within the medical community, particularly among surgeons. This is primarily attributed to its high reliability, relatively straightforward technical execution, independence from microsurgery techniques, preservation of the primary arterial blood supply to the lower extremity, and its cost-effectiveness for both patients and the healthcare system [2, 3]. Microsurgery is the preferred method of treatment in our institution, particularly when deemed necessary, even among surgeons who do not specialise in this field. The primary aim of this investigation is to ascertain the correlation between the outcome of the reverse sural artery flap procedure and various contributing factors.

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## Methods

A retrospective analysis was conducted on the medical records of patients who underwent consecutive surgical procedures for soft tissue defects utilising the Reconstructive Subcutaneous Adipose Flap (RSAF) as the primary intervention. The study period spanned from March 2020 to December 2022.

*Inclusion criteria*: In this study, we included individuals who were 16 years of age or older and presented with soft tissue defects in the lower extremity. These defects were a result of acute or chronic trauma, tumour excision, or chronic osteomyelitis. Only patients who had a minimum follow-up period of one year after their reconstructive surgery and provided their informed consent were considered for participation in this research.

*Exclusion criteria*: Patients with vascular injury, diagnosed peripheral arterial disease, polytrauma and those who did not give consent for participation were excluded from the study.

*Data Collection*: Patient demographic information, including age, gender, and medical history, as well as the geographical location and aetiology of the defect, were documented. The average duration of the surgical procedure, the average size of the defect, the postoperative treatment plan, the rate of successful healing of the flap, and any observed complications were also meticulously recorded. The comorbidities and pertinent patient information pertaining to flap failure were also documented.

## Results

In our retrospective study, we conducted an analysis on a cohort of 40 patients, encompassing a wide range of ages from 6 to 72 years. The maximum number of patients observed in this study were within the age range of 20-30 years, constituting 37.5% (n=15) of the total patient

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population. The youngest participant in the study was 6 years of age, while the oldest participant was 72 years old, as indicated in Table 1.

The majority of the patients consisted of males, accounting for 62.5% (n=25) of the total patient population. Females comprised the remaining 37.5% (n=15). The majority of our patients exhibited traumatic aetiology, accounting for 70% (n=28) of the study group, while chronic ulceration accounted for 10% (n=4) of the study group. The prevalence of diabetic ulcer and unstable scar formation was observed to be 7.5% in the study population, with a sample size of 3 individuals. The presence of a venous ulcer and a defect resulting from tumour excision each accounted for 2.5% (n=1) of the cases. A total of 10 patients, accounting for 25% of the sample (n=10), exhibited a defect in the heel region. Similarly, 9 patients, representing 22.5% of the sample (n=9), displayed a defect in the distal third of the leg. In the study group, a total of 8 patients (20%, n=8) exhibited ankle defects. Additionally, 6 patients (15%, n=6) experienced defects over the dorsum of the foot. Furthermore, 4 patients (10%, n=4) within the study group presented with defects over the medial malleolus. Moreover, 2 patients (5%, n=2) displayed defects over the middle third of the leg. Lastly, 1 patient (2.5%, n=1) had a defect specifically over the lateral malleolus (Table 1).

The dimensions of the pedicled fasciocutaneous flap ranged from 11 x 9 cm to 3 x 4 cm. The study group population consisted of individuals, of which 25% (n=10) were smokers, while the remaining participants were non-smokers. In the present study, a total of 40 participants were included. Among them, 31 individuals, accounting for 77.5% of the study group, were classified as nondiabetics. The remaining 9 participants, representing 22.5% of the study group, were diagnosed with diabetes mellitus. A total of 34 patients (n=34) exhibited no surgical complications, accounting for 85% of the study population. The study group observed instances of epidermal loss, partial flap necrosis, and complete flap necrosis, with each occurring in 5% (n=2) of the participants.

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**Table 1. Surgery Outcome determinants**

| Variable | Ratein % | NoComplication | Complication | OddsRatio & 95% CI | |
|---|---|---|---|---|---|
| **AgeGroups** | | | | | |
| 21to40yrs. | 84 | 21 | 4 | 0.81(0.13-5.05) | 0.81 |
| Others | 86.6 | 13 | 2 | 1 | |
| **Aetiology** | | | | | |
| Trauma | 92.9 | 26 | 2 | 6.5(0.99-42.3)1) | 0.10 |
| Others | 81.8 | 18 | 4 | 1 | |
| **Site** | | | | | |
| Leg(DistalThird)PlusAnkle | 94.1 | 16 | 1 | 4.44(0.47 - 42.18) | 0.21 |
| Others | 78.3 | 18 | 5 | 1 | |
| **PartExposed** | | | | | |
| TibiaandTibiaFractureSite | 90.9 | 10 | 1 | 2.08(0.22-20.17) | 0.88 |
| Others | 82.8 | 24 | 5 | 1 | |
| **FlapSize** | | | | | |
| 20to40sq. cm. | 100 | 13 | 0 | 3.71(1.4-34.44) | 0.15 |
| Others | 77.7 | 21 | 6 | 1 | |
| **Smoking** | | | | | |
| Yes | 100 | 10 | 0 | 2.5(0.27-23.53) | 0.38 |
| Others | 80 | 24 | 6 | 1 | |
| **DM** | | | | | |
| Present | 88.9 | 8 | 1 | 1.54(0.16-15.17) | 0.87 |
| Absent | 83.9 | 26 | 5 | 1 | |

