

# Microsurgical anatomy: surgical approaches to the orbit

Anatomia microcirúrgica: acessos cirúrgicos a órbita

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## ABSTRACT

**Introduction:** The ocular orbit is a complex anatomical structure, and orbital surgical interventions require precision due to the proximity of vital structures such as nerves, blood vessels, and extraocular muscles. Advances in surgical approaches have improved the safety and effectiveness of treating orbital lesions.

**Objective:** This study reviews the main orbital surgical approaches, focusing on access techniques, preoperative planning, and microsurgical practices.

**Method:** A systematic literature review was conducted using PubMed, Scopus, and Web of Science, including case studies, reviews, and articles published between 1990 and 2024. The surgical approaches discussed include transconjunctival, transcutaneous, transcranial, and endoscopic techniques.

**Result:** Each approach offers specific advantages depending on the lesion location. Preoperative planning, using advanced imaging, and the application of microsurgical techniques are critical to the success of orbital surgeries.

**Conclusion:** Detailed knowledge of orbital anatomy and the application of advanced surgical techniques are essential for successful treatment of orbital lesions, ensuring better functional and aesthetic outcomes.

**KEYWORDS:** Orbital surgery. Orbital access techniques. Transconjunctival approach. Transcutaneous approach. Transcranial approach.

## Central Message

Orbital surgery, given its complexity and proximity to vital structures, requires precise and well-planned surgical techniques. This article explores the main surgical approaches to the orbit, considering the importance of preoperative planning and microsurgical techniques to optimize clinical and aesthetic results. Understanding the different access techniques and the necessary care is essential to improve the effectiveness of interventions and minimize risks for patients.

## Perspective

The ocular orbit, due to its intricate anatomy and proximity to vital structures such as nerves, blood vessels and oculomotor muscles, presents a significant surgical challenge. Advances in surgical techniques and the introduction of new approaches have enabled safer and more effective access to the orbit, improving the ability to treat lesions with precision. This article aims to provide a comprehensive overview of the different surgical techniques available, the necessary planning and microsurgical practices to maximize the success of orbital interventions.

## RESUMO

**Introdução:** A órbita ocular é uma estrutura anatômica complexa, e as intervenções cirúrgicas orbitárias requerem precisão devido à proximidade de estruturas vitais, como nervos, vasos sanguíneos e músculos extraoculares. Os avanços nas abordagens cirúrgicas melhoraram a segurança e a eficácia do tratamento de lesões orbitárias.

**Objetivo:** Este estudo revisa as principais abordagens cirúrgicas orbitárias, com foco nas técnicas de acesso, planejamento pré-operatório e práticas microcirúrgicas.

**Método:** Foi realizada uma revisão sistemática da literatura usando PubMed, Scopus e Web of Science, incluindo estudos de caso, revisões e artigos publicados entre 1990 e 2024. As abordagens cirúrgicas discutidas incluem técnicas transconjuntivais, transcutâneas, transcranianas e endoscópicas.

**Resultado:** Cada abordagem oferece vantagens específicas dependendo da localização da lesão. O planejamento pré-operatório, o uso de imagens avançadas e a aplicação de técnicas microcirúrgicas são fundamentais para o sucesso das cirurgias orbitárias.

**Conclusão:** O conhecimento detalhado da anatomia orbitária e a aplicação de técnicas cirúrgicas avançadas são essenciais para o sucesso do tratamento das lesões orbitárias, garantindo melhores resultados funcionais e estéticos.

**PALAVRAS-CHAVE:** Cirurgia orbitária. Técnicas de acesso orbital. Abordagem transconjuntival. Abordagem transcutânea. Abordagem transcraniana.

