Keyhole and standard subtemporal approaches

TO THE EDITOR: Recently, Ercan and colleagues1 published their cadaveric laboratory investigation of keyhole versus a traditionally sized craniotomy with and without zygomatic osteotomy to assess temporal lobe retraction and surgical exposure via a subtemporal corridor (Ercan S, Scerrati A, Wu P, et al: Is less always better? Keyhole and standard subtemporal approaches: evaluation of temporal lobe retraction and surgical volume with and without zygomatic osteotomy in a cadaveric model. J Neurosurg [epub ahead of print September 16, 2016. DOI: 10.3171/2016.6.JNS16663]). The authors’ cadaveric specimens were assessed radiographically with CT-based navigation and volumetrically with computer software and a measured resin mold of the surgical corridor.

In this comparison, the keyhole and traditional craniotomy approaches exposed a similar anatomical volume with no difference in temporal lobe retraction. The keyhole approach was limited in its surgical exposure around the area of interest and in its vertical attack angle. Ercan and colleagues1 warned of only partial venous visualization of basal temporal veins in a keyhole subtemporal approach. This visualization was attributed to decreased angles and reduced surgical exposure due to the smaller keyhole craniotomy that limit the space available for execution of surgical movements. The use of an endoscope to enhance visualization in the keyhole approach was only briefly mentioned. The authors acknowledged that maneuvers for brain relaxation (mannitol, head positioning, and CSF drainage) were missing in this comparison but did not comment on the role of single-shaft instruments or dynamic movement of the microscope to facilitate visualization in a smaller corridor.2 Lastly, their use of fixed retraction may not recreate the surgical approach used in the operating room.3

The interpeduncular and ambient cisterns lie in the plane of the tentorial incisura. The tentorium leading up to the incisura extends from the petrous ridge and curves upward toward the free edge of the tentorium. Therefore, the area of interest in a subtemporal approach is actually above the plane of the lateral skull base and middle fossa floor. The ideal lateral approach that minimizes brain manipulation would utilize an inferior-to-superior trajectory—in fact, the more inferior the starting point, the less theoretical brain retraction and manipulation would be required. With this anatomical maxim in place defining the inferior aspect of the craniotomy, the superior aspect of the craniotomy is dictated only by what is necessary to create sufficient working space. In our experience, this has been 1.5–2.5 cm depending on the pathology. With this exposure in place, the amount of brain retraction is dependent almost exclusively on brain relaxation maneuvers. Again, in our experience, with proper brain relaxation techniques, even with very small keyhole approaches, fixed retractors are rarely, if ever, used.

Ultimately, the question of “is less always better” perhaps misses the point altogether. The principles that guide successful keyhole surgery are the same as those that guide a “conventional” craniotomy. Sufficient brain relaxation that obviates the need for retractors is essential regardless of the approach taken. The need for surgical maneuverability to implement safe microsurgical technique is also indisputable. However, the advent of specially designed keyhole instruments and growing surgical experience with the use of the endoscope has made the area necessary for safe surgical maneuverability substantially smaller. Once these elements are taken into consideration, the question becomes the following: Why perform a 6-cm craniotomy when a 2-cm one is sufficient? Furthermore, do these smaller surgeries translate into improved outcomes—shorter exposure time, lower infection rates, less muscle atrophy, improved cosmesis, less postoperative pain, shorter length of stay? It should be noted that keyhole approaches, given their smaller exposures, have little margin for error. Detailed anatomical knowledge and careful patient selection, operative planning, and placement of the opening are required. Keyhole techniques, much like endoscopic endonasal techniques, have a steep learning curve. Effective utilization of keyhole approaches requires brain relaxation, proper instrumentation (single shaft), and adept use of both the microscope and endoscope.

As a comparative anatomical study to provide basic information regarding the subtemporal approach and its minimally invasive modification, this work by Ercan and colleagues finds similar anatomical exposure with equal temporal lobe retraction; this underscores that a keyhole subtemporal approach, perhaps with some technical modifications, provides the same access as a traditional craniotomy. True comparisons between keyhole and larger-
sized craniotomies must consider all available modalities to achieve success in a more precise corridor.

