Anat Morphol. 2025;1(3):92-98

Received: 2025-07-05 / Accepted: 2025-09-25

Anatomical Bases of the Orbito-Zygomatic Approach

Pablo S. Paolinelli, Axel Colombo, Julián Cicler, Valentín Iglesias, Julieta Laura Rodríguez Valdivia, Fabián Dodaro

Neuroanatomy Laboratory
III Chair of Anatomy
Faculty of Medicine
University of Buenos Aires
Buenos Aires
Argentina

Correspondence
Pablo S. Paolinelli
Neuroanatomy Laboratory
III Chair of Anatomy
Faculty of Medicine
University of Buenos Aires
Buenos Aires
Argentina

Email: pablo.paolinelli@gmail.com

PAOLINELLI PS, COLOMBO A, CICLER J, IGLESIAS V, RODRÍGUEZ-VALDIVIA JL, DODARO F. Anatomical bases of the orbito-zygomatic approach. *Anat Morphol. 2025;1(3)*:92-98

ABSTRACT: The approach to the anterior and middle cranial fossae poses significant challenges for neurosurgeons due to the numerous critical structures encountered in this region. The orbitozygomatic approach (OZA), developed as an extension of the pterional approach (PA), allows access not only to the anterior and middle cranial fossae but also to the orbit. Therefore, a thorough understanding of the regional anatomy is essential to minimize surgical risks. The objective of this study is to describe the anatomy of the OZA, emphasizing the anatomical landmarks relevant to the approach. This study was conducted using five cadaveric heads preserved in 5% formalin, one dry skull, standard dissection instruments, a drill and Gigli saw, a high-speed drill, and a high-resolution camera. A stepwise, layer-by-layer dissection was performed to detail the anatomical features of the approach. The OZA provides broad access to the cranial fossae and orbit with reduced brain retraction, thereby minimizing potential damage to the parenchyma and surrounding neurovascular structures. Dissection began with the superficial layers (skin, subcutaneous tissue, temporalis muscle, and skull) to reduce approach-related morbidity. After performing the craniotomy, the temporal and frontal lobes, orbit, and lateral fissure were widely exposed. Dissection of the lateral fissure enabled access to deeper structures via multiple pathways. With meticulous microsurgical technique, this approach creates a wide and practical surgical corridor. However, its complexity lies in the proximity to deep vascular structures, where inadvertent injury may result in significant morbidity and mortality. The OZA is a highly complex approach, requiring extensive anatomical knowledge and practice. Cadaveric dissection provides a three-dimensional and topographic understanding of the neurovascular relationships along the surgical route, thereby enhancing the surgeon's familiarity with the region and ultimately improving clinical outcomes.

KEY WORDS: Orbitozygomatic approach, pterional approach, transzygomatic

INTRODUCTION

Access to the anterior and middle cranial fossae of the skull base presents complex surgical routes for the neurosurgeon. This complexity is due to the presence of numerous critical anatomical structures, including the basal surfaces of the frontal and temporal lobes, the cerebral arterial circle (circle of Willis), the optic, oculomotor, trochlear, ophthalmic, and maxillary nerves, as well as the cavernous sinus and its tributaries. Injury to any of these structures may result in significant morbidity and mortality, leading to poorer patient outcomes (De Oliveira *et al*., 1993). Potential complications associated with the orbitozygomatic approach (OZA) include brain injury secondary to retraction, hemorrhage resulting from damage to the internal carotid artery or cavernous sinus, cerebrospinal fluid fistulas, and cranial nerve injuries (Zabramski *et al*., 1998; Seçkin *et al*., 2008; Salinas Sánchez *et al*., 2015; Klironomos & Dehdashti, 2017).

The OZA described by Jane (Ikeda *et al*., 1991), Pellerin (McDermott *et al*., 1990), and Hakuba *et al*. (1986) represents an extension of the pterional approach (PA) originally described by Yasargil (Yasargil & Fox, 1975; Yasargil *et al*., 1976; Yasargil, 1984). This extension aims to widen the surgical corridor to the anterior and middle cranial fossae and the anterior portion of the posterior fossa.