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**Discussion**

The reconstruction of the distal third of the leg and foot remains a formidable undertaking for the reconstructive surgeon in the medical field. This has prompted ongoing research and refinement in the pursuit of an optimal approach to reconstructing such defects. In recent years, the utilisation of fasciocutaneous flap and free flap techniques has emerged as the predominant methods for the reconstruction of the distal third of the leg.

In our research investigation, a total of four individuals were identified as paediatric subjects. Three individuals presented with a congenital anomaly affecting the dorsum of the foot, while one child exhibited an exposed ankle joint. The average dimensions of the flap were measured to be 6 x 7 cm. Full flap viability was observed in all four paediatric patients, suggesting that the reverse sural artery flap is both applicable and safe in the paediatric population. In our study, trauma accounted for 70% of cases and served as the primary etiological factor. This finding is consistent with previous studies documented in the medical literature, wherein trauma was identified as the etiological factor in 70-90% of the cases [14, 15]. Three individuals diagnosed with diabetic ulcers were effectively managed and treated. This phenomenon has also been documented in various scholarly investigations, wherein it has been asserted that the surgical technique known as flap can be executed with a reasonable level of safety in individuals who are afflicted with diabetes and possess compromised medical conditions. 23 Patients presenting with occlusion of the anterior and posterior tibial arteries as well as varicose veins are not regarded as absolute contraindications for the utilisation of this flap, as stated in previous scholarly publications [16, 17].

The incidence of complications in our study cohort was observed to be 15%. Two patients (5%) who experienced epidermal loss were managed conservatively through the application of routine wound dressings. Two patients (5%) who experienced partial flap necrosis underwent wound debridement, revealing underlying tissue in a healthy state. The patients

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were managed conservatively through the application of regular wound dressings. Furthermore, an additional two patients (5%) who experienced complete flap necrosis were scheduled for a subsequent intervention. The necrotic flap was excised, followed by the application of negative pressure wound therapy using vacuum-assisted closure. Subsequently, a skin graft was performed once the presence of healthy granulation tissue was observed. The complication rate observed in our study is consistent with the findings of previous similar studies conducted by Samira Ajmal et al [18], which reported a complication rate of 20%.

The primary concerns that necessitate attention when assessing the viability of the reverse sural artery flap include the establishment of reverse arterial and venous circulation via axial vessels, as well as the prevention of any potential pedicle kinking subsequent to flap inset. Venous congestion, a primary contributor to flap failure, can be mitigated through the incorporation of the short saphenous vein and elevation of the lower limb during the postoperative phase. In addition to the aforementioned variables, there may exist additional factors that can exert an influence on the favourable outcome of the flap. This inquiry necessitates a comprehensive response.

Despite previous extensive anatomical studies, the precise dimensions and safe extension of the reverse sural artery flap have yet to be definitively determined. Several prior investigations have been conducted to examine the correlation between the efficacy of the reverse sural artery flap and individual variables such as diabetes mellitus, venous ulcer, smoking, and so forth [19, 20]. In our research, we selected various random independent variables such as patient age, defect aetiology, defect site, patient smoking habit, and diabetes mellitus as a chronic condition. These variables were carefully evaluated to determine if there was any correlation between them and the favourable outcome of the reverse sural artery flap procedure. Subsequently, statistical analysis was conducted to test for any potential associations. No previous literature was found that encompassed all the aforementioned

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variables and their correlation with the favourable outcome of the reverse sural artery flap procedure.

**Conclusion**

The sural flap is a highly efficacious and extensively employed therapeutic modality for addressing cutaneous deficiencies in the lower extremities. As a regional, rotational flap, it can be utilised in cases of post-traumatic, post-operative cutaneous lesions and chronic ulcers located in the vicinity of the ankle and the hindfoot that necessitate dermal coverage. While possessing knowledge and expertise in microsurgery is advantageous, it is not an obligatory requirement. This particular flap can prove beneficial in healthcare environments where access to microsurgical techniques is limited or unavailable. However, the Royal Society of Academic Surgeons emphasises the importance of employing precise surgical techniques. This study serves as a valuable reference for future investigations aiming to elucidate the determinants linked to favourable outcomes of plastic surgery involving reverse sural artery flaps.

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