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John R. Craig

Henry Ford Health, JCraig1@hfhs.org

Robert H. Deeb

Henry Ford Health, Rdeeb1@hfhs.org

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How I Do It

Reconstruction of Anterior Table Frontal Sinus Defects with Pericranial Flap and Titanium Mesh

John R. Craig, MD ; Robert H. Deeb, MD 

INTRODUCTION

While a wide variety of frontal sinus pathologies can be addressed through endoscopic approaches, external approaches are required for some conditions such as certain fractures, tumors, encephaloceles, or select cases of recalcitrant frontal sinusitis. External frontal sinus approaches most commonly include trephination, osteoplastic flap, or cranialization. In each of these approaches, the anterior table of the frontal sinus is preserved, and therefore, frontal contour is generally maintained.

In some situations, frontal sinus pathology necessitates removal of the anterior table.¹ This technique can be quite disfiguring as it results in a significant frontal bone defect and resultant forehead depression. The anterior table defect poses a reconstructive challenge and very few publications have described reconstructive options. For reconstruction, one must consider not only frontal contour restoration, but also the frontal sinus's functionality. There are different biologic or synthetic materials available to restore frontal contour, and the decision on material type is based, in part, on whether one plans to obliterate the frontal sinus or maintain sinus function. To maintain frontal sinus function, surgeons must consider performing Draf IIA/B or III frontal sinusotomies to maintain sinus outflow patency and establish sinus wall linings that support mucosalization to ensure functional mucociliary clearance.

Various materials are available to repair the contour defect associated with anterior table resection, including autologous calvarial bone, titanium mesh, porous polyethylene, methlymethacrylate, and plastic polymers.² Pericranial flaps have been utilized for frontal sinus obliteration,³ but they have not been described for establishing the inner lining of the anterior wall of the frontal sinuses after

anterior table resection. This article describes a viable technique for reconstructing large anterior table defects using a pericranial flap to reline the anterior sinus wall and a titanium mesh to restore frontal contour while preserving a functional frontal sinus.

MATERIALS AND METHODS

A representative case is presented of a 42-year-old male patient with a grade 4 frontal sinus osteoma causing diplopia due to right orbital extension of the tumor (Fig. 1). Institutional review board approval was obtained and consent was obtained from the patient. First, bilateral endoscopic sinus surgery with Draf III frontal sinusotomy was performed. Next, a coronal incision was made to access the anterior table of the frontal sinus, and a pericranial flap was harvested and preserved for later use (Fig. 2A). The osteoma was completely resected and the involved anterior table was removed, resulting in a 4 x 6 cm² anterior table defect.

Reconstruction commenced by first covering the anterior table defect with the pericranial flap to create a new anterior sinus wall inner lining. Next, a 0.3-mm thickness titanium mesh was contoured and placed over the pericranial flap and secured with screws to recreate the patient's preoperative frontal contour (Fig. 2B). Silastic sheet stents were placed in the Draf III cavity to line both the anterior and posterior aspects of the cavity to prevent stenosis of the Draf III frontal outflow tract. Stents were removed 1 month postoperatively. Figure 3 shows diagrammatically on a sagittal computed tomography scan the layers of anterior table reconstruction, as well as the effect of the Draf III frontal sinusotomy in maintaining patency and function of the frontal sinus.

RESULTS

Figure 4 shows pictures of the patient preoperatively and 8 months postoperatively, demonstrating both improved right eye position after tumor resection, and excellent frontal contouring after reconstruction. On nasal endoscopy, his frontal outflow tract was widely patent, all the walls of the frontal sinus appeared mucosalized, and there was no evidence of edema, crusting, or mucopurulence (Fig. 5). Supporting Video 1 illustrates the key points of the operative technique used to reconstruct the patient's large anterior table defect, as well as the aesthetic and functional outcomes.

From the Department of Otolaryngology, Henry Ford Hospital, Detroit, Michigan, U.S.A.

Additional supporting information may be found in the online version of this article.

