Journal of Clinical Neuroscience 24 (2016) 99–104

Contents lists available at ScienceDirect

Journal of Clinical Neuroscience

journal homepage: www.elsevier.com/locate/jocn

Clinical Study

Transorbital neuroendoscopic surgery for the treatment of skull base lesions

Rohan Ramakrishna [a], Louis J. Kim [b], Randall A. Bly [b], Kris Moe [b,c], Manuel Ferreira Jr. [b,*]

[a] Department of Neurological Surgery, Weill Cornell Medical College, New York Presbyterian Hospital, New York, NY, USA
[b] Department of Neurosurgery, University of Washington School of Medicine, Seattle, WA, USA
[c] Department of Otolaryngology, University of Washington School of Medicine, Seattle, WA, USA

ARTICLE INFO

Article history:
Received 7 July 2015
Accepted 24 July 2015

Keywords:
CSF leak
Endoscope
Neuroendoscopy
Neurosurgery
Pituitary
Skull base
Transorbital

ABSTRACT

Transorbital neuroendoscopic surgery (TONES) is a relatively new technique that not only allows access to the contents of the orbit but also the intracranial compartment, including the anterior cranial fossa, middle fossa and lateral cavernous sinus. In this study, we aimed to retrospectively review the largest experience to our knowledge with regards to surgical outcomes of skull base pathologies treated with a TONES procedure. Forty patients (aged 3–89 years) underwent 45 TONES procedures between the years of 2006–2013. Pathologies were cerebrospinal fluid leak repair (n = 16), traumatic fracture (n = 8), tumor (n = 11), meningoencephalocele (n = 5), hematoma (n = 1), and infection (n = 4). Three patients had a persistent complication at 3 months, including a case each of enophthalmos (unnoticed by patient), epiphora (delayed presentation at 2 months requiring dacryocystorhinostomy), and ptosis (improved at 1 year). Surgical success was achieved in all patients. Of special import, there were no cases of visual decline, diplopia, or stroke. There was no mortality. To our knowledge this is the first study and largest experience of TONES (level 4 evidence) to detail outcomes with respect to skull base pathologies. Our results indicate that TONES procedures can be performed with minimal morbidity. Further studies are needed to assess equivalency with craniotomy based approaches though this initial report is encouraging.

Published by Elsevier Ltd.

1. Introduction

Transorbital neuroendoscopic surgery (TONES) is a relatively new technique that not only allows access to the contents of the orbit but also the intracranial compartment, including the anterior cranial fossa, middle fossa, and lateral cavernous sinus [1–14]. In highly selected cases, the advantages of including TONES in a treatment armamentarium are multifold. First, TONES allows a multi-portal, multi-angled approach to lesions of the skull base that are extremely difficult through even expanded transnasal endoscopic procedures [13]. Second, surgical morbidity and cosmetic deformity are minimized compared to standard open, craniofacial approaches [15,16]. Third, two surgeons can work comfortably in a coplanar manner to address the lesion of interest rather than struggle to work through the relatively narrow transnasal route. Here we report the largest experience to our knowledge treating a variety of intracranial pathologies using the TONES approach as well as detailing the relevant patient outcomes associated with each procedure.

* Corresponding author at: 325 Ninth Avenue, Box 359766, Seattle, WA 98104, USA. Tel.: +1 206 616 8702; fax: +1 206 744 9944.
E-mail address: manuelf3@u.washington.edu (M. Ferreira Jr.).

http://dx.doi.org/10.1016/j.jocn.2015.07.021
0967-5868/Published by Elsevier Ltd.

2. Overview of TONES

We previously have reported on the use of TONES in both cadaver studies and small clinical series [1,3–5]. Briefly, TONES represents a group of minimally disruptive approaches to the orbit and skull base that do not functionally compromise the eyelid. These are the precaruncular (PC), preseptal lower eyelid (PS), superior eyelid crease (SLC), and lateral retrocanthal approaches (LRC). The SLC approach allows access to the anterior cranial fossa and orbital roof (Fig. 1, quadrant A). The PC approach affords access to the anterior cranial fossa, lateral nasal cavity, cavernous sinus, and optic nerve (Fig. 1, quadrant B). The PS approach allows access to the orbital floor, infraorbital nerve, inferior orbital fissure and middle fossa floor including the foramen rotundum (Fig. 1, quadrant C). Finally, the LRC approach allows access to the deep orbit, cavernous sinus, middle fossa, and infratemporal fossa (Fig. 1, quadrant D). When combined with transnasal approaches or even in isolation, TONES provides access that is minimally disruptive and avoids crossing neurovascular structures.

With this framework in mind, we present our series of cases where TONES was utilized either in isolation or in conjunction with traditional transnasal endoscopic surgery.

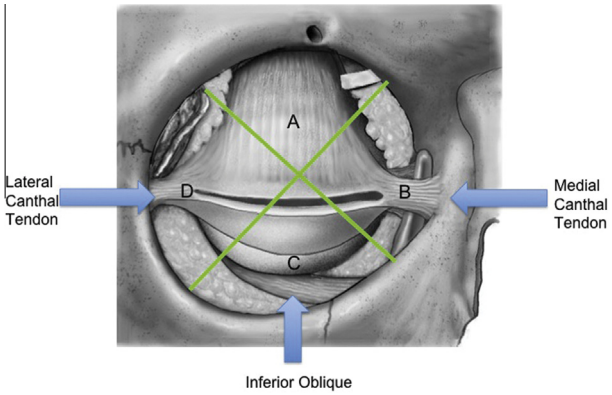

Fig. 1. Four quadrants of the orbit. Each quadrant affords access to a different area of the skull base. A = superior eyelid crease approach, B = precaruncular approach, C = preseptal lower eyelid approach, D = lateral retrocanthal approach.