Comprehensive knowledge of the anatomical structures involved in this surgical route contributes to a reduction in complication rates, provides a greater margin of maneuverability in deep surgical fields, and minimizes brain retraction. These advantages facilitate more extensive resections of space-occupying lesions and improve the management of complex neurovascular pathologies.

The objective of this article is to describe in detail the anatomy of the orbitozygomatic approach, emphasizing the most relevant anatomical landmarks through cadaveric dissection.

MATERIAL AND METHOD

The following materials were used: five cadaveric specimens consisting of the head, neck, and brain, preserved in 5% formalin; one dry skull; a felt-tip marker; and standard dissection instruments, including a No. 4 scalpel handle, left-handed forceps with and without teeth, Adson and Brucelles forceps, curved Metzenbaum scissors, curved and straight Iris scissors, curved Mayo and Castro Viejo scissors, a Penfield dissector, needle holders and various surgical sutures, a drill with a self-locking drill bit, a Gigli saw, a high-speed drill, and high-resolution cameras.

RESULTS

General anatomical exposure provided by the orbitozygomatic approach

The orbitozygomatic approach (OZA) provides access to the deeper regions of the middle and anterior cranial fossae, with the advantage of reducing excessive retraction of the temporal and frontal lobes. It can be performed as a one-, two-, or three-piece craniotomy. In neurosurgery, excessive brain retraction is associated with increased damage to the brain parenchyma and neurovascular structures and may consequently result in severe sequelae for the patient. In the present study, five human cadaveric heads fixed in 5% formalin were dissected layer by layer, from superficial to deep planes, in the regions involved in the OZA, respecting the regional anatomy that must be thoroughly studied and understood by the neurosurgeon.

The regional anatomy primarily includes the superficial layers from the skin and subcutaneous tissue, the temporalis muscle with its superficial and deep layers, and the skull of the temporal fossa, as well as the lateral frontal region, the anterior and middle cranial fossae, and the orbital cavity. A precise understanding of these superficial layers and the arteries supplying this territory allows the surgical approach line to be planned in a way that minimizes aesthetic sequelae associated with the OZA, particularly those resulting from injury to the neurovascular bundles that supply the temporalis muscle.

The orbitozygomatic craniotomy strategically exposes a wide surface of the frontal and temporal lobes, the lateral fissure, and the contents of the orbital cavity, providing a broad margin of maneuverability during dissection to access deep structures, which is later applied in the surgical procedure.

Extensive exposure of the cerebral surface, combined with dissection of the lateral fissure, further reveals deep anatomical elements and allows for the comfortable use of the sylvian, subfrontal, and subtemporal approaches.

In this manner, upon reaching deeper planes, a larger working field is achieved using microdissection and microsurgical instruments, thereby increasing the margin of maneuverability for the dissector and neurosurgeon. This is particularly relevant because injury to any of the major vascular structures encountered at depth—including the internal carotid artery, cavernous sinus, perforating branches of the circle of Willis, anterior choroidal artery, posterior communicating artery, basilar artery, and posterior cerebral arteries—is associated with a high rate of morbidity and mortality and, consequently, a poor patient prognosis.

Step-by-step anatomical results of the orbitozygomatic approach

The step-by-step description of the OZA on the cadaveric specimen, using the right side, is as follows:

The head is placed in the supine position with rotation to the left, and the arcuate incision line is drawn on the skin, starting 1 cm anterior to the tragus (anterior to the superficial temporal artery and the auriculotemporal nerve7) and then ascending, curving forward to end behind the hairline, at the level of the contralateral mid-pupillary line (Fig. 1).

Fig. 1. Right lateral view of a cadaveric. The dotted line indicates the location of the incision.

The incision is made with a N° 24 scalpel, following the previously marked line, taking care not to injure the temporalis muscle (Fig. 2A).

The frontotemporal flap is created using cutting and dissecting instruments, employing the interfascial-subperiosteal technique to avoid injury to the frontal branch of the facial nerve. This technique is based on the anatomy of this nerve in relation to the fascia of the temporalis muscle. The muscle is covered by a superficial fascia and a deep fascia. The superficial fascia divides into two layers (one superficial and one deep) (Fig. 2D) separated by adipose tissue, within which the frontal branch of the facial nerve runs. The superficial layer and the adipose layer are sectioned in a cephalocaudal direction, and the deep layer is dissected8. This way, the course of the nerve is protected.

