Double-Opposing Rotation-Advancement Flaps for Closure of Forehead Defects

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Objective: To describe a local flap for closure of forehead defects of all sizes that does not alter the brow position or hairline.

Methods: Retrospective review of 16 cases in which the double-opposing rotation-advancement flaps were used for closure of small (<10 cm²), medium (10-20 cm²), and large (>20 cm²) forehead defects. This technique was developed from Orticochea’s method for closure of large scalp wounds.

Results: All 16 patients underwent single-stage closure of forehead defects using our design. Six patients were men, 8 were women (mean age, 71 years). Preoperative defect sizes ranged from 3 to 30 cm² (mean, 18 cm²). All wounds resulted from Mohs surgery for cutaneous malignant neoplasms; 2 were adjacent to previous reconstructions. No recurrence of tumor was seen during the study period. No permanent frontal branch injuries occurred. One patient developed a moderate cellulitis. Photographic analysis showed that brow position and hairline contour were maintained in all cases.

Conclusions: The double-opposing rotation-advancement flap closure is a versatile reconstructive option for small, medium, and large forehead defects. The technique involves elevation of opposing, asymmetric flaps, with subsequent rotation of one side and advancement of the contralateral side. Single-stage closure may be accomplished without unappealing changes to the brow position or hairline.

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CLOSURE OF SURGICAL OR traumatic defects of the forehead offers several challenges to the reconstructive surgeon. First, the forehead skin is relatively thick and has limited mobility. Second, the forehead is bounded by 2 important facial landmarks that, if altered, cause an obvious visual flaw: the brow and the hairline. For smaller wounds, reconstruction typically consists of horizontally or vertically oriented linear closures. In cases nearer to the brow, an “O” to “T” flap is frequently used. In the temple region, however, there may be insufficient laxity, or the distance from the temporal tuft to the lateral brow may be unintentionally decreased.

Larger wounds require greater attention and creativity. A variety of well-conceived repairs have been described for the scalp but are infrequently applicable outside of the vertex and especially in the forehead. Among the best designs, the 3-flap and 4-flap techniques of Orticochea figure prominently. These flaps are unsuitable for forehead repair, however, because both the incision length and closure would cause significant distortion of the brow and hairline.

Herein, we describe a modification of the 3-flap technique of Orticochea as applied specifically to closure of forehead defects. We present a series of 16 patients who underwent surgery over a 4-year period in a busy Mohs referral practice. Using double-opposing rotation-advancement flaps, it is possible to close defects of 3 to 30 cm² on the forehead in a single stage, without undesirable changes in the brow position or hairline.

METHODS

A retrospective review of Mohs micrographic surgery defect repairs was undertaken. We identified 16 cases of forehead closures using the flap design described. All cases were performed between 2007 and 2011 by the senior author (A.A.J.) at a facial plastic surgery private practice and ambulatory surgery center. Procedures were performed using local anesthesia. Standard aesthetic photography was used preoperatively and postoperatively.

The double-opposing rotation-advancement (“modified Orticochea”) closure was developed from the 3-flap initially described in 1971. Our flap design omits the third limb of the incision and raises only 2 local flaps rather than 3. This modification makes the technique more suitable to forehead closure, given the smaller tissue bed relative to the vertex and the difficulty of incision camouflage in the non-hair-bearing forehead skin.

The incisions are planned in a fashion similar to the initial steps of the Orticochea 3-flap...
procedure: a line is drawn from the superior aspect of the defect toward the vertex (away from the brow or temporal hair tuft) at approximately 60° to 75° from a tangent drawn at that point on the curvilinear defect margin (Figure 1 A). The length of this limb is determined by the diameter of the defect and the patient-specific mobility of the forehead and anterior scalp soft-tissue envelope; typically, these are equivalent. This vertical line may be placed slightly off center, toward the side with more available non–hair-bearing skin for improved rotation.

A second line is drawn roughly parallel to the tangent at the origin of the first line, with a gentle curve toward the defect on either side. This makes a sort of capital “T” with a slightly curved crossbar. The length of the second line is roughly equivalent to the first line but can be lengthened conservatively during the procedure if more flap movement is needed.

