

## **TITLE PAGE**

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The Reverse Galeal Hinge Flap: Another Valuable Technique in the Repair of Scalp Defects Extending to the Calvarium

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## **The Reverse Galeal Hinge Flap: Another Valuable Technique in the Repair of Scalp Defects Extending to the Calvarium**

Over the last 30 years, the estimated incidence of nonmelanoma skin cancer (NMSC) has increased from 300,000 to greater than 2 million cases. Approximately 15% of these cancers occur on the scalp.<sup>1</sup> Given the increasing incidence of NMSC and their predilection for the scalp, the demand for scalp repairs will continue to rise. It is important that the dermatologic surgeon is equipped to manage these cases, in particular defects that extend to the bone.

The repair of large scalp defects extending to the calvarium is especially challenging for several reasons. The primary closure of any large scalp wound is complicated by the relative inelasticity of scalp tissue and the convexity of the scalp. Rotation flaps are the mainstay technique of re-approximating large scalp wounds, but are often unable to completely close very large defects.<sup>2</sup> Skin grafts can also be used to cover wounds primarily or in conjunction with other closure techniques.<sup>2</sup> However, when scalp defects extend to the bone, the poor vascularity of the osseous tissue severely limits both skin grafting and xenografting. Various approaches to making exposed bone more suitable for grafting have been described in the recent literature and these techniques and their limitations will be briefly discussed.<sup>3-5</sup> We will also present two cases that outline a simple method of reestablishing a vascular bed on exposed bone utilizing a reverse galeal hinge flap.

## **Case series**

### **Patient 1**

Patient 1 was a 62-year old male who presented with a well-circumscribed 3.5 x 3.5 cm crateriform plaque on the vertex of the scalp. Shave biopsy showed squamous cell carcinoma (SCC) extending to the base and the patient was referred for Mohs micrographic surgery. The lesion was completely excised in two stages with perineural invasion identified on the first stage only. The resulting defect size was 4.0 x 3.8 cm with approximately 1.0 x 0.8 cm of exposed bone at the center.

A vascular bed was needed on the exposed bone so we decided to use a galeal hinge flap similar to the one introduced by Halpern et al.<sup>3</sup>, but modified so that the galea could be more easily accessed. The original galeal hinge flap was performed by separating the subcutaneous tissue and galea from above, bisecting the galea, and then hinging it over the defect. In our modification of this technique, we accessed the galea from below and then reverse-hinged it over the defect (Figure 1).

The initial steps—marking, anesthesia, incision, subgaleal undermining, and flap elevation—were the same as for a unilateral rotation flap. This allowed for recruitment of a larger flap than other methods such as a rectangular flap created using two parallel incisions. Once access was established, the galea aponeurotica was identified from the underside of the flap, sized to cover the exposed bone, and sharply bisected towards the wound, leaving the edge most proximal to the defect still attached (Figure 1). This newly

freed layer was hinged over to resurface the exposed bone and sutured to the ostium's surrounding tissue (Figure 2). The galeal flap only needed to be large enough to completely cover the exposed bone and it was not dependent on any major arterial vessel. However, care should be taken to limit tension on the flap in order to preserve the inherent vascular supply of the galea.

The secondary wound was then closed in standard fashion. Purse string sutures were not required because the ostium was completely covered by the flap. Finally, a porcine xenograft was cut to the size of the primary defect and sutured into place using 5-0 fast-gut (Figure 2).

Following a period of 48 hours, the patient was instructed to clean the wound and apply petrolatum daily until the wound was completely healed. Follow-up was done at 1 week, 1 month, and then monthly thereafter. The wound was re-epithelialized by 2 months and completely healed by 5 months (Figure 3).

