

Restoring the Crown: Modern Strategies in Scalp Reconstruction

Jesús Insúa Pohls¹, Evelyn Gabriela Murillo Valdez², André Alessandro Madrid Perdomo³, José Emiliano Hernández Jaramillo⁴, Daniel Herrera Hernández⁴, Isabel Leticia Ríos Chagoya⁵, Axel Roberto Rosas Alemán⁶

¹Hospital General Regional No. 1, Ciudad Obregón, Sonora, México.

²Hospital Regional “Dr. Manuel Cárdenas de la Vega”, ISSSTE, Culiacán, Sinaloa, México.

³Hospital Centro Médico Tuxpam, Veracruz, México.

⁴Hospital de Especialidades Centro Médico Nacional La Raza, Ciudad de México, México. (ORCID: <https://orcid.org/0000-0002-7631-9814>),

⁵Hospital Rural IMSS-Bienestar No. 66, Santiago Juxtlahuaca, Oaxaca, México.

⁶Universidad Autónoma de Sinaloa, Culiacán, Sinaloa, México.

ABSTRACT

Scalp surgery encompasses a range of procedures performed for functional and cosmetic purposes, most commonly involving the excision of malignant tumors and the subsequent reconstruction of acquired defects. The unique anatomic challenges of the scalp, including its dense vascularity, limited tissue mobility, and proximity to the calvarium, necessitate a meticulous and tailored approach. The choice of reconstructive technique is dictated by defect characteristics, with options spanning primary closure, local flaps, skin grafts, dermal regeneration templates, and free tissue transfer for the most complex cases. Multidisciplinary collaboration is often critical, particularly for defects with cranial involvement requiring concurrent cranioplasty. Key considerations for success include the preservation of neurovascular structures, maintenance of natural hair orientation, and careful preoperative planning to minimize complications. This review outlines the fundamental principles and algorithmic approach to scalp surgery, emphasizing the importance of selecting the appropriate reconstructive strategy to achieve optimal oncologic, functional, and aesthetic outcomes.

KEYWORDS: Right Ventricular Dysfunction, Acute Myocardial Infarction, Ventricular Interdependence, Right Coronary Artery Occlusion, Cardiogenic Shock, Percutaneous Coronary Intervention, Speckle-Tracking Echocardiography, Prognosis.

ARTICLE DETAILS

Published On:
23 October 2025

Available on:
<https://ijmscrs.com/>

INTRODUCTION

Scalp surgery refers to operative procedures performed on the scalp for functional or cosmetic purposes, most commonly involving excision of lesions (such as skin malignancies), trauma repair, or reconstruction following oncologic resection, radiation injury, or other causes of tissue loss. The scalp presents unique surgical challenges due to its distinct anatomy, including dense vascularity, hair-bearing skin, limited tissue mobility, and proximity to the calvarium and neurovascular structures.[1-2]

The spectrum of scalp surgery encompasses:

1. Excisional Procedures: Removal of benign or malignant lesions, often requiring careful planning to achieve clear margins while preserving function and cosmesis.[3-5]
2. Reconstructive Techniques: After excision or trauma, reconstruction is tailored to defect size, depth, location, and involvement of underlying structures. Options include:
 - Primary closure for small defects with adequate tissue laxity.[2-3]
 - Local flaps (advancement, rotation, transposition) for moderate defects, leveraging adjacent scalp tissue.[2-3][6]
 - Split-thickness or full-thickness skin grafts for superficial defects, especially when local tissue is insufficient.[3][6-7]

Restoring the Crown: Modern Strategies in Scalp Reconstruction

- Free tissue transfer (e.g., latissimus dorsi muscle flap) for large, deep, or previously irradiated defects, or when calvarial or dural involvement is present.[4-6]
 - Use of dermal regeneration templates (e.g., Integra) as temporary or permanent coverage in select cases.[5][7]
 - Cranioplasty (using titanium mesh or methylmethacrylate) when bone resection is required due to tumor invasion.[4-5]
3. Specialized Flap Harvesting: The temporoparietal fascial flap and pericranial flap are frequently used for skull base and

scalp reconstruction, with their anatomical independence allowing for versatile application.[8]