Bilateral flaps are raised in a subgaleal plane for large defects or a subcutaneous plane for smaller defects and in the region of the frontal branch of the facial nerve laterally. These flaps are random but are pedicled on a wide base. The flap elevated on the acute side of the angle formed by the first line and the defect margin is rotated into the primary defect (Figure 1B). The contralateral flap is then advanced into the secondary defect, behind the rotation flap (Figure 1C). Sutting begins with a deep layer, including bites of fascia or deep dermis, using absorbable polyfilament (eg, Vicryl; Ethicon). Generally the rotation flap is approximated first, though in cases with relatively high tension, it may be helpful to begin with closure of the secondary defect. In addition, the tissue superior to the “T” created by the incisions should be undermined and may be advanced inferiorto limit tension on the repair. In cases of higher tension, galeotomies distal to the crossbar of the “T” may be used.

Once the primary and secondary defects are closed, a second layer of sutures is placed in the epidermis using a nonabsorbable monofilament (eg, nylon or Prolene; Ethicon). A standing cone deformity is typically present at the inferior edge of the design on the side of the rotation flap; this is resected as needed as a final step in the closure. An effort is made to re-move this excess in an aesthetic manner, eg, along the brow margin, hairline, or contiguous with a deep rhytid. In a minority of patients, there will be a small residual defect. Luckily, small wounds of the forehead and scalp heal very well by secondary intention. The tissue excess removed at the standing cone can be used as a Burrow graft in rare cases.

The double-opposing rotation-advancement closure was used for medium and large defects (typically in the central forehead) and for smaller defects (typically in the temple region, lateral to the brow and in front of the temporal tuft). In all locations, the key to the success of this closure technique is the maintenance of vertical skin height. This is accomplished by “stacking” flaps in a rotation-advancement arrangement (much like a cleft lip repair). Finally, an attempt is made during flap design to place the resulting incisions parallel to the forehead rhytids in the midline and radially in the temple region.

Table. Summary of 16 Forehead Defects

<table>
<thead>
<tr>
<th>Defect Size, cm²</th>
<th>Temple Region</th>
<th>Mid-Forehead</th>
<th>Hairline</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;20 (Large)</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>10-20 (Medium)</td>
<td>0</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>&lt;10 (Small)</td>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

OVERALL OUTCOMES

Sixteen patients underwent double-opposing rotation-advancement flaps for closure of forehead wounds resulting from Mohs micrographic surgery for nonmelanoma cutaneous malignant neoplasm. Six patients were men, while 8 were women; the average patient age was 71 years. Defect size ranged from 3 to 30 cm², with a mean area of 18 cm². All repairs were completed in a single stage (Table). Two patients with large initial defects had small residual defects (smaller than 2 cm²) that were allowed to granulate. A Burrow graft was used in 1 patient. No tumor recurrence was noted during the study period. No permanent frontal branch injuries occurred. One patient developed a moderate cellulitis, with cultures demonstrating methicillin-resistant Staphylococcus aureus. This was treated with local wound care and a 2-week course of trimethoprim-sulfamethoxazole (Bactrim DS; Hoffman-La Roche Inc).

Scar results were good to excellent in all cases. Two patients required injection of triamcinolone, 10 mg/mL (Kenalog; Bristol-Myers Squibb) for flap edema and mild thickening of a portion of the resulting scar. One patient requested scar revision, which was performed with resection and resewing of a 4-cm length of 1 flap edge. Aesthetic photographic analysis demonstrated that the brow position and hairline were not altered in any case.
ILLUSTRATIVE CASES

Case 1

A 52-year-old woman had a 3 × 2-cm left lateral forehead-temple region defect (6 cm²) resulting from Mohs resection of a basal cell carcinoma (BCC) (Figure 2A). Unfortunately, this was immediately adjacent to a previous “O” to “T” repair above the mid-portion of the brow, limiting reconstructive options. The double-opposing rotation-advancement flaps were raised in a subcutaneous plane to protect the frontal branch of the facial nerve (Figure 2B). The 4-month postoperative result is shown in Figure 2C and demonstrates preservation of the preoperative distance between the temporal hair tuft and lateral brow.

