Seeing the Light: Endoscopic Endonasal Transorbital Tumor Surgery

Kibwei A. McKinney, M.D.[1] Carl H. Snyderman, M.D. [2, 3] Ricardo L. Carrau, M.D. [2, 3] Anand V. Germanwala, M.D.[4] Daniel Prevedello, M.D. [3] Tonya Stefko, M.D.[5] Paul Gardner, M.D. [3] Amin B. Kassam, M.D. [2, 3] Adam M. Zanation, M.D.[1]

Department of Otolaryngology – Head & Neck Surgery, University of North Carolina – Chapel Hill[1] Department of Otolaryngology – Head and Neck Surgery, University of Pittsburgh Medical Center[2] Department of Neurological Surgery, University of Pittsburgh Medical Center [3] Department of Neurological Surgery, University of North Carolina –Chapel Hill[4] Department of Ophthalmology, University of Pittsburgh Medical Center[5]

ABSTRACT

Objectives:
1. Describe the anatomic principles, technical nuances and limitations of Expanded Endoscopic Approaches (EEAs) to primary orbital tumors.
2. Define three anatomic corridors for endoscopic endonasal intraorbital tumor surgery.

Methods:
Outcome data of the first 15 patients who underwent EEAs for primary orbital tumors at two tertiary care hospitals between 2007 and 2009. This study characterizes the anatomic principles to be considered when attempting an EEA, describes the advantages of EEAs over standard external approaches, and highlights the potential pitfalls and sequelae associated with the use of these measures.

Results:
Three options currently exist for endoscopic endonasal intraorbital tumor surgery: 1. a medial and inferior approach for extraconal lesions, 2. a transmaxillary approach for lateral extraconal lesions, and 3. a medial intraconal approach with displacement of the medial rectus muscle and intraconal dissection between the inferior and medial rectus muscles. The intraconal approach is limited by the location of the tumor in relation to the optic nerve; lesions that are located in the infero-medial quadrant are ideal. No optic nerve injuries occurred in 15 endoscopic transorbital tumor resections. The series of orbital tumor resections include hemangiomas, lymphangiomas, Allergic Fungal Sinusitis (AFS), meningiomas, schwannomas, osseous tumors and Juvenile Nasopharyngeal Angiofibromas (JNAs).

Conclusion:
Endoscopic endonasal transorbital approaches to orbital tumor requires understanding of complex orbital and skull base anatomy; however, this is a safe and viable option for select orbital lesions.

CONTACT

Adam M. Zanation, MD
Department of Otolaryngology – Head & Neck Surgery
University of North Carolina – Chapel Hill
P: 919-966-3342
F: 919-933-7941
Email: adam_zanation@med.unc.edu

INTRODUCTION

Tumors that involve the orbit can be classified into two major groups: primary tumors of the orbit and tumors of other subsites that extend into the orbit (e.g. sinonasal carcinoma). The most frequent primary orbital tumors include lymphoid tumors, cavernous hemangiomas, meningiomas (in adults), and dermoid cysts, capillary hemangiomas, and rhabdomyosarcoma (in children) (1).

External approaches to the orbit are well established, including the lateral, medial and inferior orbitotomy. The orbitozygomatic craniotomy can be utilized for tumors that extend both intra-cranially and into the orbit and is used for exposure of the optic nerve and canal. Endoscopic endonasal orbital and optic nerve decompressions have become accepted treatments for thyroid eye disease and traumatic optic neuropathy unresponsive to steroids. A few case reports of endoscopic decompression, biopsy and resection of tumors that involve the orbit have also been reported (3-12). The expanded endonasal approach (EEA) has been extended to resection of all types of skull base tumors including intradural posterior, middle and anterior fossa masses (13, 14). In this report, we describe the anatomic principles, technical nuances and limitations of our first 16 EEA approaches to primary orbital tumors. We also define three anatomic corridors for endoscopic endonasal intraorbital tumor surgery: 1. a medial and inferior approach for extraconal lesions 2. a transmaxillary approach for lateral extraconal lesions, 3. a medial intraconal approach with displacement of the medial rectus muscle and intraconal dissection between the inferior and medial rectus muscles.

