

Two-Part Pterional Craniotomy

Sharon Devasagayam¹, Arnau Benet², Michael W. McDermott¹

1. Department of Neurological Surgery, University of California, San Francisco 2. UCSF Dept of Neurosurgery, UCSF Dept of Otolaryngology - Head and Neck Surgery

✉ **Corresponding author:** Michael W. McDermott, mwmcd57@comcast.net
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Abstract

Introduction: The standard approach for pterional craniotomy involves one or two burr holes and a single bone piece encompassing the frontal, temporal and sphenoid bones. Drilling down of the sphenoid creates a defect that requires repair. We have used a two-part pterional craniotomy that avoids the need for drilling and document the modification of the standard technique here.

Methods: Two burr holes are placed, one behind the key point over the frontal fossa as well as one on the temporal fossa. A frontal temporal sphenoidal bone flap is created by cutting the bone back in a V-shape around the sphenoid wing. Extradural dissection is then done to expose the lateral part of the sphenoid wing down to the dural fold lateral to the superior orbital fissure, as well as separating the dura from the floors of the anterior and middle cranial fossa. A foot plate attachment on the drill is used to create a secondary bone piece which encompasses that portion of the greater sphenoid wing that is drilled away in the standard approach. Reconstruction is done connecting the two pieces back together with titanium plates and screws yielding a good cosmetic result.

Conclusions: A two part pterional craniotomy is an option for a standard frontal temporal sphenoidal approach that allows for preservation of bone and assists with reconstruction and may provide for a better cosmetic result.

Categories: Neurosurgery

Keywords: pterional, craniotomy, keyhole, temporal bone, frontal bone, reconstruction

Introduction

The standard approach for access to the frontal, temporal, sphenoid wing, supra-sellar regions, as well as the anterior and middle cranial fossa, can be done with a classically described pterional approach [1-5]. This begins with a burr hole at the key point, which is actually at the junction of the anterior inferior part of the anterior cranial fossa, the orbit and greater sphenoid wing. Frequently orbital contents are entered with placement of this hole. Once a pterional craniotomy is done, access to deeper portions of the anterior and middle cranial fossa is gained by drilling down the greater sphenoid wing. This creates a bony defect which must be repaired in order to achieve a good cosmetic result for the patient [6-11].

We have used a two-part pterional craniotomy recently to assist us with ease of opening and achieving a better cosmetic result but not requiring longer operative time. The first burr hole is placed behind the standard key hole more towards the anterior cranial fossa below the standard temporalis muscle cuff and the second one in the temporal fossa posteriorly. The shape of the first bone flap is not the customary approach because it preserves the lateral part of the

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sphenoid wing by cutting a V-shape around it, which is then dissected secondarily under direct observation and removed with the foot plate attachment up to the region of the key point.

Technical Report

The standard patient positioning is used and 3-point fixation. Once the skin flap is turned down to expose the skull and temporalis muscle the muscle is reflected down of the frontal temporal and sphenoid bones leaving a cuff of muscle to suture the muscle back to at the end of the procedure.

With this region of the skull sufficiently exposed, we use two, rather than the classically described four, burr holes technique of Yasagril (Figures 1-2) [1-2]. The first burr hole is placed behind the standard key point, and a second is located posteriorly in the temporal bone (Figures 3-4). The drill is used to cut between the burr holes so as to expose the dura of the frontal and temporal lobes by creating a frontal temporal sphenoid bone flap (Figures 5-6). This bone flap preserves the lateral wing of the sphenoid, unlike the drilling of the standard approach, and this region of bone is removed with the use of a foot plate attachment (Figures 7-11).