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Send correspondence to John Craig, M.D. Henry Ford Hospital, 2799 W Grand Blvd, Detroit, MI 48202. E-mail: jcraig1@hfhs.org

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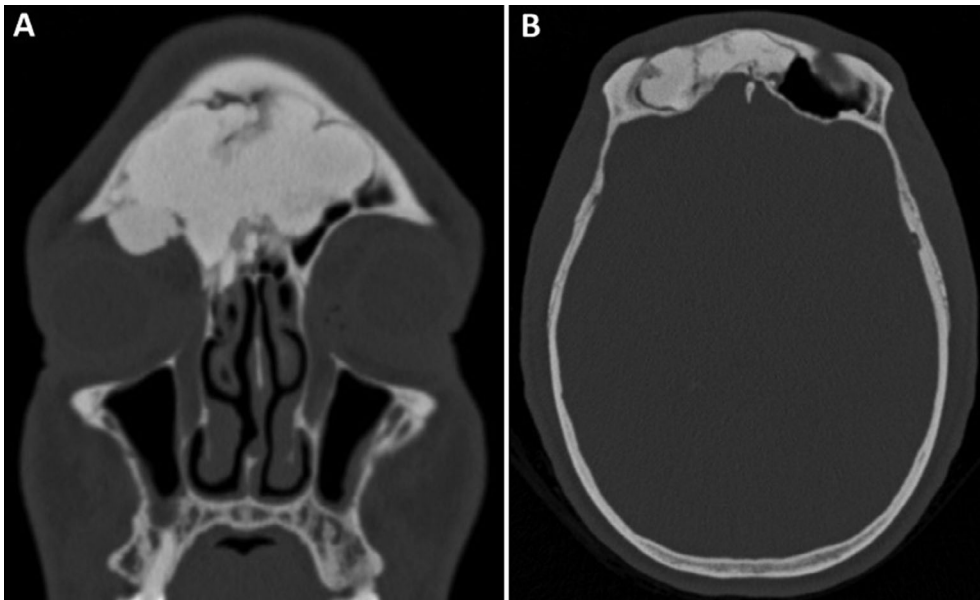


Fig. 1. Coronal A, and axial B, computed tomography scans demonstrating a grade 4 frontal sinus osteoma with extension into the right orbit. The tumor involved a significant amount of the anterior table, which had to be removed and reconstructed.

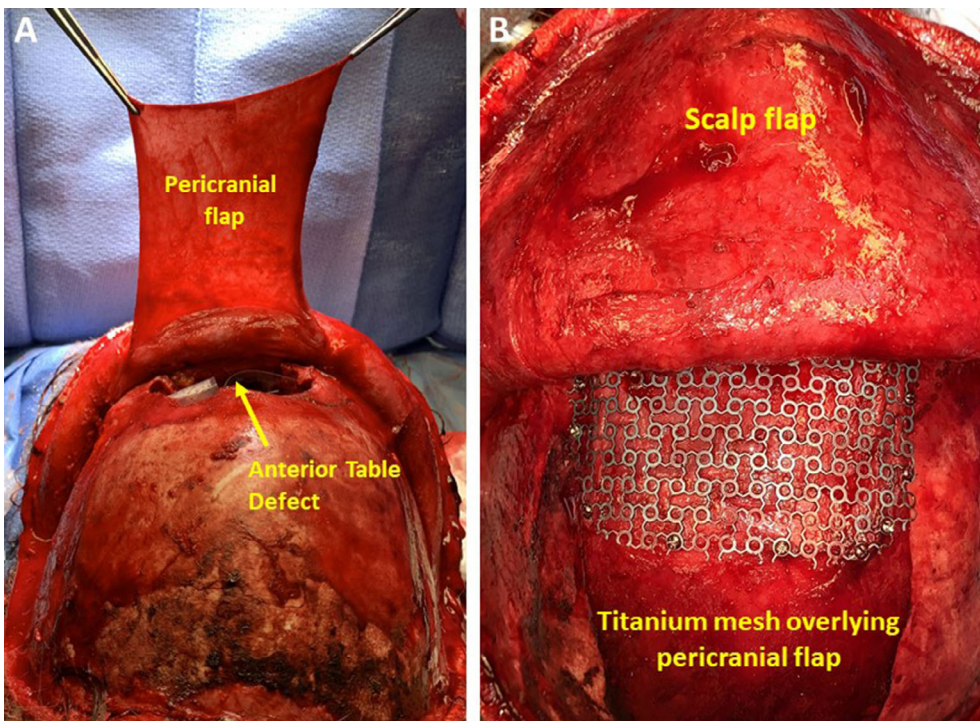


Fig. 2. Intraoperative images after the coronal approach and the osteoma had been resected along with much of the anterior table of the frontal sinus. A, Pericranial flap was harvested to place over the large anterior table bony defect as the inner lining, then B, a titanium mesh was contoured and secured with multiple screws over the pericranial flap to restore the patient's frontal contour. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