METHODS AND MATERIALS

We retrospectively reviewed the clinical and surgical outcome data of the first 16 patients who underwent expanded endonasal approaches for primary orbital tumors at the University of North Carolina – Chapel Hill and the University of Pittsburgh Departments of Otolaryngology – Head and Neck Surgery. Orbital decompressions, optic nerve decompressions, resections of sinonasal tumors (such as inverted papilloma or esthesioneuroblastoma) that involved the orbit, and approaches to intradural tumors (such as petroclival meningiomas) that involved the orbit were all excluded as nonprimary orbital tumor approaches. Two patients without a primary orbital tumor (illustrated in Case 3) were included because they underwent an entirely separate surgical procedure to remove the remaining portion of a tumor from the orbit and, thus, defined an additional transmaxillary corridor for approaching the orbit.

RESULTS

The characteristics of our entire patient cohort are summarized in Table I. The Medial/Inferior Extraconal Approach was performed most frequently, on 7/15 (47%) patients. The Medial/Inferior Intraconal Approach was the second most-utilized procedure, performed on 6/15 (40%) of our cohort. The Lateral Transmaxillary approach was used more sparingly (1/15) and was indicated only in complex cases in which the mass was uniquely localized or violated the anatomic barriers of the orbit.

Through these approaches, we were successful in achieving total resection in 10 of the 15 patients (67%). This result was confirmed by post-operative imaging as well as through serial examinations following surgery. Although subtotal resection was performed in 4/15 patients, all but one of these (orbital metastasis, Patient #14) achieved complete resolution of symptoms.

N	Pathology	Pre-Operative Clinical Findings	Approach Type	Resection	Post-Operative Outcomes
1	JNA (Case 3)	None	Lateral/Inferior Transmaxillary	Total	N/A
2	JNA	None	Medial Extraconal	Total	N/A
3	Fungus Ball	20/400, Abducens (CN VI) Palsy	Medial Extraconal With Optic Nerve Decompression	Total	20/25; CNVI Palsy→50% Improvement At 2 months Post-Op
4	Ossifying Fibroma (Case 4)	Proptosis	Medial Extraconal/ Medial Intraconal	Total	Resolved
5	Meningioma	Proptosis	Medial Extraconal	Partial	Resolved
6	Lymphangioma	None	Medial Intraconal	Biopsy	N/A
7	Meningioma (Case 1)	Decreased color vision, 20/80	Medial Extraconal	Total	Color Vision Resolved To Baseline 20/40
8	Orbital Metastasis	Proptosis/Pain	Medial Intraconal	Partial	Resolved
9	Hemangioma (Case 2)	20/60	Medial Intraconal	Total	20/30
10	Hemangioma	Proptosis	Medial Intraconal	Total	Resolved
11	Schwannoma	Proptosis	Medial Intraconal	Total	Resolved
12	Meningioma	Proptosis	Medial Extraconal	Partial	Resolved
13	Schwannoma	Pain With Lateral Gaze	Medial Extraconal	Total	Resolved
14	Orbital Metastasis	Proptosis/Pain	Medial Extraconal	Partial/Biopsy	Decreased Pain and Proptosis; Incomplete Resolution
15	Glioma	Proptosis	Medial Intraconal	Total	Resolved

