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Original Research Article

Transmaxillary approach to the Orbit: Applying An Anatomical Approach for the Dissection of the Orbital floor

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ABSTRACT

Background: There are multiple approaches for the anatomical and surgical dissection of the orbit, these approaches are made through the walls of the orbit. The most common approach is through the roof of the orbit. In recent years the anatomical transmaxillary approach to the orbit has gained significance, most notably because of its present and future surgical applications. The aim of this study is to provide a guide for the anatomical dissection of the orbit through the transmaxillary approach.

Results: ten orbits were dissected through the transmaxillary approach. The orbits were dissected following a five steps procedure, and the anatomy was illustrated with high quality images.

Conclusions: a detailed guide for the anatomical dissection of the orbit through the transmaxillary approach was conceived. This guide is meant to be easy to reproduce and serve the reader as a tool to further his anatomical knowledge of the region, increasing the precision and safety of future surgical procedures.

KEYWORDS: Orbit, Anatomy, Dissection, Regional anatomy, maxillary sinus.

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INTRODUCTION

Every surgical procedure requires previous planning based on aspects of the patient, the surgical team and the proposed procedure. There are multiple points essential to this planning. We highlight the importance of the knowledge of the anatomical region, as well as the training of techniques and approaches, which can be perfected with artificial simulation devices as well as cadaveric dissection.

In recent years there have been multiple anatomical studies detailing approaches to the orbit through its four walls using cadaveric specimens [1-2] . The conventional approach for the anatomical dissection of the orbit has been the approach through the roof of the orbit, this is an invasive approach that requires a previous craniotomy in order to expose the orbital roof.

Reviewing the literature we highlight that there are also anatomical studies intended to guide transnasal approaches of the medial wall of the orbit, including approaches for dacryocystorhinostomy [3]. There are few studies of the approaches of the lateral wall [4], which carries complexity because of the greater bone density of the lateral wall of the orbit. In recent years the transmaxillary approach to the orbit has gained relevance in guiding endoscopic procedures, including the endoscopic repair of the orbital floor [5-9].

We set ourselves as objective to provide an accurate description of a non conventional approach to the orbit, detailing the different steps of the dissection and providing visualization of the relevant structures from the point of view of the orbital floor. This guide is meant to be easy to reproduce and serve as a tool to further the reader's anatomical knowledge of the region, thus helping to increase the precision and safety of the surgical procedures of the orbit.

METHODS

The utilized materials where: Adson forceps, scalpels, microsurgical scissors (castroviejo), surgical hammer and chisel, mini grinder Deep D3250, photographic camera Nikon D3500, illumination with multiple movable lamps and magnification with magnifying glass.

We used five heads of adult human cadavers, we dissected ten orbits in total. The heads where previously fixated and preserved in formaldehyde solution at 10% concentration. The utilized specimens had no ostensible pathology. All the dissections were performed by the authors in the laboratories of Departamento de Anatomía, Facultad de Medicina, Universidad de la República, Montevideo, Uruguay.

The approach was done following five steps:

***First step*,** the skin incision was performed using scalpel and forceps. The incision starts on the lateral sector of the root of the nose, then it goes down the alar sector of the nose to then curve laterally over the upper lip and continuing the lip commisure, then it curves upward until reaching and extending over the entire lower margin of the orbit. This way the skin covering the maxillary sinus is removed. All the soft tissues underlying the skin and over the maxillary sinus are removed, this way the anterior wall of the maxillary sinus is exposed. The infraorbital foramen and the emergence of the infraorbital neurovascular bundle can be observed on the anterior wall of the sinus.

***Second step*,** the periosteum covering the anterior wall of the maxillary sinus is removed, exposing the bony surface of the sinus.

Fig. 1: Left: anterior view of the skin before the approach. Right: the skin and soft tissues covering the maxillary sinus have been removed, exposing its anterior surface.

***Third step*,** the bone that forms the anterior wall of the maxillary sinus is removed, this bone can be removed using an electrical grinder or a scalpel depending on the bone density of the specimen. We recommend starting the bone removal on the medial side of the anterior wall of the sinus, since that's where the bone is thinnest. Removing the anterior wall of the maxillary sinus creates a bone window through which the interior of the sinus is exposed.

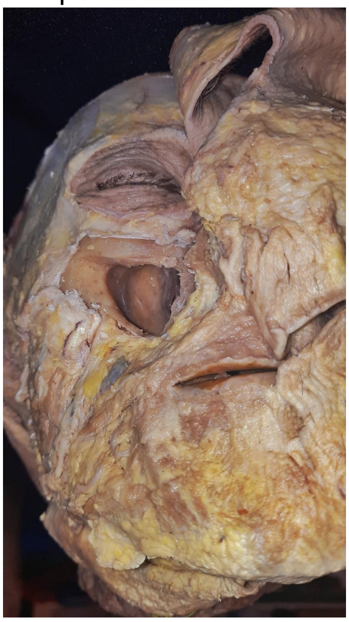

Fig. 2: The anterior wall of the maxillary sinus has been removed, exposing its cavity.