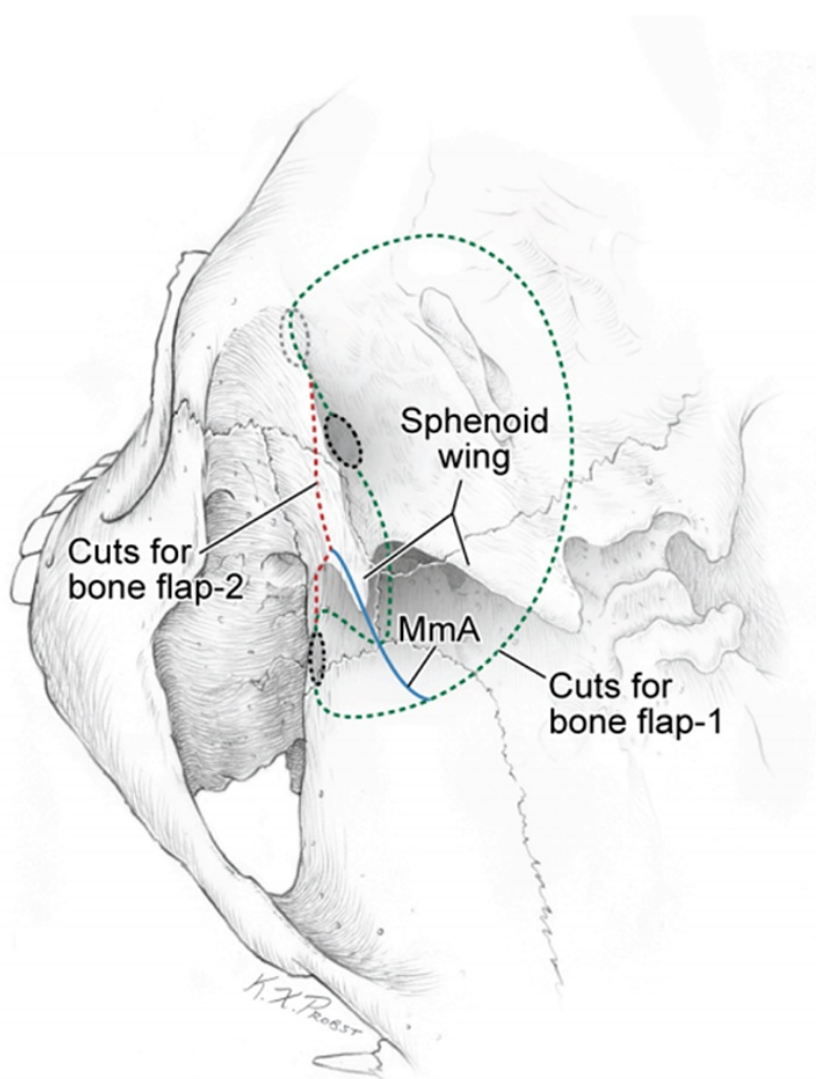


FIGURE 1: Bone exposure below muscle outlining two part craniotomy outlining position of burr holes and cut lines in

bone.

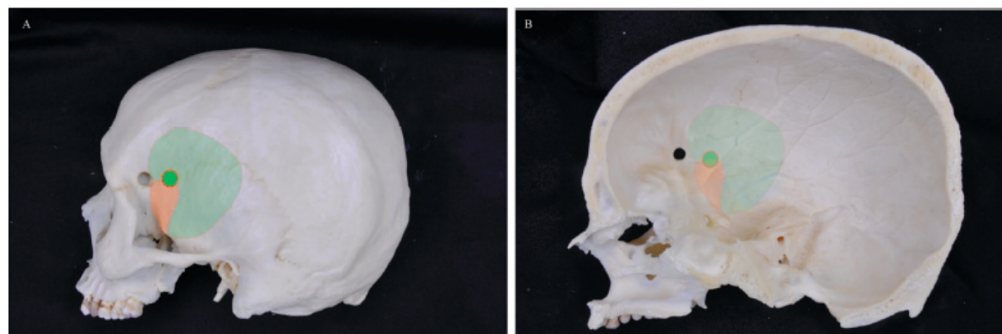


FIGURE 2: Surgical simulation photographs illustrating the position of the two-part pterional craniotomy.

A: Right pterional approach. After a wide skin flap, the temporal fascia was carefully dissected to preserve both facial and supraorbital nerves. The temporal muscle was incised 1 cm from its attachment along the superior temporal line to leave a muscle cuff in order to ease closure and optimize postoperative muscle function. The first part pterional craniotomy (Green) was performed first. Then, the complimentary second part sphenoidal craniotomy (Orange) is removed using foot plate under direct view.

B: Detail of the right classic McCarty Keyhole and relative position of the frontal burr hole for the two-part pterional craniotomy. The McCarty Keyhole has been performed to show the limit between the orbital and intracranial compartments. The exocranial facet of the sphenoid bone has been identified (Dotted line) and the frontal (White circle number one) and temporal (White circle number two) burr holes have been identified.

(b)

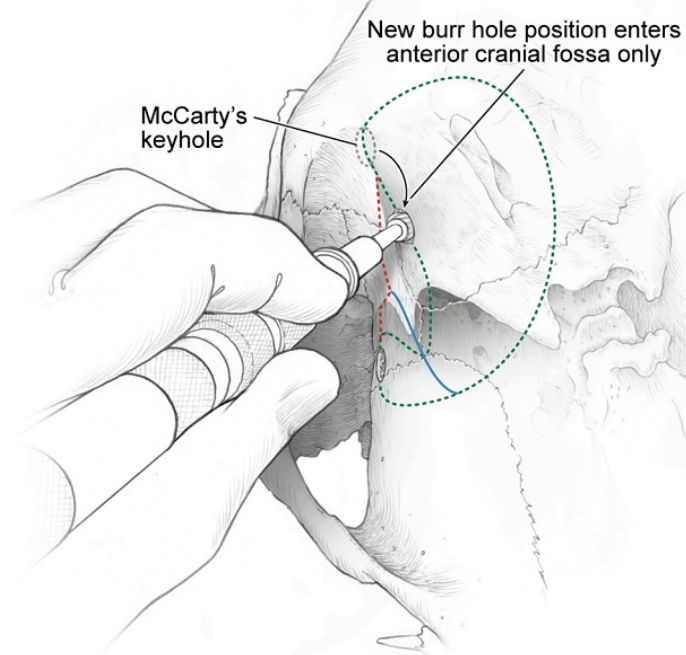


FIGURE 3: Frontal burr hole and second burr hole positions.

Frontal burr hole for anterior fossa is behind standard standard key-hole. Second burr hole posteriorly in squamous temporal bone.