Table 1. Patient Characteristics

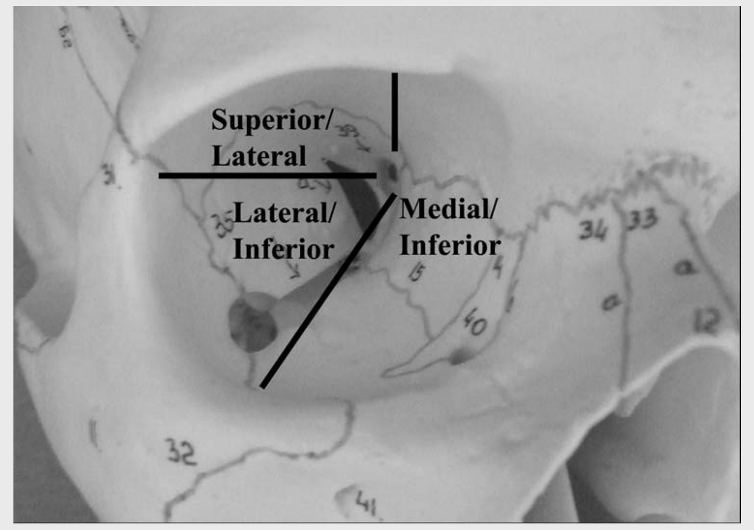

Figure 1. Cadaveric right orbit divided into the sectors around the optic nerve.

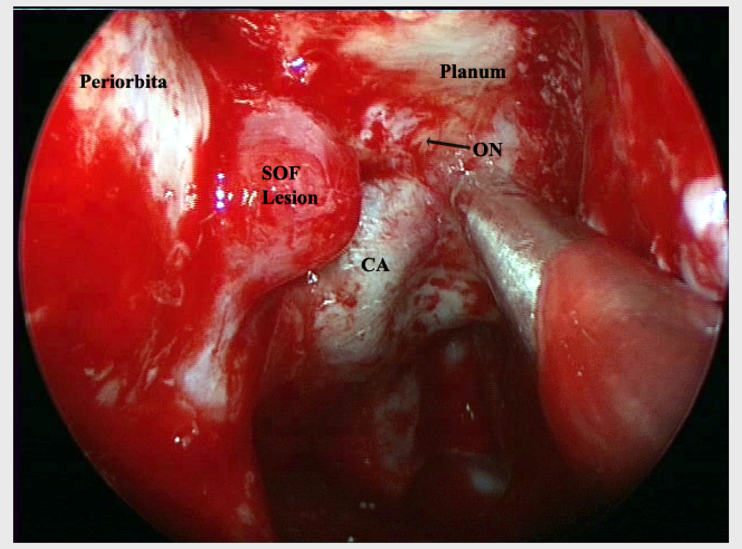

Figure 2. Endoscopic view of a right superior orbital fissure (SOF) meningioma. CA =Carotid Artery. ON = Optic Nerve

Figure 3. Medial/Inferior Extraconal Approach

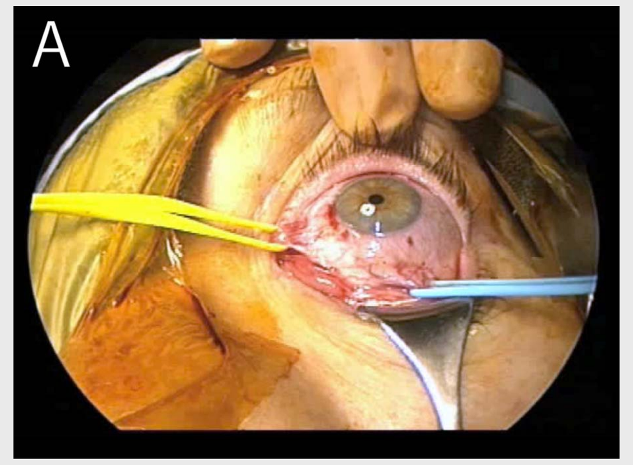

Figure 3A: Superior orbital fissure (SOF) meningioma exposure.

