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Orbital Anatomy for the Surgeon

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INTRODUCTION

The purpose of this article is to review the anatomy of the orbit from a surgical perspective. The content focuses on the skeletal and soft tissue architecture and does not include a description of the ocular globe, which is beyond the intention of this article and can be found in most anatomy texts.

SIZE, SHAPE, AND PURPOSE

The orbits are conical structures dividing the upper facial skeleton from the middle face and surround the organs of vision. Although the orbit is commonly described as pyramidal in shape, it is not an angular structure, and the walls are not regular. Rather, its walls, apex, and base are curvilinear and are perforated by foramina and fissures, and they have several irregularities where ligaments, muscles, and capsules attach.

The apex is located proximally, whereas the base opens onto the facial skeleton. The apex and base of the orbit are composed of thick bone, whereas the walls are thinner. The height of the orbit is usually 35 mm, whereas the width is approximately 40 mm as measured at the rims. The child's orbit is rounder, but with age the width increases. The widest circumference of the orbit is inside the orbital rim at the lacrimal recess. From the medial orbital rim to apex, the orbit measures approximately 45 mm in length, whereas from the lateral orbital rim to the apex, the measurement is approximately 1 cm shorter.[1,2]

When considering the size and shape of the orbit, it is a well-designed and protective structure, which shields the ocular globes (extensions of the brain). The thickened rim is able to resist fracture forces more than the weaker walls, especially the medial wall and floor. Similarly, the thicker bone at the apex shields the brain and the optic nerve from direct force. Pressure to the eye is dispersed to the walls, which absorb the forces and fracture easily. This structural feature reduces the force dispersed to the deeper orbital contents.

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The medial walls of the orbits are parallel to the sagittal plane and extend forward on the facial skeleton. The lateral walls are shorter, convergent, and more recessed, which facilitate peripheral vision (a greater projection of the orbit toward the midline of the face with gentle loss of projection laterally).

The conical design of the orbit maintains the position of the globe with acceleration; however, this design is not protective of deceleration injuries. Although the widest diameter of the orbit is inside the rim, which helps maintain ocular position during deceleration, it is not always preventative of injury, especially with high-speed injuries (Fig. 1).

OSTEOLOGY

The orbit is composed of 7 bones. The lateral wall is formed by the greater wing of the sphenoid apically and the frontal and zygomatic bones facially. The floor is formed from the sphenoid, the orbital process of the palatine bone, and the orbital process of the maxillary bone. The medial wall is formed from the lesser wing of the sphenoid, the ethmoid bone, the lacrimal bone, and the frontal process of the maxilla. The roof of the orbit is derived from the sphenoid and the frontal bones (Fig. 2).

In general, the bone is thickest at the apex, thins as the walls diverge anteriorly, and then thickens again at the rims on the surface of the face. Although the bone of the medial orbital wall is thinnest, followed by the bone of the floor of the orbit, in actuality the medial wall is strengthened by the perpendicular septa of the ethmoid sinuses. The floor of the orbit is most vulnerable to fracture when there is direct force exerted on the ocular globe because it is thin and unsupported. When orbital cellulitis occurs, its most likely source is direct extension from the ethmoid sinuses because the thin bone of the medial wall is easily penetrated by expanding masses from the sinus. The floor of the orbit is thicker and offers more resistance to maxillary sinus abnormality.

None of the walls of the orbit are flat; they are curvilinear in shape, and their purpose is to maintain the projection of the ocular globe and to cushion it when subjected to blunt force.[1–5]

FLOOR OF THE ORBIT

From the inferior orbital rim, the floor dips inferiorly while maintaining the same cephalo-caudad position for approximately 15 mm, past the inferior orbital fissure. It then gently curves cephalically to the superior orbital fissure. This anatomic subtlety is important when repairing orbital floor fractures because re-creating this gentle curvature will restore normal anatomy and will help prevent enophthalmos.

MEDIAL ORBITAL WALL

The medial orbital walls are parallel to the sagittal plane and have the greatest degree of superioinferior curvature. The medial orbital rim is less defined than the other rims. The entire wall is thin from the base to the apex, but it is strengthened by the perpendicular septa of the ethmoid sinus. The wall separates the ethmoid sinuses and nose from the orbit. The superior aspect of the medial rim is the most prominent and blends into the forehead, curving anteriorly toward the midline.

