



Interfascial approach for pterional craniotomy: technique and adjustments to prevent cosmetic complications

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Abstract

Background Interfascial dissection for pterional craniotomy is one of the main techniques to expose the pterional region.

Method A step-by-step optimized method of interfascial dissection to avoid three main esthetic complications of the pterional approach—upper facial nerve palsy, temporal muscle atrophy, and retro-orbital depression. A video of the interfascial dissection and three artistic drawings are provided in support of this technique.

Conclusion A safe method of interfascial dissection, respecting anatomy, and avoiding cosmetic complications has been proposed.

Keywords Pterional approach · Cosmetic complications · Interfascial dissection · Temporal muscle dissection · Facial nerve

Abbreviations

GA	Galea aponeurotica
LAT	Loose areolar tissue
STL	Superior temporal line
TF	Temporal fascia
TPF	Temporoparietal fascia
TM	Temporal muscle

Relevant surgical anatomy

Anatomic layers

The denomination developed by Davidge et al. to describe the anatomic layers was adopted in this study [2]. Above the superior temporal line (STL), five soft tissue layers from surface to depth comprise the skin, the subcutaneous tissue, the galea aponeurotica (GA), the loose areolar tissue (LAT), and the pericranium, firmly attached to the calvaria (Fig. 1) [6, 7]. The GA is in continuity with the frontalis muscle anteriorly, with the occipitalis muscle posteriorly, and merges laterally with the temporoparietal fascia (TPF) below the STL [2]. Above the STL, the LAT separates the GA from the pericranium, while it splits the TPF from the temporal fascia (TF) covering the temporal muscle (TM) below the STL. Along the STL, the pericranium fuses with the TF above the TM. Behind the superior and lateral orbital rim and above the zygomatic arch, the TF divides into superficial and deep layers, containing the interfascial fat pad. The TM is encompassed in its own sheath, the superficial layer below the TF, and the thin deep layer in contact with the bone. Between the superior and inferior temporal lines, the fibers of the TM are directly and firmly attached to the bone, without interposition of any sheath or periosteum.

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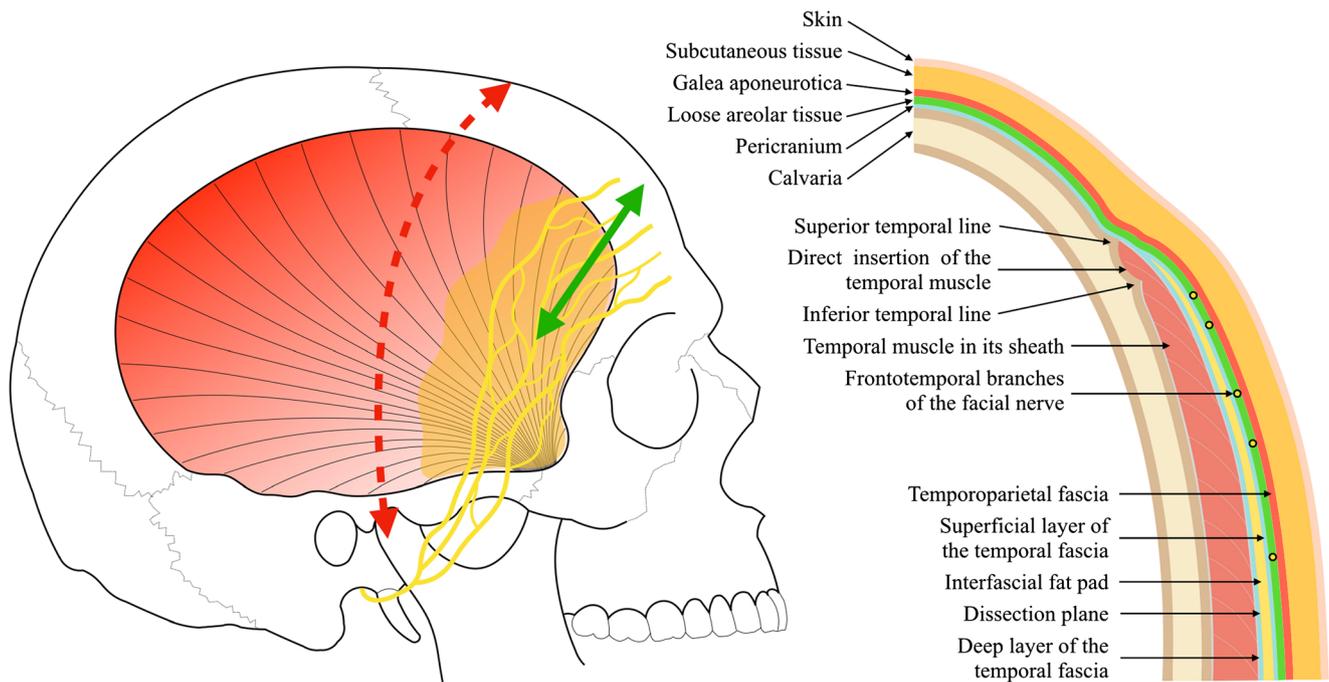