Key considerations in scalp surgery include preservation of neurovascular structures, maintenance of hair orientation for optimal cosmetic outcomes, and minimizing complications such as wound dehiscence, infection, or flap/graft loss.[1-2] Multidisciplinary collaboration is often necessary, especially for extensive defects involving the calvarium or dura, to optimize both oncologic and reconstructive outcomes.[4-5]



Figure 1. Left frontoparietal scalp + complete lesion of frontal and parietal muscle, size approximately 15x10 cm, frontoparietal muscle and fasciocutaneous flap, left inferolateral base, irregular edges, exposure of frontal bone, frontal and parietal muscle and subcutaneous cellular tissue, presence of clots without active bleeding.



Figure 2. Skin flap 1 cm above the left eyebrow with lesions measuring approximately 2 mm at the tail of the eyebrow, base of the flap measuring 3 cm lateral to the left eyebrow bone, irregular edges, partial skin loss, exposure of the frontal and parietal muscles, exposure of the frontal bone, fascia and subcutaneous tissue, clots are observed without active bleeding.



Figure 3. Skin grafting of the frontoparietal flap with simple "5-0 nylon" stitches is observed, with the presence of dermoabrasion in the left frontal region of approximately 5x8 cm, upper left eyelid edema, without bloody area.

The most common indications for scalp surgery in clinical practice are the excision of malignant and benign tumors, reconstruction following oncologic resection, management of traumatic injuries, and treatment of congenital or acquired lesions such as vascular anomalies and scar alopecia. The medical literature consistently identifies malignant scalp tumors—primarily basal cell carcinoma, squamous cell carcinoma, and melanoma—as the leading indication for surgical intervention, often requiring wide local excision and subsequent reconstruction due to the high risk of sun exposure and the anatomical challenges of the scalp.[1-5]

Reconstruction after oncologic resection is a frequent indication, with the choice of technique (primary closure, local flaps, skin grafts, or free tissue transfer) determined by

defect size, depth, and involvement of underlying structures.[1-2][4-5] Scalp surgery is also indicated for the management of benign lesions such as cysts, nevi, and vascular anomalies (e.g., infantile hemangiomas), particularly when these lesions are symptomatic, disfiguring, or complicated by ulceration or bleeding.[5-6]

Traumatic injuries, including lacerations, avulsions, and defects following craniotomy or decompressive procedures for traumatic brain injury, represent another important indication, with surgical goals focused on restoring soft tissue coverage and protecting the calvarium.[5][7] Additionally, surgery may be required for chronic wounds, scar alopecia, or defects resulting from prior surgery or radiation.[5]

Reconstructive Options for Scalp Defects

Reconstructive Technique	Ideal For Defect Size/Type	Key Advantages	Key Considerations / Potential Drawbacks
Primary Closure	Small, simple defects with adequate tissue laxity.	Simplest method, single-stage procedure, excellent color and texture match.	Limited by scalp inelasticity. Risk of tension causing widening scars or alopecia.
Local Flaps (Rotation, Advancement, Transposition)	Moderate-sized defects, deeper lesions with exposed pericranium.	Provides like-tissue with good color, texture, and hair-bearing potential. Reliable vascularity.	Requires extensive undermining. Complex planning to disguise scars and manage hair direction. Risk of tip necrosis or dehiscence under tension.
Skin Grafts (Split- or Full-Thickness)	Large, superficial defects with a well-vascularized wound bed (e.g., intact pericranium).	Technically simple, quick, good for covering large surface areas.	Poor color and texture match. Lack of hair growth. Unstable on bone without periosteum. Susceptible to contraction.
Tissue Expansion	Large defects where adjacent hair-bearing scalp is preferred for reconstruction.	Provides the best aesthetic match for large areas of alopecia with hair-bearing tissue.	Requires two stages and multiple office visits. Temporary cosmetic deformity from expander. Risk of expander exposure or infection.
Free Tissue Transfer (Free Flap)	Largest, most complex defects: composite tissue loss, irradiated wounds, exposed dura or hardware.	Brings robust, independent blood supply and bulk to fill dead space and cover vital structures.	Most complex procedure requiring microsurgical expertise and longer operating time. Donor site morbidity.
Dermal Regeneration Templates (e.g., Integra®)	Full-thickness defects where a graft bed needs to be created or a flap is not feasible.	Creates a neodermis for improved graft take, even on cortical bone. Can protect vital structures.	Requires two stages weeks apart. Higher cost. Risk of infection or template loss.