Next, the temporalis muscle is detached by making a craniocaudal incision anterior to the skin incision line, and another anteroposterior incision immediately inferior and parallel to the superior temporal line, leaving the superior insertion of the muscle intact and exposing the temporal fossa (Fig. 2B).

Once the frontotemporal region is exposed, the craniotomy is initiated by creating 4 burr holes: The first, called MacCarty's point (Fig. 3), is made posterior and superior to the frontozygomatic suture. Its purpose is to expose the anterior cranial fossa and the orbital cavity with the bony lamina separating them (roof of the orbit). The second is above the superior orbital rim, 2 cm from the first. The

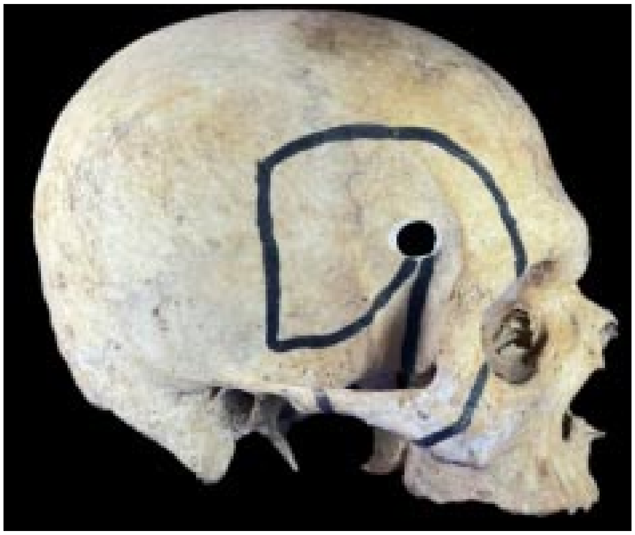

Fig. 3. Lateral view of the skull showing the craniotomy line (black line), MacCarty's point, and the remaining burr holes.

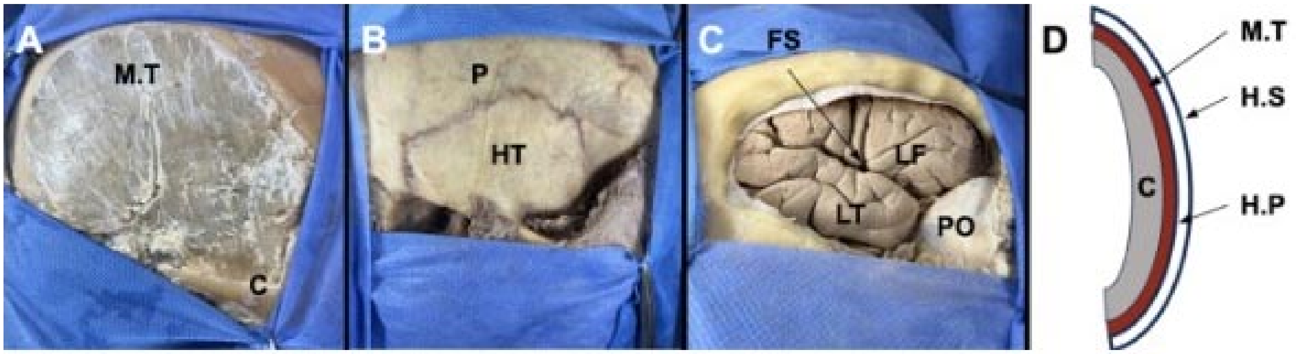

Fig. 2. A. Dissection of the temporal region showing: temporalis muscle (MT) after removing the skin, subcutaneous tissue, and zygomatic process (C). B. The bone of the temporal region is shown: temporal bone (HT) and parietal bone (P). C. The frontal lobe (LF), temporal lobe (LT), sylvian fissure (FS), and periorbita (PO) are shown after performing the craniotomy, drilling of the lateral orbital wall, and durotomy. D. Schematic of a coronal section from medial to lateral showing the skull, TM, deep layer of the superficial temporal fascia (DL), and superficial layer (SL).

third is immediately superior to the most posterior portion of the superior temporal line. The fourth is as inferior as possible on the temporal squama, near the base of the zygomatic arch. The burr holes were connected using a Gigli saw.

