



Research Paper

Emergency Scalp Reconstruction Using Transposition Flaps: A Case Series of 12 Patients

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Abstract

Introduction: Extensive scalp defects, particularly those with bony exposure, represent a surgical emergency requiring rapid and reliable coverage. The parieto-temporal transposition flap is a simple, safe and effective technique for this type of reconstruction.

Patients and methods: We report a series of 12 patients undergoing emergency surgery between January 2021 and January 2023. The main indications were post-traumatic defects (7 cases), post-infectious necrosis of the surgical site (4 cases) and deep burns (1 case). All patients received a parieto-temporal transposition flap. A skin graft of varying thickness was used to cover the donor site in 11 cases, and directed wound healing was used in 1 case.

Results: The mean age was 51 years (8 women, 4 men). The average time to management was 2.5 days for trauma-related defects and 15 days for post-infectious defects after appropriate debridement and antibiotic therapy. Two patients developed suture dehiscence requiring revision surgery, and one patient developed venous congestion of the flap, which resolved with appropriate dressings. No complete flap loss or secondary infection was observed. Average follow-up was 12 months, with favorable results.

Conclusion: The parieto-temporal transposition flap is a simple, rapid and reliable option for emergency coverage of scalp defects with bone exposure. It reduces infectious complications and achieves good aesthetic results.

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I. Introduction

The human scalp is a specialised skin structure, characterised by its thickness, rich vascularisation and multilayered composition with tightly adherent tissues. These characteristics give it a crucial role in protecting the cranial vault and underlying intracranial structures [1,2]. Its anatomical configuration - thick skin, inelastic fascial galea, convex contour and limited mobility - makes reconstruction particularly difficult, especially in cases of significant tissue loss [1,4].

Scalp malformations can arise from a variety of causes, including acute trauma, deep burns, tumor resections, complicated postoperative infections or certain congenital malformations [1,2,3,6]. Without appropriate management, these lesions expose the patient to a high risk of deep infection, osteomyelitis calvaria and serious neurological complications such as meningitis or brain abscess [2].

Reconstruction techniques vary according to the size and location of the loss of substance, the condition of the pericranium, the presence or absence of hair in the area to be covered, the quality of the graft bed and the patient's general condition [2,3]. Limited loss of substance can sometimes be managed by primary closure or skin grafting when the pericranium is intact, whereas larger defects - particularly those with bone or dural exposure - require coverage with well-vascularized tissue [1,3,4].

Historically, several strategies have been described, ranging from the use of local transposition or rotation flaps to more complex techniques such as tissue expansion or free microvascular transfers [5,6]. However, in emergency reconstruction, local flaps - particularly transposition flaps - are often the first-line solution. They provide rapid, reliable coverage, ensuring immediate protection of the skull while maintaining satisfactory aesthetic quality thanks to good texture and capillary compatibility [1,2,3,4].

In this work, we report on our experience in the emergency management of twelve scalp substance losses by transposition flap, highlighting the indications, operative technique and results obtained.

II. Patients and Methods

This retrospective study was conducted in the Plastic and Reconstructive Surgery Department of CHU IBN SINA in Rabat over a two-year period, from January 2021 to January 2023. Twelve patients with scalp abnormalities were included. The study population comprised eight women and four men, with an average age of 51 years (ranging from 28 to 74 years).

The main indications for reconstruction were :

- Post-traumatic scalp defects with bone exposure in 7 cases (58.3%);
- Skin necrosis following surgical site infection (SSI) after neurosurgical or dermatological procedures in 4 cases (33.3%);
- Deep scalp burn complicated by calvarial exposure in 1 case (8.3%).

For patients with trauma-related defects, the average delay between the initial event and surgical management was 2.5 days, allowing rapid management to reduce the risk of secondary infection. For skin necrosis due to SSI, the average delay was 15 days, corresponding to the time required for sequential debridement to obtain healthy tissue and initiation of appropriate antibiotic therapy based on bacteriological cultures.

All patients were reconstructed with a parieto-temporal transposition flap, pedicled on the superficial temporal artery, chosen for its anatomical reliability and ease of dissection. Flap planning was adapted to the location and size of the defect, with preoperative landmarks carefully designed to respect the hairline and ensure a harmonious aesthetic result.