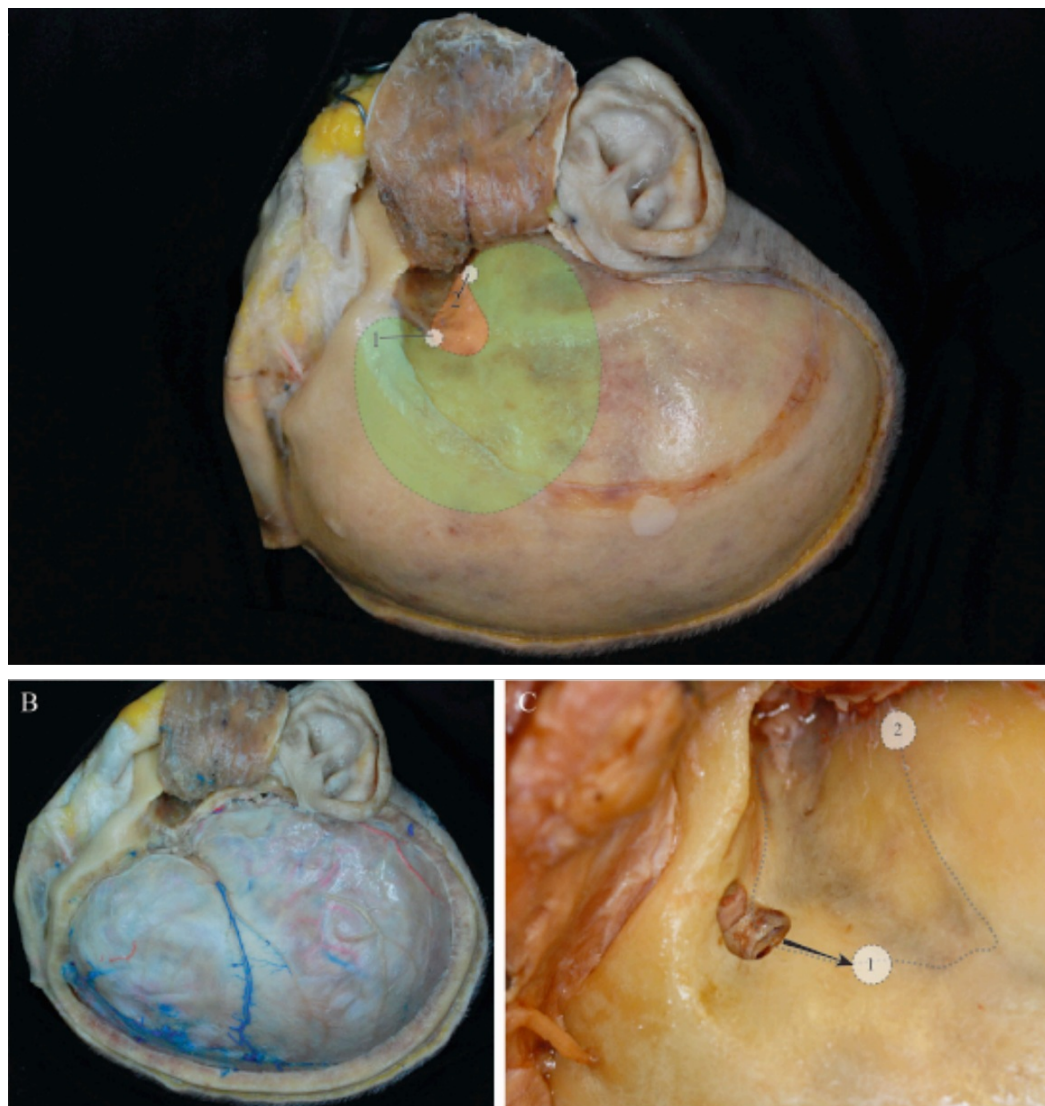


FIGURE 4: Skull photographs illustrating the two-piece pterional craniotomy.

A: Left exocranial view of the skull showing the modified bone flaps in the two part pterional craniotomy. First part (green) and the second part craniotomy (Orange).

B: Right endocranial view of the skull showing the relation of the craniotomy sub-parts to the petrous temporal bone, lesser sphenoid wing and orbit. The modified Keyhole (Green circle) is placed posterior and superior to the classic pterional keyhole. LWSB: Lesser Wing of the Sphenoid Bone