Then, the frontozygomatic pillar is removed by making cuts in the roof and lateral wall of the orbit, the body of the zygoma, and the base of the zygomatic arch (Fig. 3). This allows further downward mobilization of the temporalis muscle.

Next, the dura mater is separated from the inner table; in our case, a Penfield dissector was used, and then the bone flap is removed.

The dura mater is opened in a "C" shape (durotomy) (Fig. 2C).

Deep anatomical corridors and neurovascular structures exposed

From this point on, various anatomical corridors can be used to access deep structures: the transsylvian corridor (through the sylvian fissure), subtemporal (below the temporal lobe), pretemporal (anterior to the temporal pole), and subfrontal (below the frontal lobe).

The most important corridor is the transsylvian corridor. The superficial middle cerebral [Sylvian] vein is identified in the lateral [Sylvian] fissure, and the fissure is opened using microdissection instruments. Deep to the vein

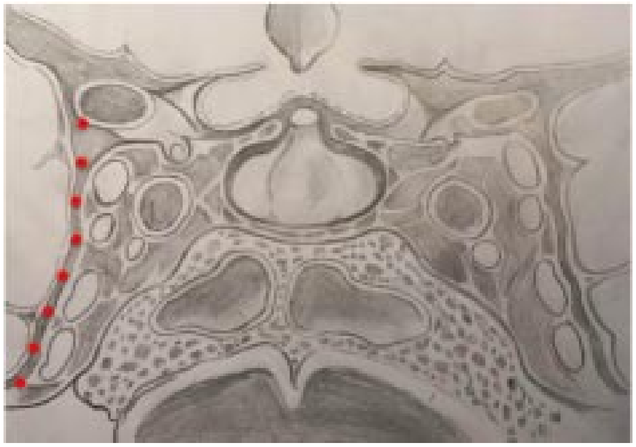

Fig. 4. Diagram of the cavernous sinus. The red dotted line indicates its lateral margin with its neurovascular relations.