3. Methods

Institutional Review Board approval for this study was obtained from the University of Washington Human Subjects Division (#44884). A prospectively maintained database was analyzed retrospectively for patients who had undergone a TONES procedure for intracranial pathology between 2006 and 2013. Inclusion criteria were the presence of a skull base defect requiring repair, optic nerve compression, cerebrospinal fluid (CSF) leak, meningoencephalocele, and skull base tumor. No patients were excluded and one was lost to follow-up (Supp. Table 1). All patients were operated on at an academic tertiary center, Harborview Medical Center, by the senior otolaryngologist (K.S.M.) and either senior neurosurgeon (L.J.K. or M.F.J.). Patients were followed for a minimum of 6 weeks. Outcome measures included the presence of orbital asymmetry, extraocular movement dysfunction, decline in visual acuity, continued CSF leak, diplopia, and eyelid malposition. Follow-up consisted of evaluation by a head and neck specialist, neurosurgeon, and ophthalmologist where necessary. For tumor cases, extent of resection and time to recurrence (where available) were noted. Procedures were completed using standard endoscopic equipment. Additional equipment utilized included ultrasonic bone aspirators. Skull base reconstructions were performed using irradiated cadaveric dermis, nasoseptal flaps, and fat for additional buttressing where necessary.

In terms of patient selection, a number of factors were considered. First, if TONES in isolation was considered, the expected surgical result and morbidity had to be at least equivalent if not better than standard craniotomy or endonasal approaches. Second, if TONES was considered as an adjunct to endonasal surgery, it had to provide working angles and operative trajectories difficult to obtain through expanded endonasal corridors. Of note, some of these patients have been published elsewhere [1,3,5] by our group but this report focuses only on neurosurgically relevant pathologies and outcomes.

4. Illustrative patients

4.1. Patient 1

A 56-year-old woman presented with a history of spontaneous CSF rhinorrhea. Subsequent evaluation revealed a Sternberg canal encephalocele eroding through the anterior skull base (Fig. 2). Given the accessibility of the lesion from a combined transorbital/transnasal approach, the patient was advised to undergo surgical treatment.

The patient underwent both traditional endoscopic transnasal surgery as well as a TONES procedure with a PC approach. The encephalocele was endoscopically circumscribed using corridors supplied by the transnasal and transorbital approaches. The encephalocele was then cauterized and resected. A dural patch of irradiated cadaveric dermis was placed, along with a nasoseptal mucosal flap. A lumbar drain was placed intraoperatively and continued for 5 days.

Postoperatively, the patient had no complications and her leak repair proved durable. During follow-up, she had no diplopia, orbital asymmetry, decline in visual acuity, or difficulty with extraocular movements.

4.2. Patient 2

A 52-year-old man with a history of a right frontal ganglioma treated at the age of 19 with surgery and radiation presented with an enlarging right orbital mass. Workup revealed an enlarging anterior fossa mass with extension into the orbit, consistent with a radiation-induced meningioma (Fig. 3). The patient had a poorly vascularized scalp that was impressively atrophic, further complicating a craniotomy-based approach.

The patient underwent a combination of endoscopic transnasal surgery as well as endoscopic transorbital surgery through a PC approach (Supp. Video 1). Removal of the mass was completed using standard endoscopic transnasal equipment. A small frontal craniotomy was performed through the posterior orbital wall to access the intracranial tumor components. The dura was repaired using irradiated cadaveric dermis and fibrin glue (Supp. Video 1).

During follow-up the patient had no visual complaints, objective abnormalities on examination or CSF leak. MRI revealed gross total resection (Fig. 4) of a World Health Organization grade I radiation-induced meningioma.

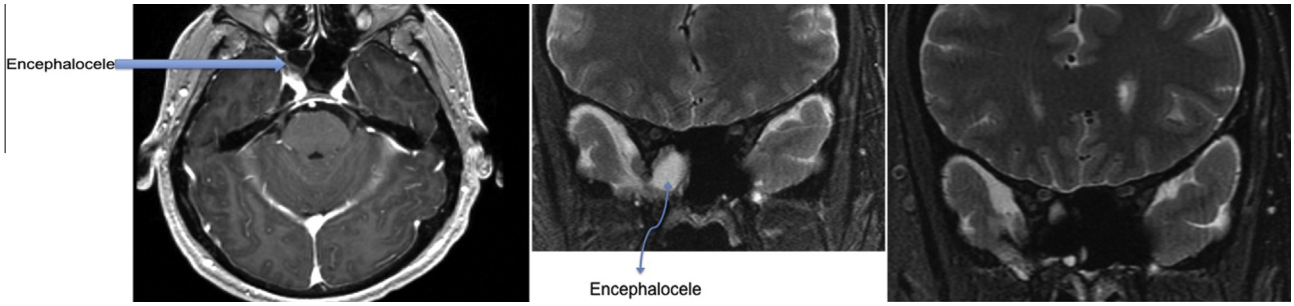

Fig. 2. Patient 1. (Left) Axial T1-weighted post-contrast and (center) coronal T2-weighted preoperative MRI showing encephalocele. (Right) Postoperative coronal T2-weighted MRI showing encephalocele repair.