Case 2

A 34-year-old man had a 4 × 4-cm central forehead-glabellar defect (16 cm²) following Mohs surgery for a BCC (Figure 3A). The double-opposing rotation-advancement flaps were raised in a subgaleal plane. A standing cone deformity was removed at the inferior border along the right medial club head of the brow toward the glabella. Follow-up at 3 months showed a well-healed scar with even brow height bilaterally (Figure 3B).

Case 3

An 86-year old woman had a 6 × 5-cm defect of the left lateral forehead (30 cm²) along the anterior hairline (Figure 4A). The double-opposing rotation-advancement flaps were raised in a subgaleal plane. Generous undermining was performed and multiple parallel galeotomies were made distal to the advancement and rotation flaps in addition to superior to the second incision (toward the vertex scalp). Closure of the defect required a small Burrey graft (1 × 2 cm), which was barely perceptible 6 weeks postoperatively in the midforehead at approximately the left midpupillary line (Figure 4B). Note that the position and contour of the hairline are not altered in the postoperative photograph.

COMMENT

Closure of facial defects requires creative solutions taking advantage of the unique tissue characteristics of each

Figure 2. Illustrative case. A, Small (<10 cm²) defect in the lateral forehead-temple region. B, Closure was accomplished with double-opposing rotation-advancement flaps developed in a subcutaneous plane to protect the frontal branch. C, Result 4 months postoperatively demonstrates preservation of skin between the temporal hair tuft and lateral brow.

Figure 3. Illustrative case. A, Medium-sized (10-20 cm²) defect in the central forehead and glabella. Closure was accomplished with double-opposing rotation-advancement flaps developed in a subgaleal plane. B, Result 3 months postoperatively confirms even brow height.
The forehead is particularly problematic—the skin envelope is relatively tight; it is bounded on all sides by hair-bearing structures; and nonideal results easily capture the eye of a viewer. Many local flap repairs have been described for this area, and there are good options among them. Unfortunately, there are cases when the standard options do not yield the best results, such as large forehead defects, lateral temple region defects, and defects near the medial club head of the brow. This is particularly true in patients who have had previous Mohs reconstruction in the forehead, as was the case in 2 of our patients.

In this series, we present a versatile local flap closure for forehead reconstructions of all sizes. This flap was inspired by and developed from a scalp reconstruction technique originally described by Orticochea. In his original design, Orticochea used 3 widely pedicled random flaps—2 for advancement and the third (typically based on the occipital scalp or upper neck) for rotation. Interestingly, different sources have presented the Orticochea 3-flap design in divergent configurations, leaving some uncertainty as to its actual execution. Our design eliminates the third flap and converts the first 2 flaps to a rotation and an advancement configuration.

The key element of our modified Orticochea flap is the stacking of 2 opposing flaps using the rotation-advancement paradigm. This allows the reconstructive surgeon to maintain vertical height adjacent to key landmarks and subunit borders. In the forehead, this is especially important given the multiple transitions between hair-bearing and non–hair-bearing skin. This advantage applies to smaller defects as well, such as in the skin between the lateral part of the eyebrow and the temporal hair tuft or sideburn. Finally, the double-opposing rotation-advancement flaps may be raised in different planes, depending on the size and location of the defect. For larger defects, particularly in the central forehead and anterior hairline, a subgaleal plane is ideal. On the contrary, in the lateral forehead, a subcutaneous plane is required to protect the frontal branch of the facial nerve.

In conclusion, the double-opposing rotation-advancement closure can be used to close small, medium, and large defects of the forehead. Repair is accomplished in a single stage without alterations in the brow position or the hairline, even in the lateral temple region. This technique, derived from a more extensive scalp reconstruction, is an important addition to the reconstructive armamentarium.

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REFERENCES