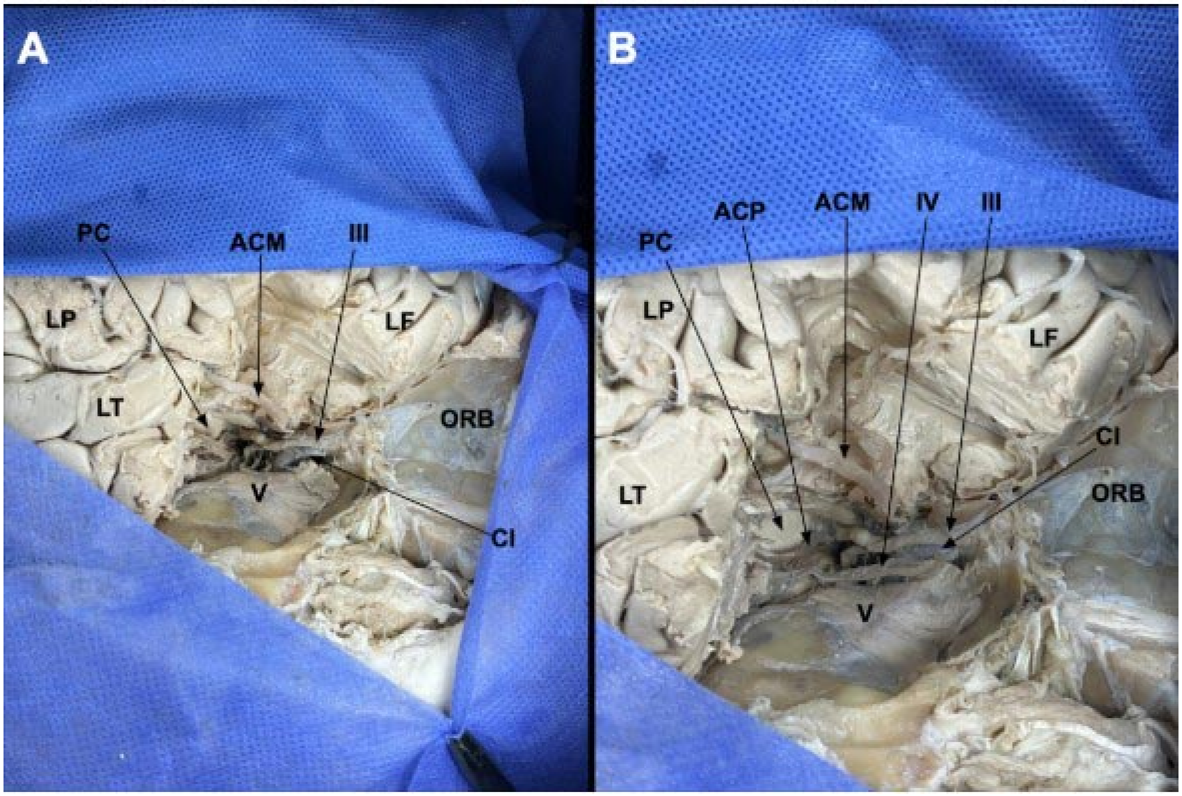

Fig. 5. A. Dissection of the middle cranial fossa after surgical removal of the dura mater. We bserved: Temporal Lobe (LT), Parietal Lobe (LP), Frontal Lobe (LF), Cerebral Peduncle (PC), Middle Cerebral Artery (ACM), Oculomotor Nerve (III), Trigeminal Nerve (V), Internal Carotid Artery (CI), Orbit (ORB). B. Same dissection but with a closer view: Trochlear Nerve (IV), Posterior Cerebral Artery (ACP).

are the M1, M2, and M3 segments of the middle cerebral artery. To expose these, a temporal pole resection (temporal poleectomy) was performed, allowing for dissection and observation of deeper structures. Once these are dissected, the frontal and temporal lobes are gently retracted, taking care not to injure the vascular structures, to access the deep structures.

First, the lateral wall of the cavernous sinus with its nerve branches is identified (Fig. 4): the 3 branches of the trigeminal nerve: ophthalmic, maxillary, and mandibular (Figs. 5A and 5B). Superior to the ophthalmic nerve, reaching the superior orbital fissure, the oculomotor and trochlear nerves are observed. Deep to these are the cavernous portion of the internal carotid artery and the abducens nerve (Fig. 6A). Posterior dissection allows us to observe the midbrain and the most superior portion of the pons, the dorsum sellae, and the basilar artery bifurcating into the posterior cerebral arteries (top of the basilar artery) along with the elements of the interpeduncular cistern (Fig. 6B).