Dissection was performed in the subgaleal plane, preserving the vascular pedicle and ensuring flap viability prior to transposition. The donor site was managed in most cases (11 patients) with a split-thickness, meshed skin graft harvested from the anterior thigh. One patient, whose donor site was smaller and suitable for directed healing, did not require grafting.

Patients benefited from regular postoperative follow-up, including appropriate dressings, monitoring of flap viability and evaluation of early and late complications. Aesthetic satisfaction was assessed at follow-up visits at 1, 3 and 6 months, and at the end of an average follow-up period of 12 months.

III. Results

Postoperative results were generally straightforward and satisfactory. Of all patients treated, two presented with partial suture dehiscence, requiring early surgical revision for additional flap mobilization and suture repair, with no impact on flap viability or final results.

One patient presented with partial venous congestion of the flap, characterized by edema and moderate congestion in the immediate postoperative period. This complication was managed conservatively with heparin-soaked dressings and close monitoring, resulting in a favorable outcome without extensive necrosis. No patient developed compressive hematoma, secondary infection or total flap loss.

After an average follow-up of 12 months (range 6-18 months), all patients showed complete and stable healing, with no evidence of recurrent dehiscence or chronic ulceration. The aesthetic quality of the coverage was judged satisfactory by both the medical team and the patients, particularly with regard to flap integration and hair restoration.

In cases of larger defects, the grafted donor site showed complete graft uptake without major complication, and no secondary re-intervention was required with the exception of minor scar revision. No significant scarring alopecia was reported, and patients expressed general satisfaction with the durability and aesthetic appearance of the reconstruction.



Figure 1. Appearance of skin necrosis due to postoperative infection following surgical approach



Figure 2. The transposition flap on postoperative day 6



Figure 3. Third-degree scalp burn



Figure 4. Postoperative transposition flap with meshed split-thickness skin graft at the donor site

IV. Discussion

Reconstruction of scalp defects remains one of the major challenges in plastic and reconstructive surgery. From historic techniques, such as trepanning the outer table to promote granulation, to current advances in microsurgery enabling free tissue transfer, the management of these defects has evolved in parallel with the development of the specialty [1,5]. Today, the challenge is not only to cover the exposed calvarium, but also to restore the hair-bearing tissues and hairline to achieve an optimal aesthetic result [5,6].

Reconstruction of scalp defects, whether resulting from oncological resection, trauma or postoperative infectious complications, remains one of the most technically and aesthetically challenging aspects of plastic and reconstructive surgery [1,2,3]. The key to success lies in adhering to the fundamental principle of homogeneous tissue substitution, using tissues of similar thickness and pile quality to achieve robust, stable and aesthetically pleasing coverage [1,3].

Historically, various techniques have been proposed to cover these defects: primary closure, skin grafts, local or regional flaps, remote pedicled flaps and free microvascular transfers [1]. Direct closure remains the preferred solution for small defects (often less than 5 cm²) when skin laxity is sufficient, offering a simple and immediately feasible approach in emergency situations. For larger defects (5-30 cm²) with calvarial or dural exposure, local or regional flaps are considered the standard for providing reliable coverage, protecting underlying structures and restoring satisfactory aesthetic continuity; these flaps are also well suited to emergency situations with controlled morbidity [1,2].

The choice of technique is based on a thorough analysis of the size and location of the defect, as well as the quality of the surrounding tissue, previous treatments (such as irradiation or repeated surgery) and the patient's general condition [1,2,3,6]. Several algorithms have been described in the literature to guide decision-making, incorporating functional and aesthetic parameters such as hairline, tissue laxity and the precise topography of the defect [1,2,4].

Secondary intention, although the first step on the reconstructive ladder, is rarely preferred for large scalp defects and is generally not an optimal solution in emergency situations, except for patients unfit for surgery [4]. It can be considered when the periosteum is preserved, allowing progressive granulation. However, the prolonged healing time, risk of osteomyelitis and often poor aesthetic results (scarring alopecia, telangiectasias) limit its use. The use of vacuum-assisted closure (VAC) systems can improve granulation bed quality by promoting debridement, stimulating vascularization and reducing bacterial load [4].