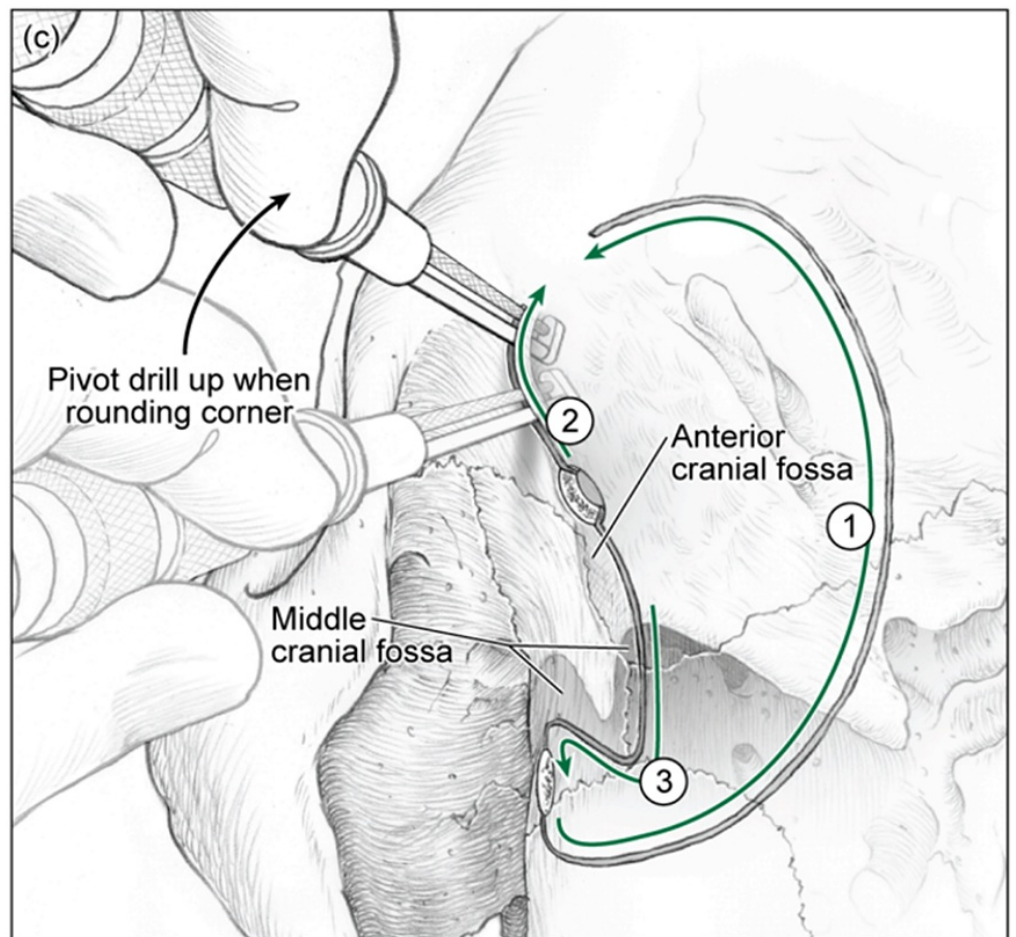


FIGURE 5: Recommended sequence of cuts with footplate.

(1) begin in temporal burr hole and cut in curvilinear fashion to supra-orbital margin, then back out.

(2) From frontal burr hole cut forward towards keyhole and then turn up towards supra-orbital margin, pivoting drill so footplate does not hang up on inner table of frontal bone above roof of orbit.

(3) From frontal burr hole cut posteriorly around back edge of sphenoid wing, then forward below wing into middle fossa turning back at end into temporal burr hole.