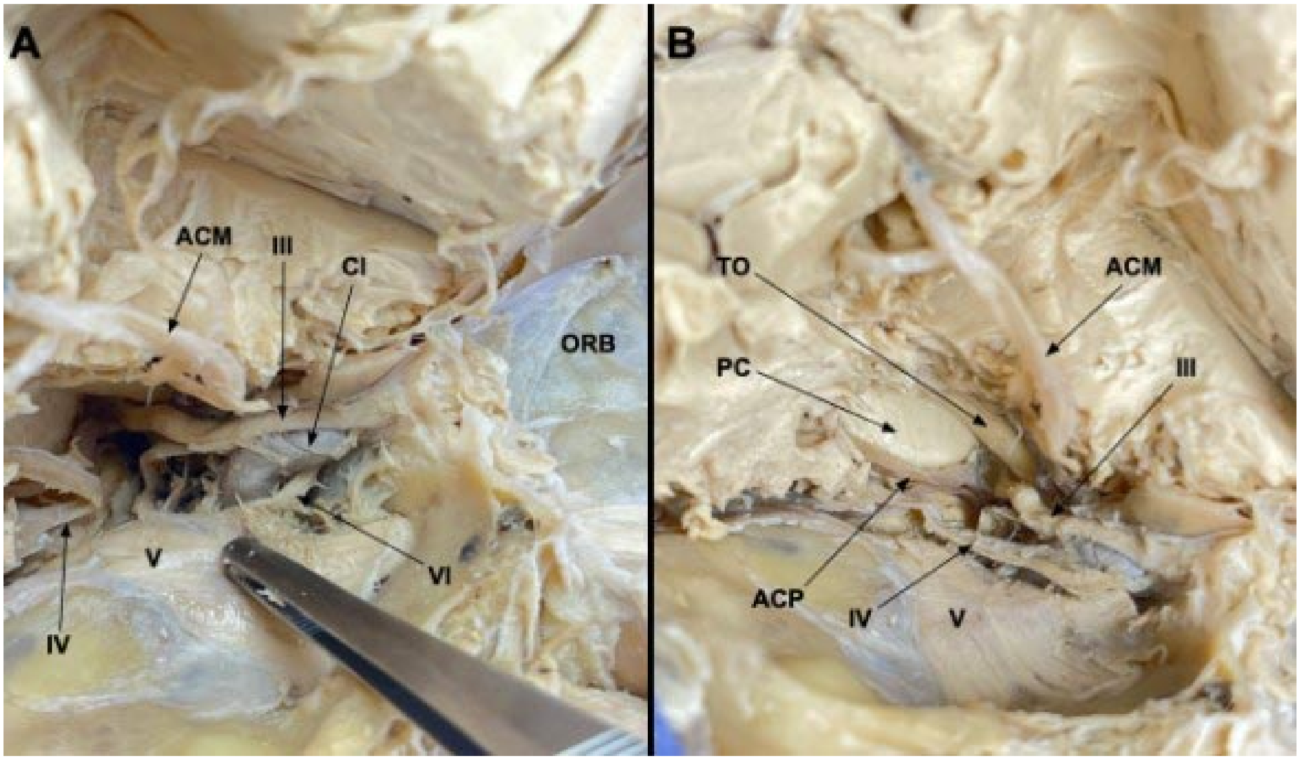

Fig. 6. A. Detailed dissection of the cavernous sinus. The tweezers retracts the Ophthalmic nerve to show the Abducens nerve (VI) and the relation with the internal carotid artery (CI). We can also observe the retracted Trochlear nerve (IV), Middle Cerebral Artery (ACM), Oculomotor nerve (III), Trigeminal nerve (V), and the orbit (ORB). B. Same dissection but without retracting the Ophthalmic nerve. We can see: cerebral peduncle (PC), Posterior Cerebral Artery (ACP), Optic Tract (TO), Middle Cerebral Artery (ACM), oculomotor nerve (III), trochlear nerve (IV).

DISCUSSION

The orbitozygomatic approach (OZA) represents a more extensive cranial base approach than the classic pterional and transzygomatic approaches (Yasargil & Fox, 1975; Yasargil *et al*., 1976; Samson *et al*., 1978; Yasargil, 1984; Zabramski *et al*., 1998; Seçkin *et al*., 2008). It is characterized by the removal of the superolateral orbital rim and the zygoma, which significantly increases surgical exposure of deep anatomical structures and, consequently, reduces the risk of injury to critical neurovascular elements (Luzzi *et al*., 2022a,b). By expanding the surgical corridor and lowering the working angles toward the skull base, the OZA allows the surgeon to operate with a wider field of view and improved instrument maneuverability, thereby decreasing the need for excessive brain retraction.

The reduction in brain retraction is a key advantage of the OZA, as retraction-related injury to the frontal and temporal lobes remains a major source of postoperative morbidity in skull base surgery (Zagzoog & Reddy, 2020). By shortening the depth of the surgical trajectory and improving the angle of attack, the OZA facilitates safer access to deep-seated lesions while preserving surrounding neural and vascular structures (Angileri *et al*., 2023). This anatomical benefit is particularly relevant in complex neurovascular and neoplastic pathologies, in which even minimal manipulation can result in significant functional deficits.

Clinically, the OZA has been widely used in the management of a variety of challenging pathologies, including large aneurysms of the anterior cerebral artery and the basilar artery apex (Tayebi *et al*., 2018a,b), meningiomas of the anterior clinoid and orbito-sphenoidal regions (Cohen-Gadol *et al*., 2012), large craniopharyngiomas (Massa *et al*., 2021), and giant pituitary adenomas (Gimenez *et al*., 2022). In these cases, the approach provides direct access to the orbit, anterior and middle cranial fossae, and the sellar, parasellar, and suprasellar regions, as well as to the petroclival area, with minimal or no brain retraction.