ROOF AND LATERAL ORBITAL WALL

The roof of the orbit curves cephalically in the lateral aspect to accommodate the lacrimal gland. The bone of this wall separates the anterior cranial fossa from the orbit. It is generally thin and becomes thinner with age. The superior orbital rim has a notch on the medial third through which the supraorbital nerve runs and supplies sensation to the forehead. Sometimes this notch is calcified and forms a distinct foramen.

The lateral orbital rim is the least projected and this facilitates lateral vision. The zygomatic portion of the lateral orbital wall is thin, but the wall thickens considerably in the sphenoid, where it borders the superior orbital fissure.

FORAMEN, FISSURES, TUBERCLES, AND CRESTS

Nasolacrimal Canal

The inferomedial orbital wall is penetrated by the nasolacrimal canal, which houses the nasolacrimal duct. Just anterior to the canal and on the frontal process of the maxilla lie the anterior lacrimal crests, which are elevated prominences to which attaches the anterior portion of the medial canthus. Just posterior to the canal is a smaller and less obvious prominence, the posterior lacrimal crest, which is part of the lacrimal bone and to which attaches the deeper fibers of the medial canthus and orbicularis oculi (Horner’s muscle, pars lacrimalis).[6,7]

Anterior and Posterior Ethmoidal Foramen

Approximately 15 mm behind the medial orbital rim at the level of the junction of the frontal bone with the ethmoid bone, the anterior ethmoidal foramen exits into the orbit. This canal houses the anterior ethmoidal artery. Approximately 1 cm further posteriorly is the posterior ethmoidal foramen through which the posterior ethmoidal artery exits. These arteries can be the source of epistaxis and/or orbital bleeding.[1–5]

Whitnall’s Tubercle

No discussion of orbital anatomy would be complete without the mention of this anatomic landmark. Located on the lateral orbital wall just inferior to the frontozygomatic suture and approximately 1 cm posterior to the lateral orbital rim is a protuberance that Whitnall indicated was present in 96% of the specimens he dissected. He further indicated that this protuberance was the attachment of the lateral canthus and other globe suspensory ligaments of significance.[8,9]

Inferior Orbital Fissure

Approximately 1 cm posterior to the inferior-lateral orbital rim lies the fissure, which connects the pterygo-palatine fossa with the floor of the orbit. The fissure is composed of the zygomatic and sphenoid bones on the lateral side and the zygoma and maxilla on the medial side. In the anterior portion of the fissure, a small canal runs anteriorly through the floor of the orbit and exits on the facial side of the maxilla approximately 5 mm inferior to the rim. Through this canal runs the infraorbital nerve, which also gives off small dental branches (anterior, superior alveolar, and middle superior alveolar nerves) before exiting facially. The artery, a terminal branch of the internal maxillary artery, and vein, which drains into the pterygoid plexus, run with this sensory-only extension of the second division of the trigeminal nerve.

Superior Orbital Fissure

Located near the apex of the orbit lies a club-shaped fissure, where the greater and lesser wings of the sphenoid meet the maxilla. This fissure serves as the conduit for the III (oculomotor), IV (trochlear), 1st division of the V (ophthalmic branch), and the VI (abducens) cranial nerves to enter the orbit from the cranial fossa. In addition, the ophthalmic vein courses through this structure.

Fractures, edema, or hematoma extending to the superior orbital fissure can result in ophthalmoplegia, ptosis, or pupillary dilatation (superior orbital fissure syndrome) (Fig. 3).

Optic Canal

Medial to the superior orbital fissure at the orbital apex lies the optic canal. It is approximately 5 mm in diameter and runs in a superior medial direction into the cranial fossa. The canal itself is less than 1 cm in length and lies entirely within the sphenoid. The walls of the canal can be thinned by the proximity of the sphenoid sinus. Through this canal run the optic nerve and the ophthalmic artery. Fractures extending to the optic canal can result in blindness in addition to the findings of superior orbital fissures syndrome (orbital apex syndrome).