Fig. 1 Anatomy of the temporal region. At left: right-sided view of the temporal muscle (red), interfascial fat pad (orange), and frontotemporal branches of the facial nerve (yellow). The double red arrow indicates the

skin incision of the pterional approach. At right: coronal view of the different anatomic layers at the level of the double green arrow

Nerves

The frontotemporal branches of the facial nerve form a reticular network of tiny nerves (usually three branches below and five branches above the STL) that innervate the frontalis, orbicularis oculi, and corrugated supercillii muscles [6]. These branches first ascend in the LAT on the outer surface of the TF and under the TPF, then cross the STL, and finally run in between the pericranium and the GA, still located in the LAT (Fig. 1).

Vessels

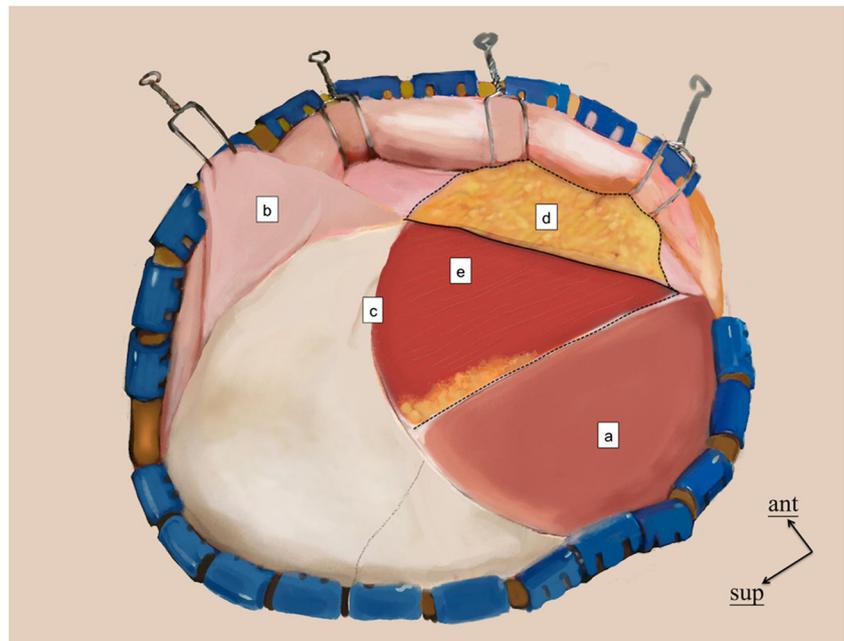
The superficial temporal artery crosses the zygomatic arch in the subcutaneous tissue in front of the tragus. The interfascial fat pad vein lies in the fat pad between the superficial and deep layers of the TF [1]. The deep TM feeder arteries and nerves course between the medial surface of the muscle and the deep layer of its sheath. A zygomatic branch of the lacrimal artery, which anastomoses with the deep temporal arteries, is found close to the orbital rim, at the point of junction with the STL [3].

Description of the technique

The patient is placed in a supine position. Using a Mayfield three-pin head holder, the neck is extended to 15° and the head is vertically rotated according to the surgical target. The

incision starts 1 cm anterior to the tragus, rises perpendicular to the zygoma, crosses the STL, and then, curves anteriorly toward the midline behind the hairline (Video). The frontal extent of the incision must be adapted to the required craniotomy, with minimal retraction. The skin, subcutaneous tissue, GA, LAT, and frontal pericranium are directly incised above the STL, sparing the TF below it. A periosteal elevator is used to elevate the scalp in one piece above the STL. Below it, a cold scalpel is used to elevate the GA from the TF, progressing into the LAT until reaching the level of the interfascial fat pad, which is detected by transparency (sometimes challenging). The superficial layer of the TF and fat are incised with a cold blade to perform the temporal interfascial dissection in order to preserve the frontotemporal branches of the facial nerve (Fig. 2) [9]. The dissection continues between the fat pad and the deep layer of the TF, that is spared, and crosses the interfascial vein, which indicates the correct dissection plane and would be coagulated [1]. The elevation of the frontal pericranium from the bone and interfascial fat pad from the inner layer of the TF are alternated in order to reach the orbital rim subperiosteally. The zygomatic branch of the lacrimal artery close to the orbital rim is coagulated and divided. The two parts of the scalp are folded toward the orbital rim and maintained with fish hooks. Once correctly exposed, the sheath of the TM is incised using a cold blade along the STL and lateral orbital rim. In case of required large exposition of the temporal squama or hypertrophic TM, an incision of the posterior part of the TM sheath along the skin incision can be performed. Retrograde elevation of the muscle is then