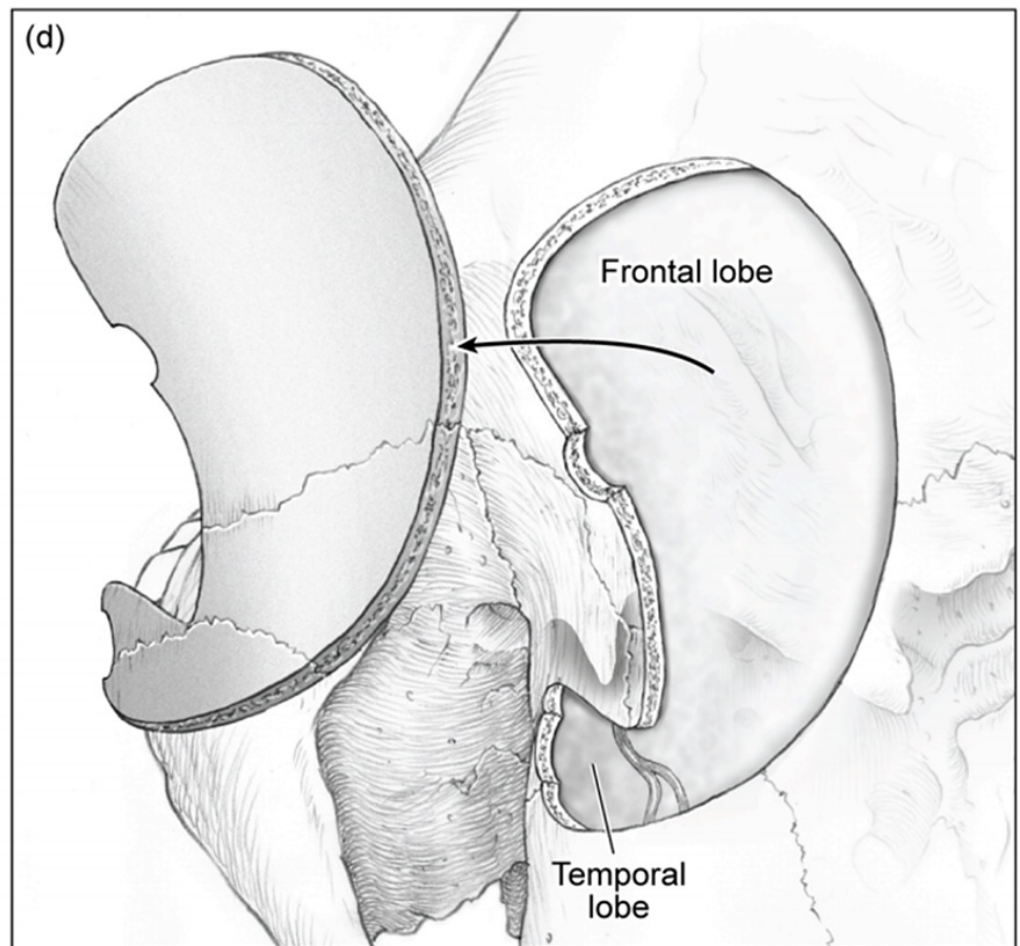


FIGURE 6: First part pterional bone piece removed showing V-shaped cut around lateral sphenoid wing.

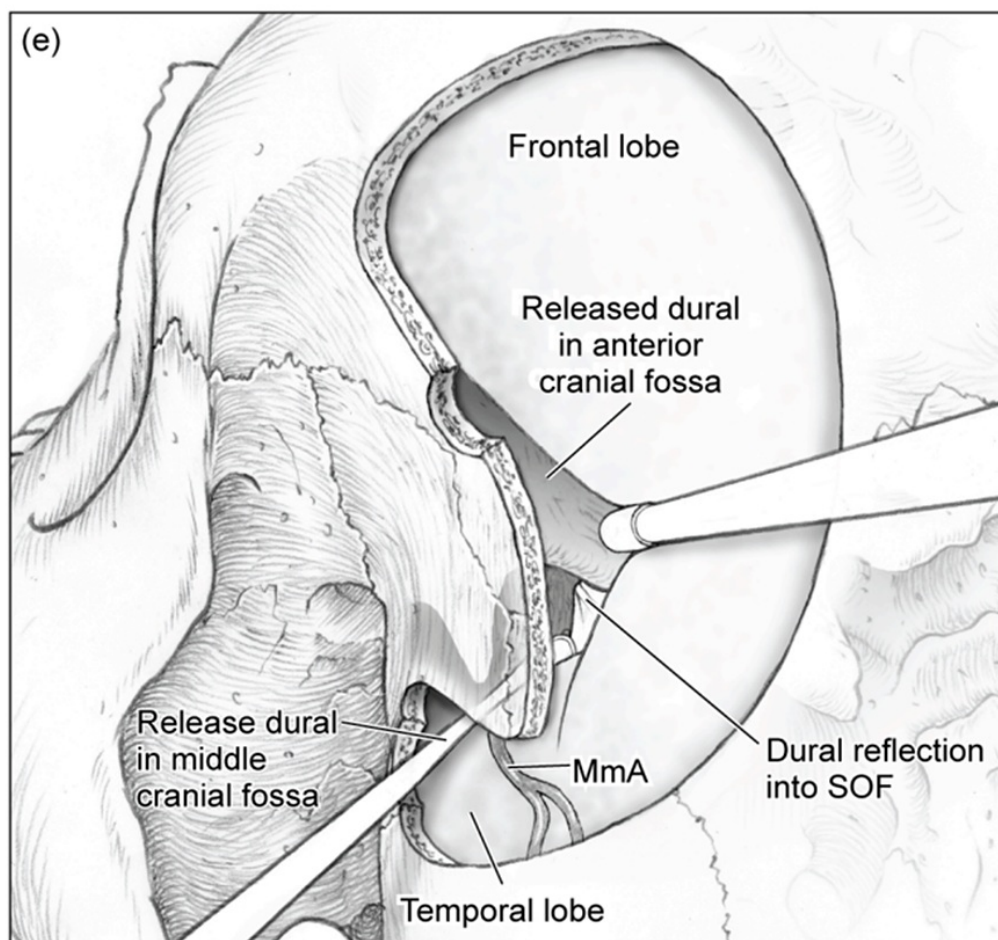


FIGURE 7: Extradural dissection begins over roof of orbit working backwards to sphenoid wing.

Once wing identified dura dissected off to dural fold over lateral aspect of superior orbital fissure. Then dura below wing to anterior limits of middle fossa dissected.