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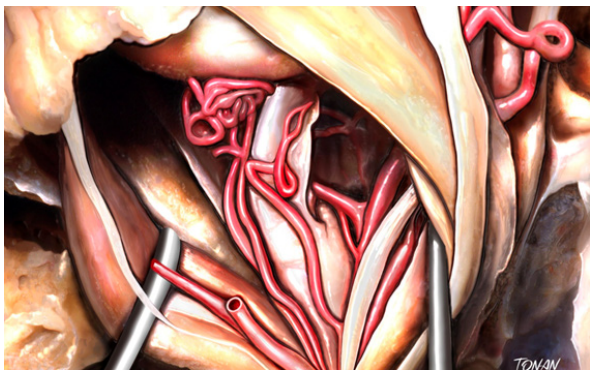
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## INTRODUCTION

The ocular orbit, a complex structure housing the eyeball and its appendages, presents a unique challenge for the surgeon due to its intricate anatomy and the proximity of vital structures such as nerves, blood vessels, and oculomotor muscles. Surgical interventions in the orbit require a highly precise and well-planned approach, as any error can result in significant functional or aesthetic impairment (Figure 2).<sup>1-3</sup>



**Figure 1** — Illustration of the microsurgical anatomy of the orbit. Copyrighted image (Tonan/CEANNE)

With advancements in surgical techniques and the development of new approaches, it is possible to access different parts of the orbit safely and effectively, minimizing risks to the patient. This article explores the main surgical approaches to the orbit, discussing the indications for each technique, the necessary preoperative planning, and the microsurgical practices that ensure the success of these interventions. By better understanding the available options and the necessary precautions, healthcare professionals can make more informed decisions when treating orbital injuries, providing better clinical and aesthetic outcomes.<sup>4-6</sup>

## METHOD

Narrative review of the literature on surgical approaches to the ocular orbit was conducted, focusing on access techniques and microsurgical practices. The databases consulted included PubMed, Scopus, and Web of Science, using terms such as "orbital surgery," "orbital access techniques," and "orbital microsurgery." The review encompassed case studies, systematic reviews, and peer-reviewed articles published between 1990 and 2024. The analysis included the main surgical approaches - transconjunctival, transcutaneous, transcranial, and endoscopic - as well as the importance of preoperative planning and microsurgical techniques. The methodology also considered potential complications and management strategies associated with orbital interventions.

## DISCUSSION

### Surgical access

Orbital surgery involves a variety of complex approaches, each chosen based on the location and nature of the lesion, as well as the specific anatomy of the patient. The orbit is a highly sensitive anatomical region surrounded by vital structures such as nerves,

blood vessels, and oculomotor muscles, requiring surgical precision and meticulous planning. This article explores the main surgical access techniques to the orbit, essential preoperative planning, and critical microsurgical techniques for the success of these interventions.<sup>1</sup>

The transconjunctival approach involves accessing the orbit through the conjunctiva, allowing exposure of the inferior and medial walls. This technique is particularly advantageous for lesions located in these regions, as it avoids skin incisions, thereby minimizing visible scars and aesthetic complications. Additionally, it allows direct access to target areas, facilitating the removal of lesions or repair of orbital fractures.<sup>1</sup>

The transcutaneous approach is performed through an incision in the skin, with subciliary and transcaruncular techniques being the most common. The subciliary incision is made just below the lower lash line, while the transcaruncular approach involves an incision in the lacrimal caruncle. Both techniques provide excellent exposure of the inferior and medial orbital walls. However, these approaches require careful attention to avoid aesthetic damage and ensure proper healing.<sup>2</sup>

The transcranial approach is used to access lesions located in the upper or deep portions of the orbit. This method involves removing part of the cranial vault, allowing direct access to the orbit and adjacent structures. This technique is often employed in cases of superior orbital tumors or situations where the lesion's extent requires a broad view and rigorous control over surrounding structures.<sup>3</sup>

The endoscopic approach utilizes endoscopes to access the orbit through the paranasal sinuses, offering a minimally invasive option for certain orbital lesions. With advancements in endoscopic techniques, this approach allows precise access with lower associated morbidity. It is particularly useful in cases of lesions involving the medial and inferior walls of the orbit, where direct access through the sinuses is possible.<sup>4</sup>