Cranio-orbital Foramen

Just anterior to the superior orbital fissure, located on the medial orbital wall, lies a small foramen through which a branch of the middle meningeal artery forms an anastamosis with the lacrimal artery. Recent attention has been called to this minor foramen because of the potential of hemorrhage and the sentinel value it has when performing optic nerve decompression or deep orbital dissection. It is present in approximately 55% of the specimens examined.[10]

EYELIDS

Extensions of skin from the forehead and cheeks, which spread over the inferior and superior aspects of the ocular globe, represent the upper and lower eyelids. These uniquely designed folds are lined by loosely attached skin on the external surface and by the conjunctiva on the internal surface. Separating the internal and external surfaces of the eyelids are several rows of hair-bearing lines at the eyelid margin (eyelashes) and the openings of the tarsal glands. The purposes of the eyelids include protection of the globes, lubrication, cleansing, and drainage of the region. The separation of the 2 lids is called the palpebral fissure, which is widest at the midpoint of the pupils; the fissure tapers medially and laterally.

The medial and lateral extensions of the eyelids and tarsus are anchored by the medial and lateral canthal (palpebral) tendons.[1,6–9,11]

MEDIAL CANTHUS

The medial canthal anatomy has been described in detail by Robinson and Stranc.[7] The upper and lower eyelids on the medial canthus do not contact the globe, but rather form a lake that collects tears. When the eyelids are everted, small punata can be visualized in the upper and lower lids, which represent the beginning of the lacrimal drainage system. The lateral fissure contacts the ocular globe and under normal circumstances tears flow from lateral to medial to the lacrimal lakes, through the lacrimal puncta, into the canaliculi, and into the lacrimal sac.

The medial canthus consists of a tendonous attachment of the orbicularis oculi muscle and a ligmamentous attachment to the tarus. The attachment is primarily at the anterior lacrimal crest, which is located on the frontal process of the maxilla. The posterior or minor contributor to the attachment is the posterior medial canthus, known as pars lacrimal or Horner’s muscle. This posterior limb also represents the attachment of the orbicularis oculi

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muscle to the posterior lacrimal crest. Located between the lacrimal bone and wedged between the anterior and posterior tendons is the nasolacrimal canal. Just above the canal is the lacrimal sac, which receives contributions from the lacrimal canaliculi to the nasolacrimal duct. It is postulated that the contracture of the orbicularis oculi muscle results in closure of the eyelids, and the movement also squeezes the lacrimal sac, which results in emptying tears into the nasolacrimal canal and eventually drainage into the nose (Fig. 4).

SEPTUM ORBITALE

Covering the orbicularis oculi muscle is a loosely attached layer of skin. Just extending back to the orbicularis oculi muscle is an extension of the periorbita that runs into the eyelid called the septum orbitale. This septum orbitale is a consistent feature of both the upper and the lower eyelids, and it separates the orbital contents from the lid contents. Its major purpose is postulated to be to contain the spread of infection. It also contains the extraconal fat that is reduced during blepharoplasty. The septum orbital extends from the tarsus to the orbital rim, where it then attaches to the bone and becomes the periorbita inside the orbit and periosteum outside the orbit.

TARSAL PLATES

Extending back to the septum orbital are multiple muscles surrounded by fat and connective tissue. In the lid margins are thick pads of dense connective tissue called tarsal plates. The tarsal plates add rigidity to the lids and also accept attachments of multiple muscles and membranes. Within the tarsal plates are large sebaceous glands (Meibomian glands). The plates are curvilinear in shape and extend away from the lid margins approximately 1 cm in the upper lid and approximately 5 mm in the lower lid.

MUSCLES AND ACTIONS

The orbicularis oculi muscle is present in the superior and inferior lids (palpebral portion) and lies just below the skin. The muscle has a palpebral and an orbital component. The septum orbitale is the next layer. Under it are other muscles connecting to the tarsus. In the upper lid is the aponeurosis of the levator muscle, which attaches to the tarsus toward the lid margin. In the lower lid, the fascia of the inferior rectus attaches to the inferior tarsus, into the orbicularis oculi muscle, and into the subcutaneous tissues of the lid. Attached to this is a small, smooth muscle, the inferior tarsal muscle (Mueller’s muscle), which rises from the posterior fascia and inserts into the tarsus. The deep surface of the levator aponeurosis also contains a layer of smooth muscle known as Whitnall’s muscle (also known as Mueller’s muscle). Both of these smooth muscles are innervated by the sympathetic fibers coming from the superior cervical ganglion via the lacrimal nerve (Fig. 5). Actions of the inferior rectus include retraction of the lower lid in addition to elevation of the globe.