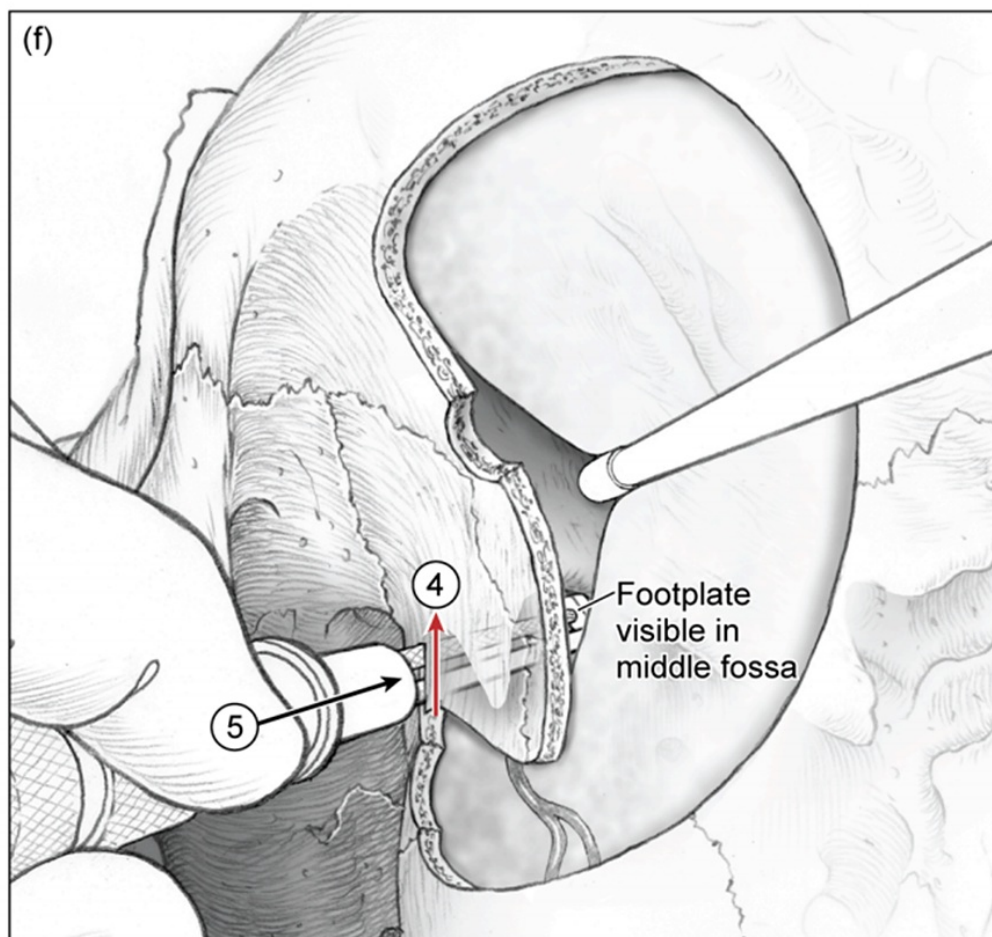


FIGURE 8: Final bone cut begins on temporal side cutting to anterior limits of middle fossa (4). Then drill is rotated (5) towards the sphenoid wing.

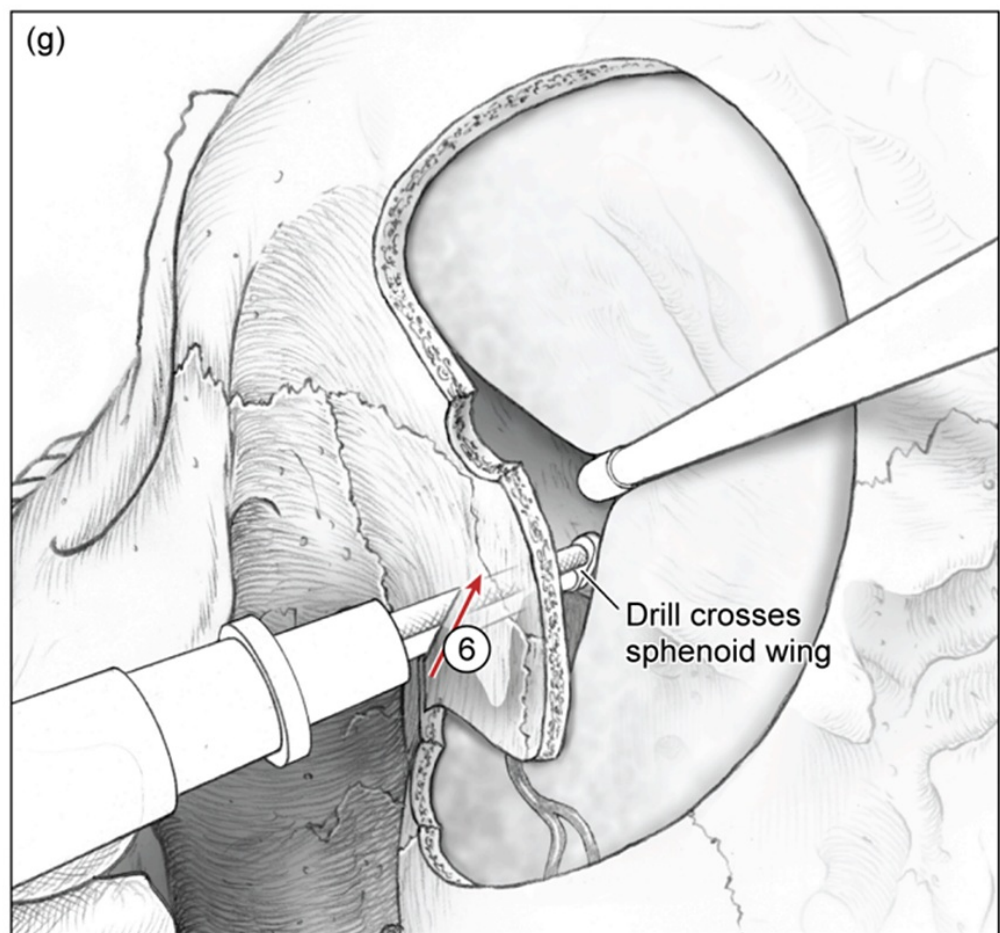


FIGURE 9: Under direct vision from above footplate is advanced passing under sphenoid wing just lateral to the dural reflection (6).