CONCLUSION

In summary, scalp surgery represents a complex and highly specialized field that demands a thorough understanding of the region's unique anatomic and biomechanical properties. The primary goal extends beyond mere defect closure to achieving optimal functional and aesthetic outcomes, which necessitates a meticulous, patient-tailored approach. The choice of reconstructive technique—ranging from primary closure and local flaps to skin grafts and free tissue transfer—is critically dependent on a comprehensive assessment of the defect's size, depth, location, and involvement of underlying structures.

The management of malignancies remains the most common indication, underscoring the importance of achieving oncologic clearance while planning for subsequent reconstruction. The successful execution of these procedures often hinges on multidisciplinary collaboration, particularly for complex cases involving the calvarium or dura. Ultimately, the principles of preserving neurovascular integrity, respecting hair orientation, and selecting the most appropriate reconstructive algorithm are paramount to minimizing complications and ensuring patient satisfaction. As techniques and materials continue to evolve, the core tenets of careful preoperative planning and adherence to surgical anatomy will continue to form the foundation of successful scalp surgery.

REFERENCES

- I. Seery GE. Scalp surgery: anatomic and biomechanical considerations. *Dermatol Surg.* 2001;27(9):827-834. doi:10.1046/j.1524-4725.2001.00350.x
- II. Leedy JE, Janis JE, Rohrich RJ. Reconstruction of acquired scalp defects: an algorithmic approach. *Plast Reconstr Surg.* 2005;116(4):54e-72e. doi:10.1097/01.prs.0000179188.25019.6c
- III. Rysz M, Grzelecki D, Mazurek M, Starościak S, Krajewski R. Surgical techniques for closure of a scalp defect after resection of skin malignancy. *Dermatol Surg.* 2017;43(5):715-723. doi:10.1097/DSS.0000000000001067
- IV. Huntoon KM, Mayer RR, Fahim DK, et al. Malignant primary tumors of scalp with cranial extension: multidisciplinary surgical strategies and outcomes. *J Neurosurg.* 2024;140(4):979-986. doi:10.3171/2023.7.JNS23974
- V. Lo Bue E, Paracampo C, Dolci L, et al. Surgical management of cutaneous carcinomas invading the scalp: a case series and proposal of a therapeutical algorithm. *World Neurosurg.* 2025;198:123964. doi:10.1016/j.wneu.2025.123964
- VI. Steiner D, Hubertus A, Arkudas A, et al. Scalp reconstruction: a 10-year retrospective study. *J Craniomaxillofac Surg.* 2017;45(2):319-324. doi:10.1016/j.jcms.2016.11.023
- VII. Harirah M, Sanniec K, Yates T, Harirah O, Thornton JF. Scalp reconstruction after Mohs cancer excision: lessons learned from more than 900 consecutive cases. *Plast Reconstr Surg.* 2021;147(5):1165-1175. doi:10.1097/PRS.00000000000007884
- VIII. Vinciguerra A, Taboni S, Bettini P, et al. Surgical anatomy of the scalp: technical hints for harvesting the temporoparietal fascial and pericranial flap. *Head Neck.* 2025. doi:10.1002/hed.28161