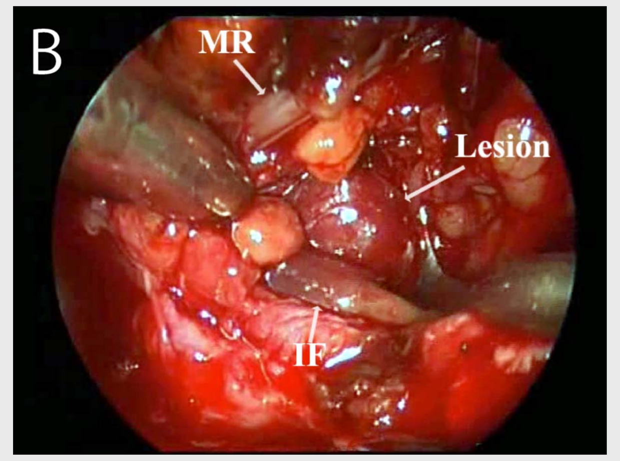

Figure 3B: Sharp dissection of the meningioma away from the optic nerve.

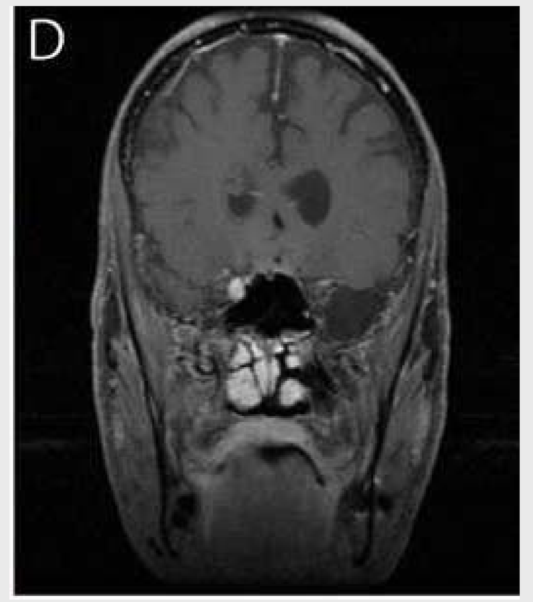

Figure 3D: Pre-operative MRI with contrast

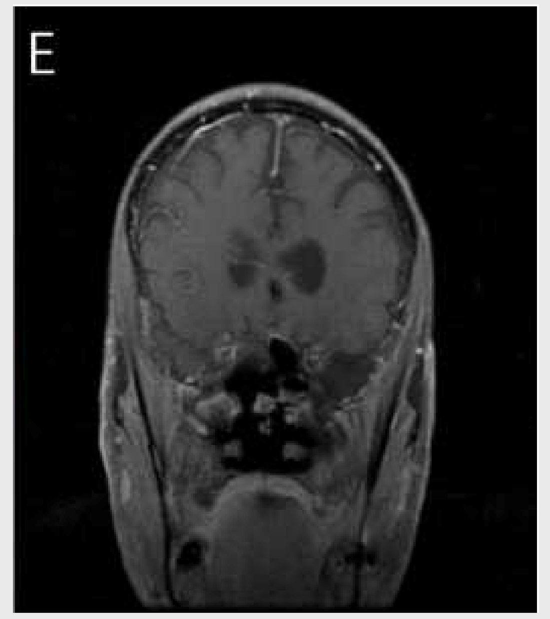

Figure 3E: Post-operative MRI With contrast showing complete tumor excision

DISCUSSION

Several key anatomic principles must be adhered to for safe resection of orbital tumors with an endonasal approach. First, it is critical to avoid crossing the optic nerve. Thus, the endonasal approach is contraindicated for tumors localized to the superior/lateral orbit. Secondly, entry through the lamina papyracea should occur below the level of the ethmoidal foramina in order to avoid damage to the ethmoid arteries and reduce the risk of retrobulbar hemorrhage and vision loss. Finally, the dissection should occur between muscle groups rather than through individual muscles for preservation of function.