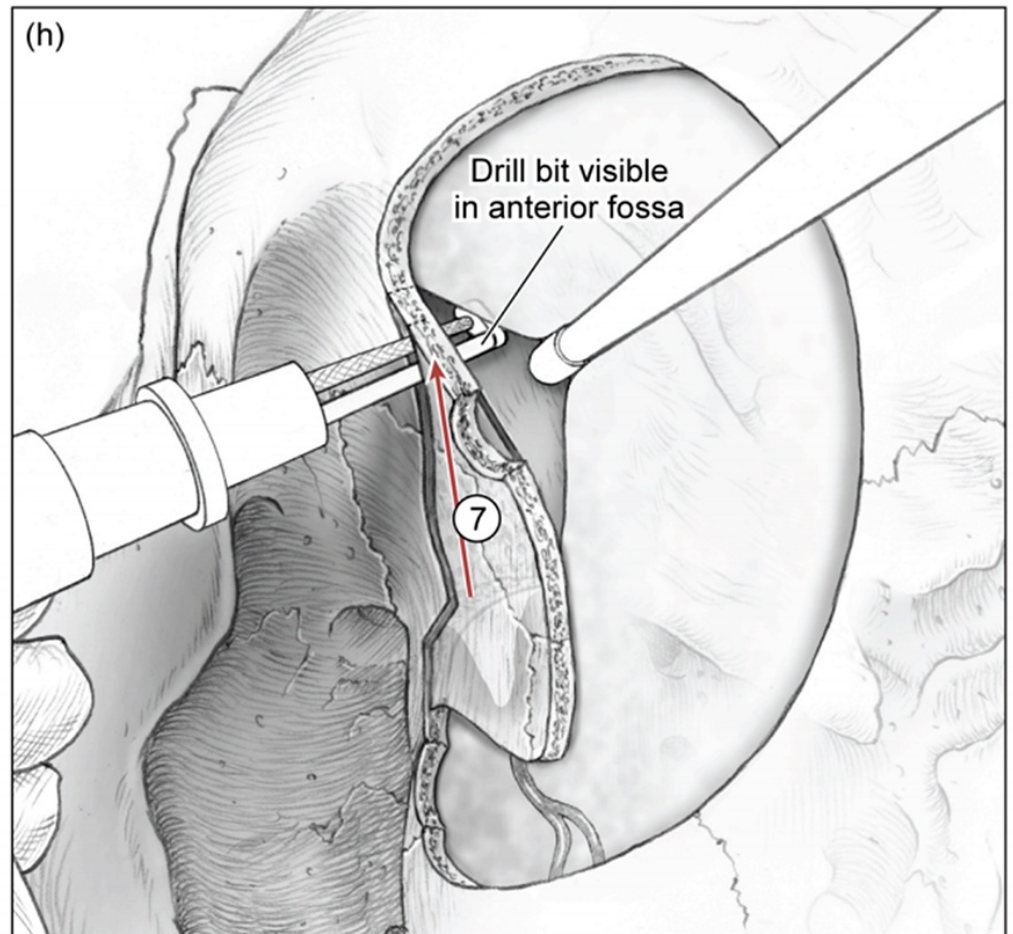


FIGURE 10: Once footplate passes the sphenoid ridge drill is turned anteriorly and cut is directed parallel to roof of orbit directly towards keypoint (7).

