Transorbital Endoscopic Amygdalo-Hippocampectomy

H. Isaac Chen MD; Leif-Erik Bohman MD; Laurie Loevner MD; Timothy H. Lucas MD, PhD
Department of Neurosurgery, Division of Neuroradiology
University of Pennsylvania, Philadelphia, PA

Introduction: Surgical resection of the mesial temporal lobe is the standard of care for medically intractable epilepsy arising from mesial temporal sclerosis. Despite its highly favorable risk-benefit ratio, temporal craniotomy carries certain risks, including retraction injury, stroke, and cognitive dysfunction from white matter tract disruption. Many of these complications are related to exposure of the lateral temporal lobe. In cadaveric specimens, we investigated transorbital endoscopic amygdalo-hippocampectomy (TEA) as an alternative to open craniotomy. This approach provides a direct route to the mesial temporal structures via the lateral orbital wall.

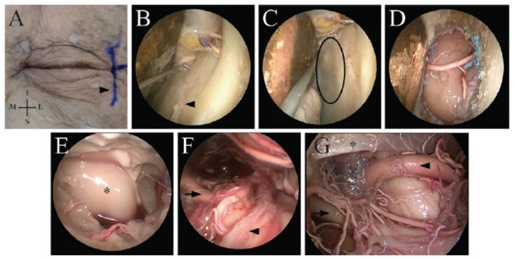
Table 1. Compiications of temporal craniotomy

Complication	Reference	N	Incidence (%)
Visual field deficit	Wiebe et al, 2001	40	55
	Egan et al, 2000	29	76
Trochlear nerve palsy	Cohen-Gadol et al, 2003	47	19
Oculomotor nerve palsy	Sindou et al, 2006	100	5
Language deficit	Acar et al, 2008	39	2.5
	Jensen et al, 1975	858*	5
Memory deficit	Acar et al, 2008	39	5
Hemiparesis	Wieser et al, 2006	478	1
	Rydenhag and Silander, 2001	654	2.2
	Behrens et al, 1997	279*	1.4

*Temporal lobe procedures only

Methods: Dissections were performed in 2 cadaveric heads (4 hemispheres) that were alcohol fixed and injected with latex for vessel visualization. Neuroendoscopes provided visualization of the intracranial space. Pre- and post-dissection computed tomography (CT) and magnetic resonance (MR) images were obtained for the purposes of neuro-navigation and recording the extent of resection. Quantitative predictions of the limits of exposure based on pre-dissection imaging were compared to intra-dissection measurements and validated with images from 10 epilepsy patients undergoing surgical evaluation.

Figure 1. Dissection technique



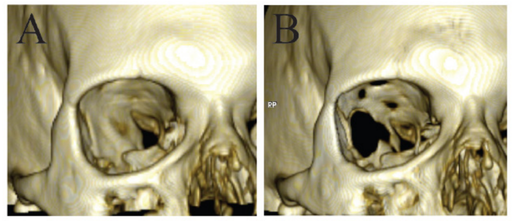
(A) Curvilinear incision is made adjacent right lateral canthus. (B) Orbital contents are dissected in sub-periorbital manner & retracted medially. (C) Planned region of the orbital craniectomy is outlined by the oval. (D) After craniectomy, removal of the dura reveals the temporal pole. (E) Dissection through the temporal pole using frameless stereotactic navigation leads to the pez of the hippocampus (asterisk). (F) Resection of the medial temporal lobe structures, including the head and body of the hippocampus, is complete. (G) With a 30° angled endoscope, the lateral brainstem and ambient cistern are readily visible. Above the tentorium cerebelli (asterisk), the posterior cerebral artery (arrowhead) wraps around the cerebral peduncle. The optic tract (arrow) is seen medial to the preserved choroidal vessels.

Table 2. Anatomical measurements

Globe displacement	
Mid-pupillary line to midline – pre-retraction	33.5 ± 3.1
Mid-pupillary line to midline – with retraction	27.5 ± 3.7
Estimated globe displacement	6.0 ± 1.4
Peri-orbital tissue thickness	
Medial	5.7 ± 1.0
Lateral	4.9 ± 0.9
Lateral orbital rim to dura	25 ± 2.9
Craniectomy dimensions	
Medial-lateral	10.2 ± 3.3
Superior-inferior	12.2 ± 1.5

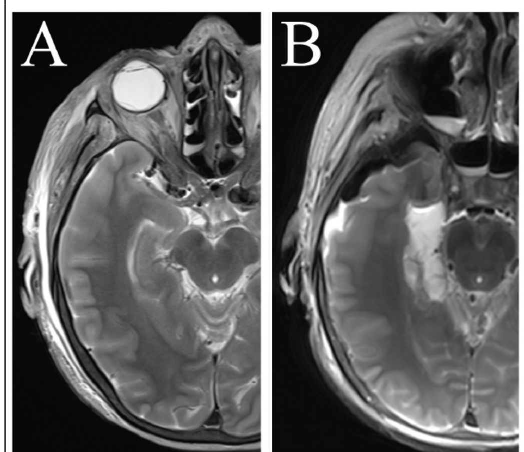
Values are mean ± standard deviation in millimeters.

Figure 2. Orbital craniectomy



Three-dimensional reconstructions of the pre- (A) and post-dissection (B) CT scans. An orbital view of the skull demonstrates the orbital craniectomy lateral to the superior orbital fissure, with preservation of a rim of bone. Estimates of intracranial access did not require unroofing the SOF.

Figure 3. Extent of hippocampal resection



Pre- (A) and post-dissection (B) axial T2-weighted MR images show near-complete resection of the hippocampal head and body. Following dissection, extent of hippocampal resection reaches the quadrigeminal cistern posterior to the collicular plate.

Table 3. Actual and predicted angles of exposure

	Actual	Predicted (cadaver)	P-value (Actual vs. Predicted (cadaver))	Predicted (patients)	P-value (Actual vs. Predicted (patients))
Hemispheres	4	4		20	
Medial-lateral	43 ± 5	45 ± 2	0.85	42 ± 4	0.85
Superior-inferior	72 ± 10	69 ± 7	0.56	64 ± 5	0.21

Values are mean ± standard deviation in degrees.

Results: The transorbital approach permitted up to 97% of the hippocampal formation to be resected with no brain retraction and minimal globe retraction (6.0 ± 1.4 mm). Temporal lobe white tracts were preserved. A wide range of intracranial structures could be accessed with TEA methods. No significant differences were found between MRI-based predictions of angles of exposures and intra-dissection measurements.

Conclusions: TEA is a feasible alternative to standard craniotomy for near-total amygdalo-hippocampectomy. The transorbital approach could result in better patient outcomes because it spares the lateral temporal lobe and white matter pathways and removes the need for brain retraction. These results support clinical investigation of this novel surgical approach.

Learning Objectives: By the conclusion of this session, participants should be able to: (1) Describe the complications associated with open craniotomy for temporal lobe access, (2) understand the technique of transorbital endoscopic amygdalo-hippocampectomy (TEA), and (3) define the benefits and potential risks of the TEA approach.

References:
1. Moe KS, et al: Transorbital neuroendoscopic surgery. Neurosurgery 67:ons16-28, 2010.
2. Wiebe S, et al: A randomized, controlled trial of surgery for temporal-lobe epilepsy. New England Journal of Medicine 345:311-318, 2001.