

Sural and Reverse Sural Flaps in Reconstruction: A Concise Review

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ABSTRACT

Background: Sural-based flaps, including the reverse/distally based sural artery flap (RSAF) and the medial sural artery perforator (MSAP) flap, remain widely used for distal lower-extremity and selected head-and-neck reconstruction due to reliable anatomy and acceptable morbidity.

Methods: A focused narrative review of systematic reviews, pooled analyses, large clinical series, and key anatomic studies was performed to summarize indications, outcomes, risk factors, and technical considerations.

Results: RSAF shows survival rates of approximately 95–97%, with venous congestion and partial necrosis as the most common complications. Smoking, venous insufficiency, advanced age, larger flap size, and heel location increase complication risk, whereas diabetes and peripheral vascular disease are not consistently associated with total flap loss. MSAP flaps provide thin, pliable tissue with low donor-site morbidity and survival rates near 96%. In head-and-neck and lower-extremity reconstruction, MSAP outcomes are comparable to other free flaps, with superior donor-site aesthetics but persistent risk of venous congestion.

Conclusions: RSAF remains a reliable workhorse for distal leg and foot defects, while MSAP offers a versatile perforator alternative with favorable donor-site outcomes when anatomy and expertise allow.

KEYWORDS: Sural flap; Reverse sural artery flap; Distally based sural flap; Medial sural artery perforator flap; MSAP; Lower extremity reconstruction; Foot and ankle defects; Head and neck reconstruction; Perforator flaps; Soft tissue reconstruction

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INTRODUCTION

Sural-based flaps—including the distally based/reverse sural artery flap (RSAF/DBSA) and the medial sural artery perforator (MSAP) flap—remain well-established reconstructive options for distal leg, ankle, and foot defects, as well as selected head-and-neck and extremity reconstructions. Their sustained use reflects a favorable balance of reliability, technical accessibility, and acceptable morbidity across different resource settings (1–3).

Types and Indications

The distally based/reverse sural artery flap is a pedicled fasciocutaneous flap commonly used for coverage of the lower third of the leg, ankle, foot, and heel. It offers a large arc of rotation, avoids microsurgical anastomosis, and remains technically straightforward—particularly valuable when free tissue transfer is not feasible (1,4–6).

The MSAP flap is a thin, pliable perforator flap based on the medial sural artery system. It can be harvested as a free (or selected pedicled) flap and is widely used for oral cavity/head-and-neck reconstruction and for small-to-moderate extremity defects. Advantages include a long pedicle and generally favorable donor-site outcomes (2,3,7–9).

Reverse / Distally Based Sural Flap

Effectiveness and Survival

Systematic reviews and pooled analyses report overall flap survival around 95–97%, with total flap loss approximately 2.5–3.2% and overall complication rates roughly 14–26% (1,10,11). Long-term series similarly demonstrate preservation of ankle motion and high patient-rated satisfaction, with most outcomes graded good or excellent (12).



Figure 1. Reverse sural flap on right foot, to cover raw area on dorsum and lower third

Risk Factors and Complications

Common complications include partial flap necrosis, venous congestion, and marginal edge loss (1,10,13). Smoking is a consistent risk factor, increasing partial flap necrosis to nearly 29% compared with about 12% in non-smokers (1). Older age and venous insufficiency independently increase complication risk, with venous disease associated with markedly higher odds of adverse events (10). Flap size also matters: in osteomyelitis-associated wounds, larger paddles

correlate with increased complications and failure (14). Site-specific outcomes differ as well; heel reconstructions show less favorable long-term survival than ankle/lower-leg sites, which may approach excellent durability in extended follow-up cohorts (15). Notably, diabetes and peripheral vascular disease are not consistently linked to higher total flap loss in pooled data, supporting RSAF as a reasonable salvage option in carefully selected patients with these comorbidities (1,11).



