

High-Impact Flaps in Reconstructive Plastic Surgery: A Narrative Review

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INTRODUCTION

Modern reconstructive plastic surgery is built upon a limited number of flaps that have demonstrated long-term reliability, anatomical consistency, and reproducible clinical outcomes. These flaps, often regarded as high-impact flaps, are not defined by novelty but by their sustained clinical relevance and ability to address complex defects with predictable results and acceptable donor-site morbidity.¹⁻³

The maturation of reconstructive surgery during the late twentieth century was driven by improved understanding of vascular anatomy and the development of microsurgical techniques. Foundational anatomical studies clarified the concept of axial and perforator-based blood supply, enabling the design of reliable fasciocutaneous, neurocutaneous, and composite flaps.¹⁻² These advances allowed surgeons to expand reconstructive indications while improving functional outcomes.

Among regional options, distally based neurocutaneous flaps provided effective solutions for distal lower-extremity defects without the need for microsurgical anastomosis.¹⁻³ In parallel, free tissue transfer revolutionized reconstruction of complex defects, particularly in skeletal reconstruction, where vascularized bone transfer became the gold standard.⁴⁻⁶ Additionally, thin and pliable fasciocutaneous free flaps and function-specific flaps for weight-bearing areas have played

a critical role in restoring both form and function. This review focuses on high-impact flaps, emphasizing anatomical reliability, clinical effectiveness, and long-term relevance.

Reverse Sural Flap

The reverse sural flap is a distally based neurocutaneous flap widely used for reconstruction of defects of the distal third of the leg, ankle, and foot. Its anatomical basis lies in the vascular axis accompanying superficial sensory nerves, as demonstrated by Masquelet et al., who established the concept of nerve-associated axial vascular supply.¹

Further refinement of the technique identified the superficial sural artery as a reliable source of retrograde perfusion, expanding the flap's arc of rotation and clinical applicability.² Clinical outcome studies demonstrated that the reverse sural flap provides dependable coverage in patients unsuitable for microsurgical reconstruction.³

Despite its advantages, venous congestion remains the most frequent complication. A large complication analysis highlighted that comorbidities such as diabetes and peripheral vascular disease significantly increase the risk of partial flap necrosis.³ Nevertheless, the reverse sural flap remains a high-impact regional option due to its simplicity, reliability, and avoidance of microsurgical anastomosis



Figure 1. Reverse sural flap applied to a raw area on the dorsum of the left foot. For a third-degree burn.

Free Fibular Flap

The free fibular flap represents one of the most significant innovations in reconstructive microsurgery, particularly for reconstruction of segmental bone defects. Hidalgo's landmark publication established the fibula free flap as a reliable method for mandibular reconstruction, demonstrating excellent vascular reliability and functional restoration.⁴ Anatomical and clinical validation confirmed the consistency of the peroneal vascular pedicle and the feasibility of harvesting an osteoseptocutaneous flap suitable for

composite reconstruction.⁵ The fibula provides sufficient bone length, allows osteotomies for three-dimensional shaping, and supports long-term structural stability. Donor-site morbidity, although generally acceptable, is not negligible. A systematic review demonstrated that wound complications and functional sequelae can occur, underscoring the importance of meticulous technique and patient selection.⁶ Despite these considerations, the free fibular flap remains the gold standard for vascularized bone reconstruction.



Figure 2. Free fibular flap. Secondary to a fracture of the right leg with bone exposure and a raw area.

Radial Forearm Free Flap

The radial forearm free flap (RFFF) is a thin, pliable fasciocutaneous flap characterized by a long and reliable vascular pedicle. Its role in intraoral reconstruction was firmly established through large clinical series demonstrating consistent flap survival and excellent contour adaptability.⁷ The favorable tissue characteristics of the RFFF make it particularly suitable for reconstruction of defects requiring

thin, well-vascularized tissue, such as the oral cavity and pharynx. However, donor-site morbidity, including the need for skin grafting and aesthetic concerns, remains a significant limitation.

Despite the emergence of alternative flaps, the radial forearm flap continues to be a high-impact option when precision and tissue pliability are paramount



Figure 3. Radial joint flap of the left hand. Conventional technique.

Anterolateral Thigh Flap

The anterolateral thigh (ALT) flap has become one of the most versatile flaps in reconstructive surgery due to its reliable vascular anatomy, long pedicle, and ability to harvest large skin paddles. Large clinical series have demonstrated its consistent survival and adaptability across multiple anatomical regions.⁸

The ALT flap offers reduced donor-site morbidity compared with other free flaps and can be tailored through thinning techniques to meet contour requirements. Its versatility and safety profile have established it as a workhorse flap in contemporary reconstructive practice.



Figure 4. ALT flap plus TAIC in the donor area.

Medial Plantar Flap

Reconstruction of weight-bearing plantar defects requires tissue capable of withstanding shear forces and repetitive loading. The medial plantar flap provides durable glabrous skin closely resembling native plantar tissue, making it particularly suitable for heel reconstruction.⁹

Clinical series have demonstrated high flap survival rates and satisfactory functional outcomes, reinforcing the importance of biomechanical compatibility in reconstructive success.⁹ The medial plantar flap remains a high-impact, function-specific reconstructive option for plantar defects



Figure 5. Mid-plantar flap of the right foot.

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Table 1. Comparison of High-Impact Flaps in Reconstructive Plastic Surgery

Flap	Tissue Components	Vascular Basis	Typical Indications	Key Advantages	Main Limitations	Donor-Site Morbidity
Reverse sural flap	Fasciocutaneous / neurocutaneous	Superficial sural artery, nerve-based vascular axis	Distal third of leg, ankle, foot defects	No microsurgery required; reliable regional option; short operative time	Venous congestion; limited size; less suitable in severe vasculopathy	Sensory deficit in sural nerve territory; visible donor scar
Free fibular flap	Vascularized bone ± skin	Peroneal artery and venae comitantes	Segmental bone defects (mandible, long bones)	Long bicortical bone segment; allows osteotomies; high reliability	Technically demanding; longer operative time	Potential wound issues, ankle instability, sensory changes
Radial forearm free flap	Thin fasciocutaneous flap	Radial artery	Oral cavity, pharynx, hand defects	Thin, pliable tissue; long pedicle; consistent anatomy	Donor-site aesthetics; requires skin graft	Visible forearm scar; tendon exposure risk
Anterolateral thigh (ALT) flap	Fasciocutaneous ± muscle	Descending branch of lateral circumflex femoral artery	Large soft-tissue defects (head & neck, trunk, extremities)	Large skin paddle; long pedicle; low donor morbidity	Variable perforator anatomy; flap thickness in obese patients	Usually minimal; well concealed donor site
Medial plantar (instep) flap	Glabrous fasciocutaneous flap	Medial plantar artery	Weight-bearing plantar and heel defects	Durable, sensate, biomechanically compatible tissue	Limited flap size; technical precision required	Donor-site grafting; potential plantar discomfort

CONCLUSION

High-impact flaps form the foundation of modern reconstructive plastic surgery. The reverse sural flap, free fibular flap, radial forearm free flap, anterolateral thigh flap, and medial plantar flap each address distinct reconstructive challenges with proven anatomical reliability and clinical effectiveness. When supported by robust, verifiable evidence, these flaps continue to represent essential tools in contemporary reconstructive practice.

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