Fourth step, the mucous membrane covering the maxillary sinus roof is removed, exposing the bone which corresponds to the floor of the orbit. The bone of the floor of the orbit is characterized by its thin thickness and it can be removed using scalpel and Adson grippers, taking care of not injuring the infraorbital neurovascular bundle which passes through it. It is also necessary to remove the bone that forms the lower orbital margin, which presents a greater density. While removing the bone of the floor of the orbit it is necessary to section the proximal insertion of the inferior oblique muscle in the orbital floor. Once the orbital floor has been removed the infraorbital neurovascular bundle is fully exposed until its emergence in the infraorbital foramen, this bundle can be pulled to the side or sectioned proximally and removed so it doesn't hinder the dissection of the orbital content.

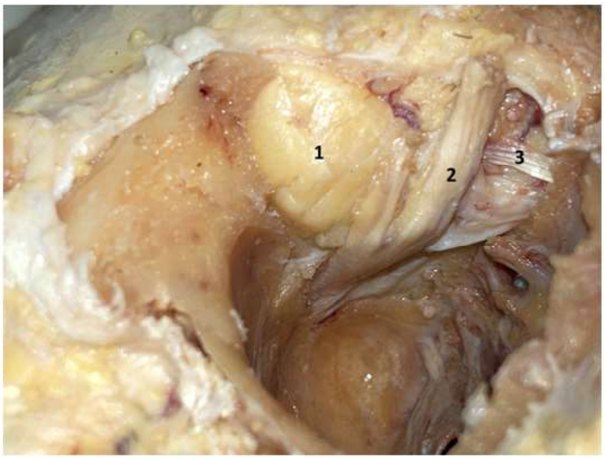

Fig. 3: Inferior view, right orbit. The floor of the orbit has been removed exposing the orbital content. 1: periorbital fat. 2: Infraorbital neurovascular bundle. 3: tendon of the inferior oblique muscle.

Fifth step, the removal of the orbital floor exposes the extraconal compartment of the orbital cavity. The dissection and removal of the orbital fat exposes the inferior oblique and inferior rectus muscle. The proximal insertion of the inferior rectus muscle in the annulus of Zinn is sectioned and thus the muscle is pulled anteriorly, exposing the intraconal compartment of the orbit.

Then the content of the intraconal compartment is dissected. The dissection of this compartment must be delicate and is aided by the use of microsurgical instruments, good lighting and use of magnifying instruments such as magnifying glasses.

Once the orbit is accessed through the orbital floor, the infraorbital nerve in the infraorbital bundle is the first structure identified, this bundle advances anteriorly over the infraorbital sulcus and enters in the infraorbital canal. The content of the orbit is covered by periorbital fascia which covers the orbital fat. The dissection of the periorbital fascia and the orbital fat reveals the inferior oblique muscle as well as the inferior, medial and lateral rectus muscles.

The inferior oblique muscle is identified in the anterior sector of the orbital floor, its proximal insertion has been sectioned with the removal of the orbital floor. From its proximal insertion the muscle is directed superior, lateral and posteriorly towards the globe. It receives posteriorly its nerve which comes from the inferior division of the oculomotor nerve and advances anterior and inferiorly between the inferior and lateral rectus muscles. The inferior, medial and lateral rectus muscles are identified from their proximal insertion in the annulus of Zinn to their anterior insertion in the globe. The inferior ophthalmic vein is identified between the inferior and lateral rectus muscles.

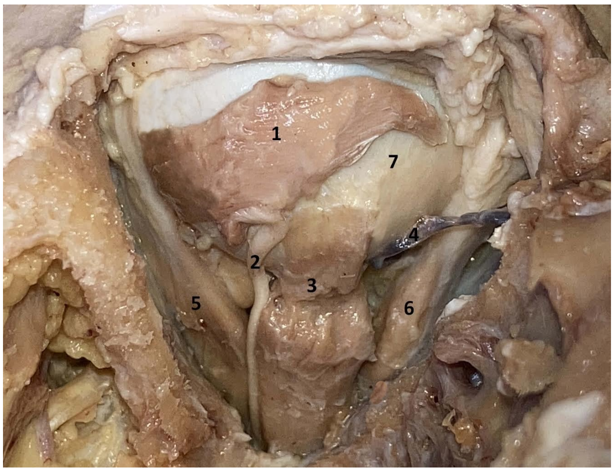

Fig. 4: The infraorbital bundle is removed and the insertion of the inferior oblique muscle in the orbital floor has been sectioned. The extraconal compartment is exposed. 1: inferior oblique muscle. 2: nerve of the inferior oblique muscle. 3: inferior rectus muscle. 4: inferior ophthalmic vein. 5: lateral rectus muscle. 6: medial rectus muscle. 7: globe

The inferior rectus muscle is then sectioned from the annulus of Zinn and is pulled anteriorly. This exposes the intraconal compartment of the orbit, allowing the approach of this compartment. The nerve of the inferior rectus muscle is sectioned in this process.