Figure 2. Sural flap on left foot, adequate filling and post-surgical evolution

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Technical Refinements

A range of modifications—such as wider pedicles, adipofascial extensions, venous supercharging, and careful fascial handling—have been proposed to reduce partial necrosis and improve reliability, although comparative

evidence is heterogeneous (4,13). Hemodynamic-focused reviews emphasize preventing pedicle kinking/compression and optimizing venous outflow as key determinants of flap survival (13).



Figure 3. Bruised area on the dorsum of the left foot with bone and tendon exposure secondary to direct trauma.

Medial Sural Artery Perforator (MSAP) Flap

Anatomy and Reliability

Anatomic studies typically demonstrate 1–3 reliable perforators, often located 8–13 cm distal to the popliteal crease, with pedicle lengths approximately 10–16 cm and arterial diameters reported within clinically usable ranges (7–9). Donor-site advantages include thin skin quality, preservation of major axial vessels, frequent primary closure, and generally low morbidity (2,7–9).

Clinical Outcomes

Large clinical series (≈200 consecutive cases) report MSAP survival around 96%, with broad applications across head-and-neck and extremity reconstruction and use of chimeric/dual-paddle variants as needed (7). In head-and-neck reconstruction, systematic reviews suggest MSAP provides comparable recipient-site outcomes to other common free flaps while offering better donor-site

appearance and function, with similar speech and swallowing outcomes (2,3). For lower extremity defects (foot/ankle/knee), MSAP provides durable coverage with favorable functional results (including Enneking-based reporting in some series) and high return-to-work; the main complication remains venous congestion with limited distal necrosis in a subset (9).

Pitfalls and Anatomical Variation

Intra-operative variability in perforator number and position is common; algorithmic strategies recommend readiness to convert to alternative medial/lateral sural or posterior tibial perforators through the same incision if ideal MSAP perforators are absent (16). Practical technical guidance emphasizes meticulous perforator dissection, avoidance of torsion, careful inset, and selective use of monitoring adjuncts such as implantable Dopplers (17).

Table 1. Comparison of Sural-Based Flaps in Reconstruction

Feature	Reverse / Distally Based Sural Artery Flap (RSAF)	Medial Sural Artery Perforator Flap (MSAP)
Flap type	Pedicled fasciocutaneous flap	Free or pedicled perforator flap
Vascular basis	Sural nerve vascular axis with retrograde flow from peroneal perforators	Perforators from the medial sural artery
Typical indications	Distal third leg, ankle, foot, heel defects	Head and neck (oral cavity), small–moderate extremity defects

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Need for microsurgery	No	Yes (free flap in most cases)
Technical complexity	Low–moderate	Moderate–high
Arc of rotation / reach	Wide arc to ankle and foot	Determined by pedicle length and recipient vessels
Tissue characteristics	Moderately thick fasciocutaneous tissue	Thin, pliable skin paddle
Pedicle length	Short to moderate	Long (≈10–16 cm)
Donor-site morbidity	Moderate; skin graft often required	Low; primary closure common
Overall flap survival	~95–97%	~96%
Common complications	Venous congestion, partial flap necrosis	Venous congestion, distal tip necrosis
Key risk factors	Smoking, venous insufficiency, age, flap size, heel location	Perforator variability, venous congestion
Performance in diabetes/PVD	Generally acceptable as salvage option	Limited data; careful selection required
Major advantages	Simple, reliable, no microsurgery, useful in low-resource settings	Excellent tissue quality, low donor-site morbidity, versatility
Main limitations	Venous congestion, aesthetic donor-site issues	Anatomical variability, microsurgical demand

Overall Perspective

Reverse/distally based sural flaps are reliable, technically accessible workhorses for distal leg/ankle/foot reconstruction, particularly where microsurgical resources are limited; outcomes hinge on patient selection (smoking, venous status, age), flap size, site, and venous management. MSAP flaps offer a versatile thin perforator option with excellent donor-site profile for head-and-neck and selected extremity defects; although evidence is largely retrospective, outcomes consistently support high survival and favorable function.

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