Fig. 2 Interfascial dissection. Dotted line: incision of the superficial layer of the temporal fascia; continuous line: interfascial dissection plane; (a) temporal fascia overlying the temporal muscle in its sheath; (b) frontal pericranium; (c) superior temporal line; (d) interfascial fat pad; (e) deep layer of the temporal fascia



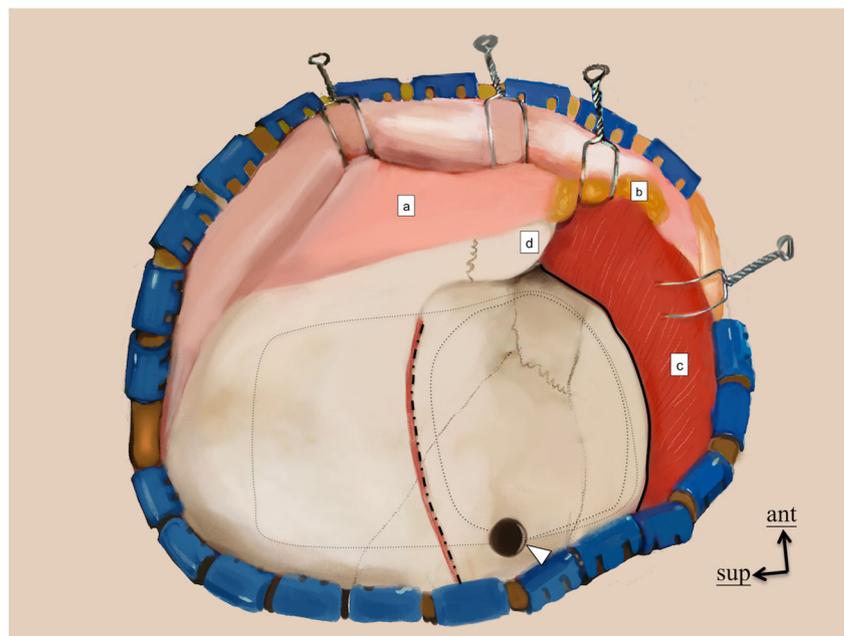
achieved with a cutting spatula and without monopolar coagulation, from anterior to posterior, and from below to above, detaching the muscle fibers insertion by their closed angle [5]. This subperiosteal and atraumatic dissection respects the innervation and vascularization of the TM, coursing in the inner sheath of the muscle. Finally, the TM is reflected postero-inferiorly with multiple fish hooks to expose the pterion (Fig. 3). To avoid postoperative retro-orbital depression, one burr hole is placed posteriorly, below the STL, or downright on the temporal squama, saving the bone dust for the time of closure. The underlying dura is separated from the bone using

a small curved dural elevator, with semicircular movements in the epidural space. The superior and inferior parts of the craniotomy start from the burr hole and are directed toward the orbital rim and the sphenoid ridge. The pterion is ultimately drilled to complete the craniotomy.

Indications

Pterional approach is indicated for anterior and middle skull base cases and for anterior circulation vascular cases.

Fig. 3 Temporal muscle dissection and craniotomy. In this case, an additional incision at the posterior part of the temporal muscle was performed along the skin incision. Thick dotted line: superior incision of the temporal muscle; continuous line: retrograde dissection plane of the temporal muscle; white arrow: unique burr hole; thin dotted lines: variable sizes and shapes of the pterional craniotomy; (a) frontal pericranium; (b) interfascial fat pad; (c) temporal muscle; (d) frontal process of the zygomatic bone



Limitations

Pterional approach is not appropriate for parasagittal, sella turcica, and third ventricle lesions.

How to avoid esthetic complications

The main issue with the pterional approach is the achievement of optimal surgical exposition without cosmetic complication. Injury of the frontotemporal branches of the facial nerve leading to upper facial palsy is characterized by the loss of forehead wrinkles and ptosis of the eyebrow (Fig. 4). The interfascial dissection procedure remains the safest way to preserve both the branches of the facial nerve and the TM, providing a direct subperiosteal exposition of the zygomatic arch, without any additional incision. Care should be taken not to venture too far forward in the dissection of the GA from the TF to spare these branches of the facial nerve. To avoid restraining the retraction of the TM, the incision in the superficial layer of the TF should be close enough to the zygomatic arch. Postoperative TM atrophy and dysfunction can be explained by direct muscle fibers injury, ischemia, denervation, or inappropriate tension during reattachment [4]. The resulting temporal hollowing is particularly bothersome, considering the consequent facial asymmetry (Fig. 5). Interfascial dissection combined with retrograde elevation of the TM without using monopolar coagulation preserves both superficial sheath of the TM bonded to the TF, and deep sheath containing vascularization and innervation of the muscle. To prevent excessive muscle tension during closure time, careful reattachment of the TF to the muscle cuff, fixation plates or transosseous stitches, is essential [8]. Retro-orbital depression is a circular centimetric skin depression caused by the bony defect of the burr hole. It also potentially occurs below the STL due to TM atrophy and muscle prolapse in the burr hole. Preoperative reflection must be made to optimize the number and placement of burr holes from one to four, considering that the adhesion of the dura increases with age. To correctly fill the burr holes and the craniotomy grooves using the bone dust