The optic nerve covered by the optic sheath is identified in the central part of the intraconal compartment. The ophthalmic artery advances anteriorly under the optic nerve and then it emerges over its medial side and then it is distributed in the medial part of the orbit.

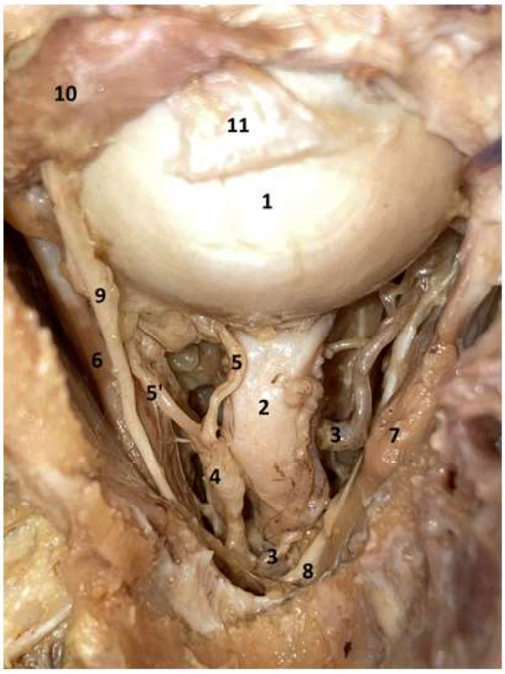

Fig. 5: The insertion of the inferior rectus muscle in the annulus of Zinn is sectioned and the muscle pulled anteriorly, exposing the intraconal compartment. 1: globe. 2: optic nerve. 3: ophthalmic artery. 4: ciliary ganglion. 5;5': short ciliary nerves. 6: lateral rectus muscle. 7: medial rectus muscle. 8: nerve of the medial rectus muscle. 9: nerve of the inferior oblique muscle. 10: superior oblique muscle. 11: inferior rectus muscle.

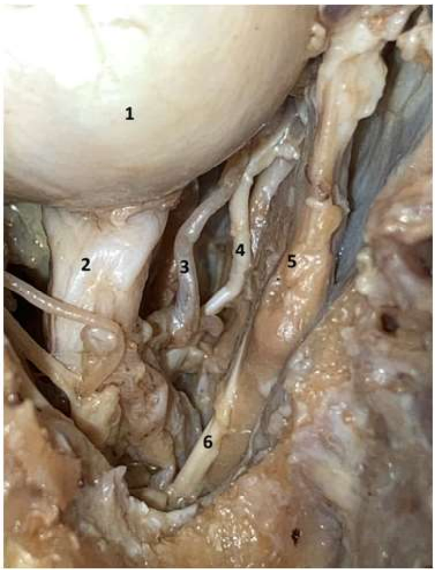

Fig. 6: Medial sector of the intraconal compartment. 1: globe. 2: optic nerve. 3: ophthalmic artery. 4: nasociliary nerve. 5: medial rectus muscle. 6: nerve of the medial rectus muscle.

The ophthalmic artery and its branches are identified in the medial part of the orbit, as well as the nasociliary nerve which goes anteriorly intimately related with the ophthalmic artery. The nasociliary nerve gives off ethmoidal and infratrochlear branches which distribute over the medial wall of the orbit. Posteriorly the nerve of the medial rectus muscle can be seen reaching the lateral surface of this muscle.

Laterally to the optic nerve the short ciliary nerves can be seen, these nerves travel anteriorly from the ciliary ganglion towards the globe. The ciliary ganglion can be seen over the most posterior part of the medial surface of the lateral rectus muscle and intimately related with the abducens nerve, which rapidly enters the medial surface of the lateral rectus muscle.

Fig. 7: Lateral sector of the intraconal compartment. 1: optic nerve. 2: ophthalmic artery. 3: ciliary ganglion. 4; 4'; 4'': short ciliary nerves. 5: lateral rectus muscle. 6: abducens nerve.

Pulling the optic nerve laterally it is possible to observe the inferior surface of the superior rectus muscle, the nerve of this muscle which originates for the upper division of the oculomotor nerve can be seen entering its inferior surface.