From an anatomical perspective, the OZA enables simultaneous visualization of multiple deep corridors, including the transsylvian, subfrontal, pretemporal, and subtemporal routes (Suzuki *et al*., 2024). This versatility allows the surgeon to tailor the surgical strategy according to the location, size, and extension of the lesion, rather than forcing the pathology to fit a limited exposure (Reddi, 2003). As demonstrated in the present cadaveric study, detailed knowledge of the superficial and deep anatomy encountered during the OZA is essential for maximizing its advantages and minimizing approach-related morbidity.

In this context, cadaveric dissection remains a fundamental tool for understanding the three-dimensional relationships of the skull base and for refining surgical techniques. The step-by-step anatomical analysis presented in this study reinforces the importance of meticulous anatomical training in skull base surgery and supports the OZA as a powerful and versatile approach for the management of complex lesions involving the anterior and middle cranial fossae.

CONCLUSION

The anatomy of the orbitozygomatic approach is highly complex and involves multiple anatomical challenges that must be carefully considered to achieve optimal surgical outcomes. Continuous and meticulous practice on cadaveric models, as demonstrated in this study, enables surgeons to develop a precise three-dimensional and topographical understanding of the critical anatomical structures encountered along the approach route. When translated into clinical practice, this anatomical mastery contributes to safer surgical execution, improved outcomes, and ultimately to an enhanced quality of life for patients.

ACKNOWLEDGMENTS

The authors would like to express their sincere gratitude to the Faculty of Medicine of the University of Buenos Aires, the Third Chair of Anatomy of this Faculty, and the collaborators of the Neuroanatomy Laboratory for their valuable support and contributions.

Conflicts of Interest. The members of this work have no conflicts of interest.

Funding. The authors not receive external funding for this study.

Ethical Considerations. The cadaveric material used in this study was obtained through the voluntary body donation program of the Faculty of Medicine of the University of Buenos Aires, Argentina. This program is approved and supervised by the institution's Department of Bioethics.

REFERENCES

Angileri FF, Raffa G, Curcio A, Granata F, Marzano G, Germanò A. Minimally invasive surgery of deep-seated brain lesions using tubular retractors and navigated transcranial magnetic stimulation-based diffusion tensor imaging tractography guidance: the minefield paradigm. Oper Neurosurg. 2023;24(6):656-664. https://doi.org/10.1227/ons.000000000 0000652

Cohen-Gadol AA. Intraorbital meningioma: resection through modified orbitozygomatic craniotomy. Neurosurg Focus. 2012;32(Suppl 1):E1. https://doi.org/10.3171/2012.V1.FOCUS11272

De Oliveira E, Siqueira M, Tedeschi H, Peace DA. Technical Aspects of the Fronto-Temporo-Sphenoidal Craniotomy. In: De Oliveira E, Tedeschi H, Rhoton AL Jr, editors. Surgical Anatomy for Microsurgery VI: Cerebral Aneurysms and Skull Base Lesions. Tokyo: Sci Med Publications; 1993. pp.3-8.

Gimenez P, Asad M, Bradley K, Thorogood N, Bennett W, Abhinav K. Surgical resection of giant extrasellar thyrotropinoma: use of orbitozygomatic and endoscopic endonasal approach. Surg Neurol Int. 2022;13:119. https://doi.org/10.25259/SNI_1182_2021

Hakuba A, Liu S, Nishimura S. The orbitozygomatic infratemporal approach: a new surgical technique. Surg Neurol. 1986;26(3):271–276. https://doi.org/10.1016/0090-3019(86)90161-8

Ikeda K, Yamashita J, Hashimoto M, Futami K. Orbitozygomatic temporopolar approach for a high basilar tip aneurysm associated with a short intracranial internal carotid artery: a new surgical approach. Neurosurgery. 1991;28(1):105-10. https://doi.org/10.1097/00006123199101000-00016

Klironomos G, Dehdashti AR. Orbitozygomatic craniotomy and transsylvian approach for resection of a tuberculum sella meningioma with extension to the posterior fossa. Neurosurg Focus. 2017;43(Video Suppl 2):V13. https://doi.org/10.3171/2017.10.FocusVid.17380