Melissa M. Stamates, MD
Ricky H. Wong, MD
NorthShore Neurological Institute, Evanston, IL

References

Disclosures
The authors report no conflict of interest.

Response
We appreciated the interest generated by our paper as reflected in the comments by Drs. Stamates and Wong.

As we clearly stated, our study is a comparative one and the results are what they are, given the constraints of the study. Obviously we changed the microscope angle during the execution of the procedure: this is a standard tenet of microsurgical techniques. The results, as recorded in the study, are that “the keyhole subtemporal craniotomy was not associated with less temporal lobe retraction than the standard subtemporal approaches. While the anatomical space was the same in both craniotomies, the surgical space, the space in which one can execute surgical maneuvers, was larger in the standard subtemporal craniotomy than in the keyhole craniotomy. In addition, the standard craniotomy allowed visualization of the stretched temporal lobe basal vein so that maneuvers to control/limit this stretching may be undertaken. This venous visualization was limited in the keyhole approaches, where it was only achieved partially by using the endoscope.”

Perhaps the results are not surprising (a larger bony and dural opening allows you more usable angles of attack on the target). However, we felt it was important to share the findings with our colleagues, particularly in light of the somehow unverified proposal/acceptance of different techniques that oftentimes are thought to be preferable to well-established ones just because they have the hallmark of being minimally invasive and having a smaller incision or the like.

As has been stated before, there are tools to evaluate and prove/disprove new surgical techniques.1,2 The phrase “in our experience” is somehow of a circular self-referential nature that, unless pointing to quantum leap improvement in measurable outcome, has very little substance.

We are clearly in favor of a learning curve (a paraphrase to indicate suboptimal outcome) if it takes us to a better place in terms of a reproducible and measurable better outcome for our patients. If we are able to prove that we achieve a better outcome with a smaller incision, different surgical techniques, or no surgery at all, then all the better for our patients and our field.

Mario Ammirati, MD, MBA
Mercy Health/St. Rita’s Medical Center, Lima, OH
Serdar Ercan, MD
Ohio State University Wexner Medical Center, Columbus, OH

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Blunt cerebrovascular injuries in severe TBI

TO THE EDITOR: We thank Esnault et al.1 for their study, which is a valuable effort to look at blunt cerebrovascular injury (BCVI) in patients with severe traumatic brain injury (EsnaULT P, Cardinale M, BoreT H, et al: Blunt cerebrovascular injuries in severe traumatic brain injury: incidence, risk factors, and evolution. J Neurosurg [epub ahead of print July 29, 2016. DOI: 10.3171/2016.4.JNS152600]). The only intracranial hemorrhage complication in their study was an epidural hematoma following an iatrogenic procedure — insertion of an intracranial pressure monitoring device. We do have a few questions for the authors.

They mention that the incidence of a poor outcome (Glasgow Outcome Scale Score 1–3) was similar in patients with or without BCVI. However, among the 14 patients with BCVI who received systemic anticoagulation, was there any hematoma expansion after initiating therapy?

Of the 4 patients with BCVI who suffered an ischemic stroke, 2 had a stroke despite early anticoagulation therapy. Assuming these strokes occurred in the ipsilateral vascular territory (left internal carotid artery), do the authors have any thoughts on the failure of anticoagulation to prevent stroke in these patients?

We also ask the authors to specify, if possible, how many patients underwent digital subtraction angiography (DSA) and in what situations. The practice seems to be variable, with some people advocating DSA in CT angiography (CTA)–positive patients, while most others reserve DSA for CTA-negative patients who have focal neurological deficits.4

The authors mention a recent paper describing the sensitivity of CTA as rather low.3 It would be interesting to know the incidence of ischemic stroke in the CTA-negative patients in the study.

J Neurosurg Volume 127 • July 2017 229