DISCUSSION

Some frontal sinus pathologies require external approaches for optimal outcomes,⁴ and when disease

involves the anterior table, resection of the anterior table may be necessary. At the conclusion of these cases, one must decide whether to obliterate the frontal sinus or

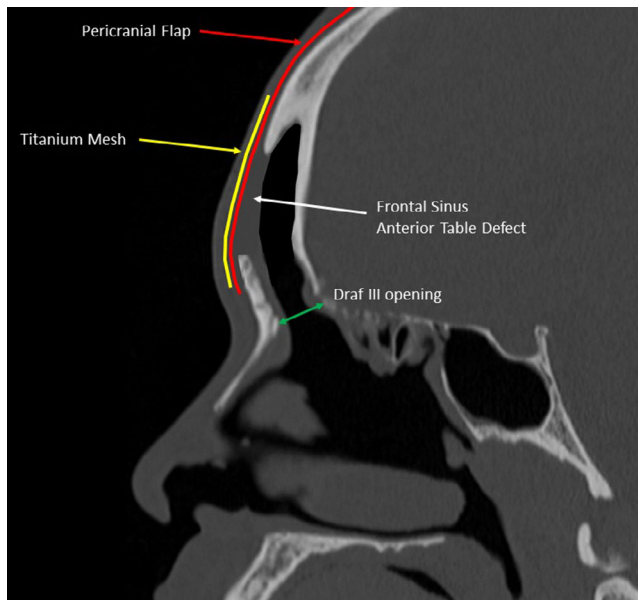


Fig. 3. Postoperative sagittal sinus computed tomography scan with annotated diagrammatic representation of the two-layer reconstruction of the large frontal sinus anterior table defect. The pericranial flap is first laid over the bony defect to establish the new inner lining of the anterior wall of the frontal sinus (red line). Then a titanium mesh is placed over the pericranial flap and secured to the edges of the bony defect, to establish a rigid frontal contour. The frontal sinus is also aerated and, therefore, functional with a wide frontal outflow tract created by a Draf III frontal sinusotomy (green arrow). [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

maintain its function. Frontal sinus obliteration renders the sinus non-functional and brings risks of infection

and mucocele,⁴ so frontal sinus preservation should be pursued when feasible. While techniques have been described to reconstruct anterior table defects,^{2, 5} very few studies have discussed the need to re-establish an inner lining across the defect to preserve frontal sinus function.

After anterior table resection, if titanium mesh or synthetic grafts are used alone to reconstruct the defect without a biologic inner lining, the exposed portions of those materials could prevent remucosalization and promote scar formation or infection, which could lead to a non-functional sinus. The pericranial flap is an ideal option for reconstructing the frontal sinus's inner lining to promote sinus functionality. It is well-vascularized, pliable, and easily harvested during the coronal approach. In addition, contour restoration is still possible by contouring and securing a titanium mesh over the pericranial flap. Lastly, Draf IIA/B or III frontal sinusotomies should be performed to optimize sinus outflow patency.

One limitation of this article was the lack of long-term follow-up. It is possible for a forehead contour defect to develop outside of 8 months postoperatively, and therefore, ongoing evaluations are necessary. In addition, while the Draf III cavity was widely patent at 8 months, there could be further partial stenosis of the cavity over time. Therefore, patients who undergo these types of procedures require long-term monitoring of both their functional and aesthetic outcomes.

In conclusion, after resection of the anterior table of the frontal sinus, the anterior table defect can be repaired with a pericranial flap and titanium mesh to achieve both frontal contour restoration and frontal sinus preservation.