Luzzi S, Giotta Lucifero A, Bruno N, Baldoncini M, Campero A, Galzio R. Cranio-orbito-zygomatic approach. Acta Biomed. 2022a; 92(S4):e2021350. https://doi.org/10.23750/abm.v92iS4. 12784

Luzzi S, Giotta Lucifero A, Bruno N, Baldoncini M, Campero A, Galzio R. Pterional approach. Acta Biomed. 2022b;92(S4):e2021346. https://doi.org/10.23750/abm.v92iS4.12775

Massa D, Glerean M, Rasmussen J, Altszul M, Fainstein-Day P, Ajler P. Craniopharyngiomas: experience and results. Neurocirugia (Engl Ed). 2021;32(3):105–113. https://doi.org/10.1016/j.neucir.2020.03.008

McDermott MW, Durity FA, Rootman J, Woodhurst WB. Combined frontotemporal-orbitozygomatic approach for tumors of the sphenoid wing and orbit. Neurosurgery. 1990;26(1):107–116. https://doi.org/10.1097/00006123-199001000-00015

Reddi A. Pathology and operative strategy. J Clin Pathol. 2003;56(9):647-8. https://doi.org/10.1136/jcp.56.9.647

Samson DS, Hodosh RM, Clark WK. Microsurgical evaluation of the pterional approach to aneurysms of the distal basilar bifurcation. Neurosurgery. 1978;3:135–140. https://doi.org/10.1227/00006123-197809000-00001

Salinas Sánchez JL. Abordajes quirúrgicos de la patología de la base del cráneo desde el campo de la cirugía maxilofacial [doctoral thesis]. Málaga: Universidad de Málaga; 2015.

Seçkin H, Avcı E, Uluç K, Niemann D, Bas¸kaya MK. The work horse of skull base surgery: orbitozygomatic approach. Technique, modifications, and applications. Neurosurg Focus. 2008;25(6):E4. https://doi.org/10.3171/FOC.2008.25.12.E4

Suzuki Y, Koktzoglou I, Li Z, Jezzard P, Okell T. Improved visualization of intracranial distal arteries with multiple 2D slice dynamic ASL-MRA and super-resolution convolutional neural network. Magn Reson Med. 2024;92(6):2491-2505. https://doi.org/10.1002/mrm.30245

Tayebi Meybodi A, Benet A, Rodriguez Rubio R, Yousef S, Mokhtari P, Preul MC, Lawton MT. Comparative analysis of orbitozygomatic and subtemporal approaches to the basilar apex: a cadaveric study. World Neurosurg. 2018a;119:e607–e616. https://doi.org/10.1016/j.wneu.2018.07.217

Tayebi Meybodi A, Benet A, Rodriguez Rubio R, Yousef S, Lawton MT. Comprehensive anatomic assessment of the pterional, orbitopterional, and orbitozygomatic approaches for basilar apex aneurysm clipping. Oper Neurosurg (Hagerstown). 2018b;15(5):538–550. https://doi.org/10.1093/ons/opx265

Yasargil MG. Interfascial Pterional (Frontotemporosphenoidal) Craniotomy. In: Yasargil MG. Microneurosurgery. Stuttgart: Georg Thieme Verlag; 1984. Vol. 1. pp.215–220.

Yasargil MG, Fox JL. The microsurgical approach to intracranial aneurysms. Surg Neurol. 1975;3:7–14.

Yasargil MG, Antic J, Laciga R, Jain KK, Hodosh RM, Smith RD. Microsurgical pterional approach to aneurysms of the basilar bifurcation. Surg Neurol. 1976;6:83–91.

Zabramski JM, Kiris T, Sankhla SK, Cabiol J, Spetzler RF. Orbitozygomatic craniotomy: technical note. J Neurosurg. 1998;89:336–341. https://doi.org/10.3171/jns.1998.89.2.0336

Zagzoog N, Reddy KK. Modern Brain Retractors and Surgical Brain Injury: A Review. World Neurosurg. 2020;142:93-103. https://doi.org/10.1016/j.wneu.2020.06.153