### Preoperative planning

The success of any orbital procedure begins with detailed preoperative planning. Imaging assessment is crucial, involving advanced techniques such as magnetic resonance imaging and computed tomography to map the orbital anatomy and identify the lesion's exact location. In addition, three-dimensional planning can be employed to determine the best access path, thus minimizing the risk of damage to critical structures such as optic nerves and blood vessels. This planning phase is essential for choosing the most appropriate surgical approach and ensuring the procedure's success.<sup>2</sup>

### Microsurgical techniques

Microsurgical techniques are indispensable in orbital surgery due to the proximity of vital anatomical structures. The use of surgical microscopes allows for magnified visualization of orbital structures, facilitating precise dissection and preservation of nerves and blood vessels. Fine and delicate instruments are used to minimize tissue trauma, and advanced suturing techniques are employed to ensure proper closure and reduce visible scarring.

Skill in performing these techniques is essential to avoid postoperative complications and achieve satisfactory aesthetic results.<sup>4</sup>

### Neurovascular considerations

The orbit, as a confined space densely populated by nervous and vascular structures, presents considerable risks during surgical intervention. Understanding the surgical and topographic anatomy of the orbit is essential for preserving the functionality of these structures, regardless of whether the orbit is the primary focus of surgery or a passage to access deeper structures.<sup>5</sup>

The orbit can be divided into different compartments, such as the eyeball, the muscular cone, and the intraconal and extraconal spaces. These compartments house various neural and vascular structures, which are closely related. The muscular cone, which includes six extraocular muscles responsible for ocular movements, is one of the most critical regions. This cone converges at the orbital apex, forming the tendinous ring (or Zinn's ring), through which pass the optic nerve, oculomotor nerve, abducens nerve, the nasociliary branch of the ophthalmic nerve, and the ophthalmic artery. The separation of the muscular cone defines the intraconal and extraconal spaces, each with its own surgical considerations.<sup>5</sup>

### Surgical indications

Treatment of orbital fractures and repair of traumatic injuries orbital fractures are frequent traumatic injuries following facial trauma, occurring in approximately 20% of severe facial injury cases and often accompanied by ocular damage.<sup>6</sup> These fractures can result from assaults, sports accidents, or other types of trauma, both direct and indirect, affecting the eyeball or the orbital, facial, and cranial bones.<sup>7</sup> The most common presentation of orbital fractures is associated with complex zygomatic fractures, which involve the cheekbone and, consequently, the lateral wall of the orbit.<sup>8</sup>

### Potential complications and management

The orbital anatomy is a complex and critical region, highly susceptible to injuries that can result in visual and ocular motility complications. Surgical procedures involving the orbit, as discussed by Maroon and Kennerdell<sup>1</sup> and Natori and Rhoton<sup>3</sup>, present considerable risks of visual loss, diplopia, and restrictions in ocular movement. These complications may occur due to the proximity of delicate neural and vascular structures surrounding the orbit.

## CONCLUSION

Orbital surgery requires detailed anatomical knowledge and a refined technical approach to ensure safe and effective outcomes. Each access technique -transconjunctival, transcutaneous, transcranial, and endoscopic - has its indications and advantages depending on the lesion's location and nature. Meticulous preoperative planning, utilizing advanced imaging technologies and mapping strategies, is crucial to minimize risks and optimize outcomes. Microsurgical techniques play a fundamental role in preserving vital structures and reducing postoperative complications. The continuous advancement in surgical techniques and complication management contributes to improving clinical and aesthetic outcomes in orbital surgeries.

### Author's contribution

Nicole Custódio Porto Silva: Validation, Writing – review & editing  
Wilson da Silva Rocha Vidal Neto: Formal analysis, Methodology  
Maria Antônia Oliveira Machado Pereira: Conceptualization, Investigação  
Giovana Claussen Bitolo: Data curation, Writing – original draft  
Christopher Aquino Pereira Lima: Conceptualization, Investigação  
Amanda Letícia Miozzo: Formal analysis, Methodology  
Gustavo Rassier Isolani: Project administration

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