Primary closure, on the other hand, should be considered whenever technically possible, particularly for defects less than 3 cm in diameter [4]. It has the advantage of being immediately feasible in an emergency situation, provided that skin laxity is sufficient. It often requires significant subgaleal detachment to mobilize sufficient tissue. Tension must be borne by the galea to preserve superficial hair follicles and minimize the risk of alopecia [4].

When direct closure is not possible, **skin grafting** - total or fractionated - remains a reliable alternative, provided the recipient bed is well vascularized or a granulation bed has been previously established; however, the absence of periosteum or the presence of a cranial implant limits its immediate use in emergency situations [4,6]. The use of biomaterials, such as dermal matrices like Integra®, can be useful when the periosteum is absent or the bed compromised, but this requires a preparation period and does not always meet the requirements of immediate coverage in emergency situations [4,6].

Local and regional flaps remain the preferred option for small to medium-sized scalp defects, mainly due to their ability to provide tissue of similar characteristics and preserve hair quality [1,2,3,5]. Their planning requires a detailed understanding of the vascular anatomy of the scalp, which is supplied by supratrochlear, supraorbital, superficial temporal, postauricular and occipital branches [3]. These techniques are particularly well-suited to rapid and effective implementation in emergency situations, making them the cornerstone of immediate management.

In our series, the parieto-temporal transposition flap proved to be a relevant choice for the rapid management of medium to large defects, due to its simplicity of design, vascular reliability and adaptation to aesthetic constraints [1,4]. It has proved particularly effective for emergency coverage of defects with calvarial or dural exposure, offering a rapid, reproducible and aesthetically satisfactory solution with reduced operative time [1,2,3].

In cases of larger defects (>50 cm²) or poor-quality tissues (due to radiotherapy or chronic infection), **tissue expansion** and **free flaps** become necessary to restore sufficient skin volume and functional coverage [3,4,6]. Although tissue expansion can provide an optimal aesthetic outcome, it is not applicable in emergency situations, as it requires a protocol lasting several weeks [4]. Conversely, free flap transfer (such as latissimus dorsi or anterolateral thigh flaps) is technically feasible in emergency settings but requires an experienced team and dedicated microsurgical resources, which may limit its immediate availability in certain contexts [4,5,6].

Despite the complexity of these procedures, our experience confirms that major complications are rare and do not compromise flap viability. Minor issues, such as suture dehiscence, distal venous congestion, or partial graft loss at the donor site, can be effectively managed with appropriate care or minor secondary revisions [1,2,3,4]. Residual cicatricial alopecia can be corrected later by tissue expansion, depending on the patient's wishes [5].

In conclusion, the choice of scalp reconstruction technique should remain pragmatic, balancing effectiveness, emergency feasibility, and the quality of the aesthetic outcome. In this regard, a well-planned and well-executed local transposition flap remains a reference solution for emergency coverage of extensive scalp defects, while other options should be adapted according to the clinical context and available resources.

V. Conclusion

Scalp defect reconstruction must combine effectiveness, feasibility in emergency settings, and a satisfactory aesthetic outcome. When the calvarium or dura mater is exposed, these defects constitute a surgical emergency requiring prompt and reliable reconstruction to prevent severe infectious complications and to restore the protective function and aesthetics of the scalp. Our experience confirms that the parieto-temporal transposition

flap is an excellent option for effectively covering small to medium-sized defects in an acute context, thanks to its robust vascular supply, technical simplicity, and the high-quality tissue coverage it provides.

When local conditions allow, primary closure and local flaps remain the preferred techniques for limited defects in emergency situations, while skin grafts or biomaterials can serve as temporary solutions when the graft bed is suitable. For larger defects, free microvascular transfer offers reliable coverage but requires specialized resources and may not always be immediately available in emergencies. Tissue expansion should be reserved for delayed reconstructions to optimize the final aesthetic result.

In summary, the choice of technique should be guided by defect size, the quality of available tissues, the patient's general condition, and the urgency of coverage, always favoring a pragmatic, reproducible approach tailored to the resources of each center. The parieto-temporal transposition flap, as a rapid and effective solution, remains a key tool in the reconstructive arsenal for scalp defects.

Acknowledgments and Conflicts of Interest

The authors declare that they have no conflicts of interest and that they received no specific funding for this study.

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