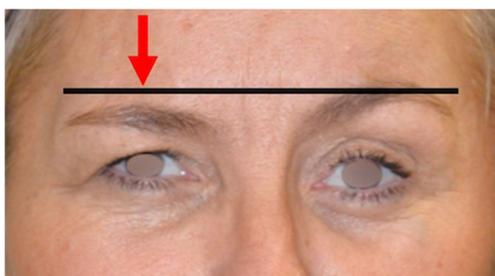


Fig. 4 Postoperative palsy of the frontotemporal branches of the facial nerve: black line: supraorbital line; red arrow: right pseudo palpebral ptosis



Fig. 5 Postoperative temporal muscle atrophy: red arrow: left temporal hollowing

is critical. Bone cement or an adequately placed star-shaped plate over the burr holes to fix the bone flap can sometimes be helpful.

Specific perioperative considerations

An appropriate radiological workup to the pathology is necessary. The vertical rotation of the head, the length of the skin incision, and the size and shape of the craniotomy have to be anticipated and adapted to the targeted lesion, to the experience of the neurosurgeon and to the hair of the patient to obtain optimal exposure, minimal brain retraction, and no esthetic adverse effects.

Specific information to give to the patient about surgery and potential risks

General information about benefits and risks of a neurosurgical intervention, including the shape and size of the incision, should be provided. Informed consent must be obtained from the patient prior to surgery.

Key points

- Reaching the anterior and middle skull base and anterior circulation is best achieved by the pterional approach.
- Vertical head rotation and length of the skin incision depend on the surgical target.
- Interfascial dissection prevents palsy of the frontotemporal branches of the facial nerve.
- The interfascial vein is a landmark of the interfascial fat pad.
- Performing retrograde dissection of the TM without monopolar coagulation prevents atrophy.
- Correct exposition of the temporal fossa and of the zygomatic arch is important.
- Size and shape of the craniotomy vary depending on the surgical target.

- Careful TM reconstruction prevents excessive tension and dysfunction.
- Saving the bone dust is important as it can be used to fill burr holes and craniotomy grooves to prevent retro-orbital depression.
- Bone cement or adequately placed star-shaped plate over the burr hole can be helpful.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Campero A, Ajler P, Paíz M, Elizalde RL (2017) Microsurgical anatomy of the interfascial vein. Its significance in the interfascial dissection of the pterional approach. *Oper Neurosurg* 13(5):622–626
2. Davidge KM, van Furth WR, Agur A, Cusimano M (2010) Naming the soft tissue layers of the temporoparietal region: unifying anatomic terminology across surgical disciplines. *Oper Neurosurg* 67:ons120–ons130
3. Gray H, Lewis WH (1918) *Anatomy of the human body*. Lea & Febiger, Philadelphia
4. Kadri PA, Al-Mefty O (2004) The anatomical basis for surgical preservation of temporal muscle. *J Neurosurg* 100(3):517–522
5. Oikawa S, Mizuno M, Muraoka S, Kobayashi S (1996) Retrograde dissection of the temporalis muscle preventing muscle atrophy for pterional craniotomy. *J Neurosurg* 84(2):297–299
6. Poblete T, Jiang X, Komune N, Matsushima K, Rhoton AL (2015) Preservation of the nerves to the frontalis muscle during pterional craniotomy. *J Neurosurg* 122(6):1274–1282
7. Salas E, Ziyal IM, Bejjani GK, Sekhar LN (1998) Anatomy of the frontotemporal branch of the facial nerve and indications for interfascial dissection. *Neurosurgery* 43(3):563–569
8. Spetzler RF, Lee KS (1990) Reconstruction of the temporalis muscle for the pterional craniotomy. *J Neurosurg* 73(4):636–637
9. Yasargil MG (1985) *Microneurosurgery: microsurgical anatomy of the basal cisterns and vessels of the brain, diagnostic studies, general operative techniques and pathological considerations of the intracranial aneurysms: 1st (first) edition, 21621st edition*. Thieme Medical Publishers, Incorporated

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