Fig. 8: The optic nerve is pulled laterally, revealing the inferior surface of the superior rectus muscle. 1: globe. 2: optic nerve. 3: superior rectus muscle. 4: nerve of the superior rectus muscle. 5: superior ophthalmic vein.

CONCLUSION

We consider that our experience provides a detailed guide for the anatomical dissection of the orbit through the transmaxillary approach, as well as it provides quality images to aid in the realization of this approach. All the structures of the orbit can be identified with this approach through an inferior point of view.

This approach offers certain advantages over other anatomical approaches of the orbit. Compared with the classical approach through the roof of the orbit, the transmaxillary approach is a less invasive approach and it carries less complexity since it doesn't involve a craniotomy.

Conflicts of Interests: The authors declare that they have no competing interests.

Author Contributions

Augusto Garrido: conception and design, data acquisition, drafting and revising. Final approval.
Juan Pedro Frigerio: conception and design, data acquisition, drafting and revising. Final approval.
Patricio Fornos: conception and design, data acquisition, drafting and revising. Final approval.
Alejandra Neirreitter: conception and design, data acquisition, drafting and revising. Final approval.
Gustavo Armand Ugón: design, revising. Final approval.

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REFERENCES

[1]. Rhoton AL. Martins C, Costa e Silva IE, Campero A, Yasuda A, Aguiar LR, Tatagiba M, et al. Microsurgical Anatomy of the Orbit: The Rule of Seven. Anatomy Research International. 2011 Sep 28;2011:1–14.
https://pubmed.ncbi.nlm.nih.gov/22567293/

[2]. Rhoton AL. The orbit. Neurosurgery [Internet]. 2002 Oct 1 [cited 2023 Aug 8];51(4 Suppl):S303-334. https://pubmed.ncbi.nlm.nih.gov/12234452/

[3]. Chastain JB, Sindwani R. Anatomy of the Orbit, Lacrimal Apparatus, and Lateral Nasal Wall. Otolaryngologic Clinics of North America. 2006 Oct;39(5):855–64. .
https://pubmed.ncbi.nlm.nih.gov/16982251/

[4]. Williams JS, Sahu PD. Surgical management of the orbit in thyroid eye disease: lateral orbital decompression. Current Opinion in Otolaryngology & Head and Neck Surgery [Internet]. 2021 Aug 1 [cited 2023 Aug 8];29(4):289–93.
https://pubmed.ncbi.nlm.nih.gov/34183558/

[5]. Carmine Antonio Donofrio, Riccio L, Pathmanaban O, Fioravanti A, Caputy AJ, Pietro Mortini. Endoscopic sublabial transmaxillary approach to the inferior orbit: pearls and pitfalls—A comparative anatomical study. Neurosurgical Review. 2021 Feb 10;44(6):3297–307.
https://pubmed.ncbi.nlm.nih.gov/33564984/

[6]. Engin Gonul, Erdogan E, Bulent Duz, Erdener Timurkaynak. Transmaxillary Approach to the Orbit: An Anatomic Study. Neurosurgery. 2003 Oct 1;53(4):935–42.
https://pubmed.ncbi.nlm.nih.gov/14519225/

[7]. Martínez, Fernando, Salle, Federico, Campero, Algorta, et al. ABORDAJE ORBITOCIGOMÁTICO: APLICACIÓN DE UN ABORDAJE NEUROQUIRÚRGICO PARA EL ESTUDIO ANATÓMICO DE LA ÓRBITA. Revista Argentina de Anatomía Online [Internet]. 2013 [cited 2023 Aug 8];4(1):14–7.
https://revista-anatomia.com.ar/archivos-parciales/2013-1-revista-argentina-de-anatomia-online-c.pdf

[8]. Rodríguez Vargas G, Guevara Arroyo V. MODIFICACIÓN DEL ABORDAJE DE CALDWELL-LUC PARA EL APRENDIZAJE DE LA ANATOMÍA DE LA ÓRBITA. Revista Médica de la Universidad de Costa Rica. 2013 May 30;7(1). https://revistas.ucr.ac.cr/index.php/medica/article/view/9997

[9]. Hitotsumatsu T, Rhoton AL. Unilateral Upper and Lower Subtotal Maxillectomy Approaches to the Cranial Base: Microsurgical Anatomy. Neurosurgery. 2000 Jun;46(6):1416–53. https://pubmed.ncbi.nlm.nih.gov/10834647/

[10].Izquierdo LA, Salazar JAM, Tramontini CL, Jens CT. Anatomía de la órbita y su contenido en tac y resonancia magnética. Revista Médica Sanitas [Internet]. 2015 Jul 1 [cited 2023 Aug 8];18(3):163–7. https://revistas.unisanitas.edu.co/index.php/rms/article/view/428

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