## **Patient 2**

Patient 2 was a 77-year old male with a poorly defined 1.5 x 1.5 cm ulcerated plaque on the vertex that, on shave biopsy, also proved to be SCC extending to the base. The patient was referred for Mohs micrographic surgery and the lesion was completely excised in one stage. The resultant defect size was 1.9 x 1.9 cm and closed with a primary repair that was under significant tension despite wide undermining in the subgaleal plane. His post-op course was complicated by a *Staphylococcus aureus* infection with wound

dehiscence to the calvarium. Given the patient's scalp inelasticity and prior complications with a primary repair, we decided to attempt a repair utilizing the reverse galeal hinge flap.

This patient's defect was smaller and slightly left of center so we decided to access a smaller flap from the right. Otherwise, the procedure and follow-up instructions were the same as noted above for Patient 1. As seen in the follow-up image at 4 months (Figure 4), this wound also healed quickly and without further complications.

In summary, similar to the galeal hinge flap introduced by Halpern et al.<sup>3</sup>, our modified galeal hinge flap utilizes bisected galea aponeurotica to reestablish a vascular bed on osseous tissue that can be used for xenografting and possibly skin grafting. Both techniques can be performed under local anesthesia and accomplished in a single stage.

## **Discussion**

Reconstructing large scalp defects with exposed bone is a unique challenge for the dermatologic surgeon and the recent literature reflects several different approaches to this problem. These techniques can all be performed in a single-stage procedure, but they are of varying complexity.

Barry et al.<sup>4</sup> fenestrated the bone to access the diploic blood supply and allow for healing by second intention. This technique had excellent results, but was more involved, requiring the additional use of surgical bone drills and sedation for patient comfort.

Hussain et al.<sup>5</sup> resurfaced the bone with galeal/periosteal flaps to support a split-thickness skin graft, but this required the creation of multiple flaps to accomplish the repair.

Halpern et al.<sup>3</sup> introduced a galeal hinge flap to resurface the bone, but accessing the galea through the wound seemed more technically challenging and limited the size of the flap. As a result, purse string sutures were often required to decrease the size of the wound and allow the ostium to be completely covered. We commend Halpern et al.<sup>3</sup> for their novel and effective technique and, building on their work, offer a slightly modified method of gaining greater access to the galea. Our technique allows the creation of a larger galeal flap that is technically easier to perform and may be more widely utilized.

Our cases show that the modified galeal hinge flap can, in a single session under local anesthesia, create an appropriate bed to promote second intention healing with xenograft assistance. We found standard infiltration with 1% lidocaine and epinephrine (1:200,000) effective for anesthesia and limiting blood loss, though tumescent anesthesia with a diluted formulation can be considered to decrease the total dose used. Based on the success Halpern et al.<sup>3</sup> had with full-thickness skin grafts, we hypothesize that our reverse hinge flap—composed of the same tissue—could similarly support full- or split-thickness skin grafts as well. We acknowledge that this method would need to be used on several more cases to address its reliability. Additionally, we utilized porcine xenografts in our cases, but full- or split-thickness skin grafts should also be evaluated for cases requiring decreased healing time.

In conclusion, the modified galeal hinge flap is a technically simple way to create a vascular bed on exposed bone so that a xenograft or possibly a skin graft can be placed. This is a useful method to repair deep scalp defects with exposed bone in a single session under local anesthesia.

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**Figure 1.** Illustration of the reverse galeal hinge flap. After subgaleal undermining, a flap is elevated to allow the galea to be bisected towards the defect from below. Note: Figure 1 is an original illustration by Diana Pino at the U.S. Navy Bureau of Medicine and Surgery's Visual Information Directorate and we thank them for their efforts.

**Figure 2.** Patient 1: The bisected galea aponeurotica is reverse-hinged to cover the ostium and sutured to the ostium's surrounding tissue. Secondary wound is then closed and a porcine xenograft sutured over the primary defect.

**Figure 3.** Patient 1: Initial defect with exposed periosteum. Wound is completely healed at the 5-month follow-up visit.

**Figure 4. A.** Patient 2: Initial defect that extended to the calvarium. Wound is completely healed at the 4-month follow-up visit.