Published in final edited form as:

Int Forum Allergy Rhinol. 2014 July ; 4(7): 583–586. doi:10.1002/alr.21329.

Swing Technique for Middle Turbinate Preservation in Expanded Endonasal Skull Base Approaches

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Keywords

endoscopic skull base surgery; endoscopic orbital surgery; middle turbinate; orbital apex; orbit

Introduction

Endoscopic approaches to the skull base have rapidly gained acceptance and popularity as surgeons have become increasingly comfortable with the endoscopic anatomy, developed specialized instrumentation, and gained experience with expanded surgical techniques¹. As team experience has progressed, so have the complexity of disease processes and anatomic locations approached with endoscopes. Two-surgeon approaches to the skull base and orbital apex have become commonplace at many institutions with the combination of a Neurosurgeon and Rhinologist, and potentially an Oculoplastic surgeon. The two-surgeon binostril approach to complex diseases of the middle fossa and orbit are often augmented by trans-septal approaches, and have benefitted from middle turbinate sacrifice to assist in visualization. The willingness to sacrifice the middle turbinate in such procedures contradicts traditional teaching in endoscopic sinus surgery², and if our true goal is the “minimally-invasive” approach, we should strive to maintain the middle turbinate whenever possible.

Anatomy/Physiology

The middle turbinate develops embryologically from the second ethmoturbinal and functions as a valuable surgical landmark for endoscopic orientation. The middle turbinate is critical for several physiologic functions related to nasal airflow, humidification and conditioning of inspired air, and sensory function including olfaction. Nasal breathing is a complex phenomenon influenced by the turbinates, which affect nasal airflow and the subjective sensation of obstruction during the normal nasal cycle^{3–5}. Additionally, the nasal turbinates serve to warm and humidify inspired air⁶. Olfaction is another major physiologic function influenced by the middle turbinate. Olfactory epithelium, consisting of

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Financial Disclosures: None

Potential conflicts of interest: None

IRB approved (COMIRB 11-1442)

pseudostratified columnar neuroepithelium, is typically located in the cleft between the septum, middle and superior turbinates⁷. Olfactory epithelium has been found to reside on the anterior aspect of the middle turbinate⁸, and although redundancy in the system is expected, unnecessary sacrifice of this tissue is best avoided.

Case Illustration and Surgical Technique

A 43 year-old woman presented with intermittent blurred vision and periorbital headache on the left side. Clinical examination demonstrated 20/20 visual acuity and normal intraocular pressure, but was remarkable for optic disc pallor and trace afferent papillary defect. A CT was obtained showing a 3.3×1.4 cm enhancing lesion at the orbital apex [Figure 1]. Given the location of the lesion and expected vascularity, surgery was planned utilizing a two-surgeon, four-handed binostril technique with a transseptal approach. The anticipated goals for surgery were biopsy for pathologic analysis, decompression, and debulking versus complete resection.

Under general anesthesia, the nasal cavity preparation and room setup is similar to routine endoscopic sinus surgery. The maxillary, ethmoid, and sphenoid sinuses are thoroughly dissected as in functional endoscopic sinus surgery. The basal lamella of the middle turbinate is traversed, leaving the vertical and horizontal attachment intact, with blood supply originating from the anterior ethmoid and sphenopalatine arteries. If necessary, a transseptal approach or septal dislocation procedure can be performed for additional access^{9, 10}. The vertical attachment of the middle turbinate in the parasagittal plane is sharply incised, and the turbinate is released from the skull base [Figures 2A,B]. The middle turbinate is left pedicled to the lateral nasal wall, displaced inferiorly in the nasal cavity, and protected with a cottonoid [Figures 2C,D], preserving the blood supply from the sphenopalatine branch to the middle turbinate. The required skull base or orbital procedure is completed (a nasoseptal flap can be utilized if needed), and the middle turbinate is then retrieved and lifted to its native position. The cut edges are reapproximated and the middle turbinate is stabilized in this location by suture fixation to the septum [Video]; it is not necessary to thoroughly suture the turbinate back to its original attachment although this can be done if care is taken to avoid trauma to the lateral lamella of the cribriform plate. Routine postoperative care is recommended as indicated, which includes topical saline sprays and/or rinses.

In this case, decompression and subtotal resection was performed; pathology demonstrated an orbital paraganglioma. The postoperative appearance at 12 months shows the endoscopic appearance, with mild scarring of the middle turbinate. Its position in the nasal cavity is maintained, preserving its role for nasal airflow [Figure 3]. The patient had no nasal complaints at 12-month followup visit.

Discussion

Transnasal endoscopic approaches for the treatment of skull base and orbital apex pathology provide improved visualization and decreased morbidity in comparison to traditional open approaches¹. With this technique, the middle turbinate is often resected to improve access,

however, the associated morbidity may not be trivial as the middle turbinate is known to serve valuable anatomic and physiologic functions²⁻⁴. Biopsy of the medial aspect of the preserved middle turbinate indicates a return to histologic normalcy, including the potential for trigeminal innervation and olfactory regeneration, and continued research could help restore functionality to such regenerated olfactory neurons [Figure 4].

In an era where improving access and decreasing morbidity appear paramount, we describe a technique to offer similar access while potentially preserving the anatomy and function of the middle turbinate. At this point, these considerations are anecdotal, but may be borne out in fairly simple prospective study. Preservation of the middle turbinate is technically straightforward and may result in less morbidity when accessing the sphenoid and orbital apex. In the case described, middle turbinate preservation was easily performed and did not negatively influence visualization or instrument mobility during the procedure, while offering a long-term maintenance of nasal airflow conditioning and the potential for olfactory regeneration. In addition to preserving the potential functions of the middle turbinate, placement in its native position did not negatively impact postoperative surveillance of the site of pathology, as routine nasal endoscopy can be easily performed.

Conclusion

Preservation of the middle turbinate in endoscopic transsphenoidal and orbital apex approaches utilizing the described technique is technically simple, and may help maintain airflow conditioning and allow for olfactory regeneration. The ambition for expanding minimally invasive transnasal approaches to skull base and orbital pathology should also aspire to preserve intranasal structures whenever feasible.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Axial cut Computed Tomography image showing a 3.3×1.4 cm enhancing lesion at the orbital apex.

Figure 2.

The parasagittal (vertical) attachment of the middle turbinate is sharply released from the skull base [A,B], and gently displaced inferiorly while preserving the lateral blood supply from the sphenopalatine artery branch [C,D]. Upon completion of the procedure, the middle turbinate is sutured back into its native position.

Figure 3. One-year postoperative endoscopic view of the left nasal cavity demonstrates mild scarring of the middle turbinate. Its position in the nasal cavity is maintained, preserving its role for nasal airflow.

Figure 4.

Biopsy of the medial aspect of the middle turbinate from the patient in Figures 1 and 3 at one-year postoperatively. Tuj1+ (marker for immature neurons) neurons (red arrow) are present, indicating a potential for olfactory regeneration. Axons are seen on the right.