The endonasal corridor has some advantages over external approaches for medial/inferior lesions. The endonasal approach minimizes external scarring and preserves cosmesis.[5] External approaches to lesions of the medial orbital require significant displacement of orbital structures including the globe. Given the deep, cone-shaped surgical window provided by the external approach, it also has the disadvantage of suboptimal visibility relative to the endonasal approach. In addition, external approaches to intraconal lesions may also require de-insertion of extraocular muscles, with subsequent impact on extraocular mobility. The added illumination and magnification of the endoscope cannot be understated; however, the loss of 3D perception may be disorienting to the surgeon unfamiliar with these endoscopic techniques.

CONCLUSIONS

We have defined three corridors for endoscopic endonasal orbital tumor surgery: 1. a medial and inferior approach for extraconal lesions 2. a medial intraconal approach with displacement of the medial rectus muscle and intraconal dissection between the inferior and medial rectus muscles, 3. a transmaxillary approach for lateral extraconal lesions.

Endoscopic endonasal transorbital approaches to orbital tumors require an understanding of complex orbital and skull base anatomy; however, this is a safe and viable option for selected orbital lesions.

REFERENCES

1. Mercandetti M. Tumors, Orbital. eMedicine Chapter. Last Updated 2/5/2010. Available at: http://www.emedicine.com/oph/topic758.htm. Accessed 3/1/2010.
2. Norris JL, Cleasby GW. Endoscopic orbital surgery. Am J Ophthalmol 1981; 91:249-52.
3. Miller NR, Agrawal N, Sciubba JJ, et al. Image-guided transnasal endoscopic resection of an orbital solitary fibrous tumor. Ophthal Plast Reconstr Surg. 2008; 24:65-7.
4. Gerencer RZ, Patel U, Hunter C, et al. The role of endoscopic sinus surgery in the diagnosis and treatment of metastatic orbital carcinoid tumors. Ear Nose Throat J. 2007;86:157-61.
5. Lund VJ, Rose GE. Endoscopic transnasal orbital decompression for visual failure due to sphenoid wing meningioma. Eye 2006; 20:1213-9.
6. Karaki M, Kobayashi R, Mori N. Removal of an orbital apex hemangioma using an endoscopic transethmoidal approach: technical note. Neurosurgery 2006; 59:ONSE159- 60.
7. Luu QC, Lasky JL, Moore TB, et al. Treatment of embryonal rhabdomyosarcoma of the sinus and orbit with chemotherapy, radiation, and endoscopic surgery. J Pediatr Surg 2006; 41:e15-7.
8. Har-El G. Combined endoscopic transmaxillary-transnasal approach to the pterygoid region, lateral sphenoid sinus, and retrobulbar orbit. Ann Otol Rhinol Laryngol 2005; 114:439-42.
9. Naraghi M, Kashfi A. Endonasal endoscopic resection of ethmoido-orbital osteoma compressing the optic nerve. Am J Otolaryngol 2003; 24:408-12. 19
10. Herman P, Lot G, Silhouette B, et al. Transnasal endoscopic removal of an orbital cavernoma. Ann Otol Rhinol Laryngol 1999; 108:147-50.
11. Senior BA, Lanza DC, Kennedy DW, et al. Computer-assisted resection of benign sinonasal tumors with skull base and orbital extension. Arch Otolaryngol Head Neck Surg 1997; 123:706-11.
12. Sethi DS, Lau DP. Endoscopic management of orbital apex lesions. Am J Rhinol. 1997; 11:449-55.
13. Kassam A, Snyderman CH, Mintz A, et al. Expanded endonasal approach: the rostrocaudal axis. Part II. Posterior clinoids to the foramen magnum. Neurosurg Focus 2005; 19(1):E4.
14. Kassam A, Snyderman CH, Mintz A, et al. Expanded endonasal approach: the rostrocaudal axis. Part I. Crista galli to the sella turcica. Neurosurg Focus 2005; 19(1):E3. Review.
15. Hadad G, Bassagasterguy L, Carrau RL, et al. A Novel Reconstructive Technique After Endoscopic Expanded Endonasal Approaches: Vascular Pedicle Nasoseptal Flap. Laryngoscope 2006; 116:1882-86