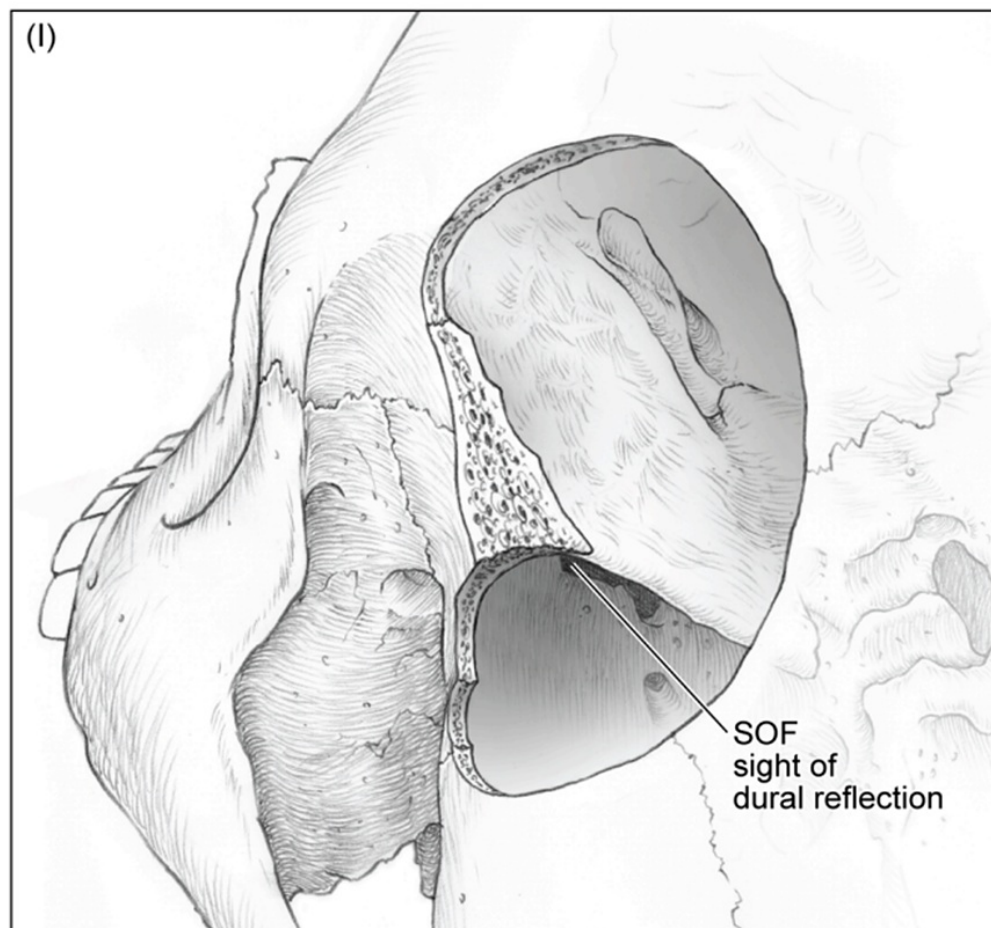


FIGURE 11: Final exposure after second part pterional craniotomy that has not required any drilling of lateral sphenoid wing.

The dura can be opened in a semi-lunar fashion and reflected back to maximize cortical exposure as necessary. At the end of the procedure, standard cranial reconstruction using titanium plates and screws is undertaken, followed by normal closure of the retracted superficial tissue. This technique does not increase surgical time, but results in a superior reconstructive and thus cosmetic result. A cadaver video dissection with audio can be seen following the link: <http://www.youtube.com/watch?v=qyG4UF3XdBk>

Discussion

The pterional craniotomy ("frontotemporosphenoid") is the term given to an approach which is focused on the junction of the frontal, temporal, parietal, and sphenoid bones [1-5]. This particular craniotomy has become one of the most dominant approaches amongst neurosurgeons by virtue of its extreme versatility and proven utility.

The pterional craniotomy evolved from the frontolateral craniotomy described by Dandy, which was originally created to expose the optic chiasm and pituitary. The now "classical" pterional approach was popularized by Yasargil in the second half of the 20th century [1-2].

Modifications have continued to arise, and the beauty of the pterional approach has been that it is a procedure adept at managing a large spectrum of disorders ranging from neoplastic pathologies to vascular lesions arising anywhere on the circle of Willis [12-16]. A neurosurgeon is able to address lesions via this technique that are in the sella and parasellar regions, as well as subfrontal, frontolateral and temporal areas. As required by the scenario at hand, the pterional approach elegantly provides access to the optic nerves, chiasm, lamina terminalis, cavernous sinus, as well as the circle of Willis. Further testament to its versatility is how commonly and easily it can be combined with other approaches. Nowhere is this highlighted better, than the orbitozygomatic approach, which at its core is essentially the original pterional approach proposed by Yasargil. The difficulty for the surgeon is crossing the sphenoid wing with the drill. This can usually not be done with a footplate attachment and other methods, such as drilling a trough across the wing or simply fracturing it open, are commonly used. Once the free bone flap is removed, the bone of the lateral wing is usually drilled down to expose the orbito-cranial periosteal fold to assist with better medial intradural exposure. Reconstruction of this bony defect is required at closure to provide a good cosmetic result and avoid a temporal hollow. The two part pterional technique avoids the difficulty of free bone flap by allowing direct exposure and sub-periosteal dissection of the sphenoid wing prior to removal in the second step of the procedure. The second bone piece is removed using the footplate under direct vision using the medial orbito-cranial periosteal fold as the medial landmark for crossing the wing with the footplate. At closure, no reconstruction is required other than connecting the bone pieces together with plates and screws.

The so-called mini-pterional craniotomy, like the transcalyary orbital keyhole technique, is aimed at providing an alternative to the pterional approach [13, 16]. This procedure has been shown to give exposure comparable to the classical pterional approach for much of the anterior circulation, while at the same time reducing the extent of dissection of the temporalis muscle. However, the pterional approach still affords the neurosurgeon greater exposure of the temporal lobe, better exposure of the MCA branches, and furthermore, allows a greater flexibility by facilitating a more anterior approach than possible with the mini-pterional. Lastly, this technique continues to also drill down the sphenoid bone, something unnecessary in our approach, and which has the potential to compromise the bony support and thus cosmetic outcome for the patient.

Conclusions

The two part pterional approach is an option to the classic technique and has several advantages for the surgeon and patient. For the surgeon the technique may be easier in that it avoids the difficulty with crossing the sphenoid wing and may eliminate the need for reconstruction with titanium mesh or other implants at closure. For the patient, improved cosmesis may result from preservation of the sphenoid bone supporting the temporalis muscle, avoiding the depression just behind the orbit.

Additional Information

Disclosures

Human subjects: All authors have confirmed that this study did not involve human participants or tissue. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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