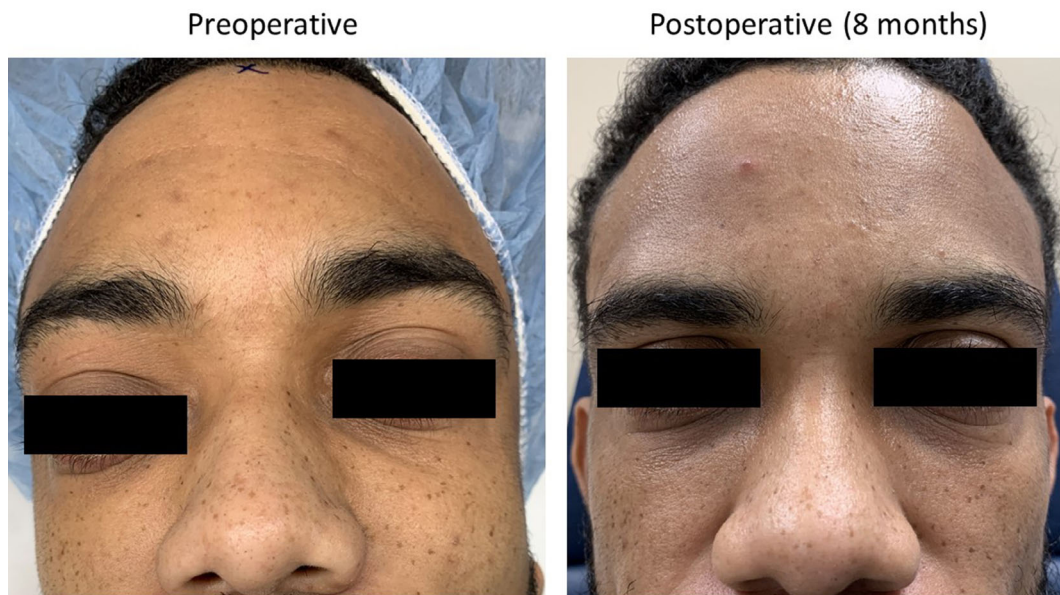


Fig. 4. Preoperative A, and postoperative B, frontal views demonstrating that the patient's frontal contour was preserved after the extensive osteoma resection and anterior table reconstruction with the pericranial flap and titanium mesh. Permission for use was obtained from the patient. [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

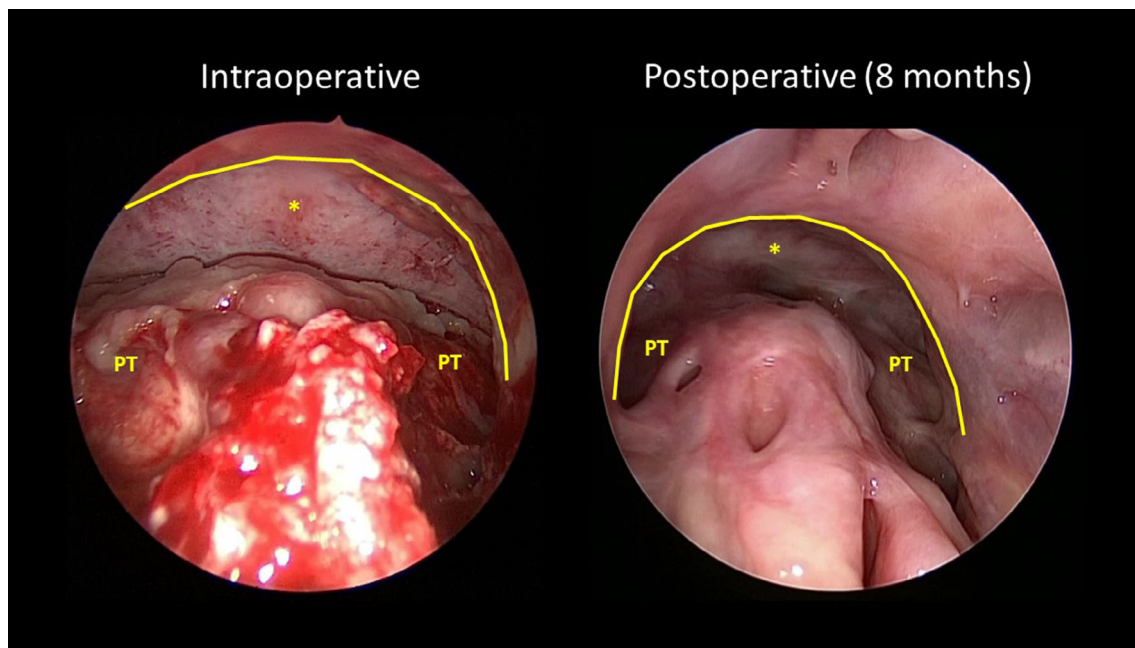


Fig. 5. Endoscopic images with a 70° scope of the Draf III cavity intraoperatively and 8 months postoperatively. The nasofrontal beak (yellow line) represents the anterior boundary of the Draf III, and the posterior table (PT) of the frontal sinus represents the posterior boundary. Note that the anterior table of the frontal sinus is formed by the undersurface of the pericranial flap intraoperatively (yellow asterisk), and is nicely mucosalized 8 months postoperatively (yellow asterisk). [Color figure can be viewed in the online issue, which is available at www.laryngoscope.com.]

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