During normal opening and closing, the upper lid does most of the movement. With closure of the lid, contraction of the orbicularis oculi muscle is necessary, and this contraction requires VII cranial nerve activity. Opening of the eyelids requires contracture of the levator superioris muscle, which is innervated by the third cranial nerve, which enters the orbit through the superior orbital fissure and sends branches to most of the muscles of extraocular movement. Reflex closure of the eyelids occurs via the sympathetic pathways traveling to the smooth muscles of the upper and lower eyelids.

CONJUNCTIVA

The deepest layer of the eyelid is the conjunctiva, which is a modification of the skin layer, and forms the inner surface of the lid. The inner surface of the lid is a smooth layer, which folds onto itself from the eyelid and covers the outer surface of the eyeball. Where the conjunctiva reflects on itself at the inner aspect of the eyelid is the fornix. Sensory innervation of this tissue comes from the first division of the trigeminal nerve (ophthalmic branch).

The conjunctiva is attached to the deep layer of the tarsus and also covers the fascia of the inferior rectus in the lower lid and the fascia of the levator superioris and superior rectus muscle in the upper lid.

LATERAL CANTHUS

The lateral canthus anchors the tarsus of both lids laterally to the zygomatic bone at the tubercle on the lateral wall (Whitnall's tubercle). Also attaching to this tubercle are the aponeurosis of the levator and the check ligament of the lateral rectus. This structure extends to the septum orbital, whereas the fusion of the upper and lower orbicularis oculi occurs superficial to the septum (lateral paleplral raphe), which becomes confluent with the tempor-oparietal fascia.

THE PERIORBITA

As the optic nerve traverses the optic canal, it is surrounded by dura, which then attaches to the bone of the orbit. Similarly, anywhere the cranium comes in contact with the orbit (superior orbital fissure, anterior and posterior ethmoidal foramina, and the cranio-orbital foramen), the dura becomes continuous with the underlying bone. This underlying bone becomes the periorbita, which is loosely attached to the bone compared to the periosteum of the facial bones or the superficial surface of the skull. The periorbita also extends to the eyelids as orbita septum.

On the orbital surface of the optic canal and the medial aspect of the superior orbital fissure, the periorbita thickens and gives rise to the tendenous attachments of the 4 rectus muscles, the levator superioris, and the superior oblique muscle. This tendonous ring is called the annulus of Zinn.

The eyeball is surrounded by fat, muscle, sheaths, capsules, connective tissue, and so forth. It is contained and suspended in the orbit by an elaborate labyrinth of tendenous and ligamentous attachments and interwoven capsules, which fasten it medically and laterally.[2]

BULBOUS SHEATH OR TENONS CAPSULE

The bulbous sheath or tenons capsule is a fibrous layer between the eyeball and the intermuscular orbital fat that is interspersed between the 6 muscles of extraocular movement. It attaches to the sclera on the anterior and posterior surfaces of the eyeball and becomes continuous with the fascia of the muscles posteriorly and around the inferior oblique muscle.[8,9]

LOCKWOOD'S LIGAMENT

The thickened lower part of the bulbous sheath is known as the suspensory ligament of Lockwood. This fascial sling blends with the lateral canthus and the lateral check ligament and transverses from lateral to medial, suspending the globe and resisting anterior and posterior displacement of the eye. On the medial orbital wall, the suspensory attachment is on the lacrimal crest, where it blends with the canthus and the medial check ligament. On the floor of the orbit are the inferior oblique and inferior rectus muscles, which cover the inferior orbital fissure and serve as the inferior check ligament. On the superior surface, the superior check ligament is the fascia of the levator, which is anchored laterally at Whitnell's tubercle and medially to the trochlea.

Manson and colleagues have described 4 extensions of the ligament, including an arcuate, capsulopalpebral, inferior rectus, and conjunctival fornix.

WHITNALL'S LIGAMENT

This fascial sling extends from the trochlea (orbital roof, a cartilaginous pulley that contains the tendons of the superor oblique muscle) to the lateral orbit wall. It has attachments to the levator aponeurosis and the superior rectus, as well as the conjunctiva and Tenon's capsule.

MEDIAL AND LATERAL CHECK LIGAMENTS

The medial and lateral check ligaments extend from the orbital septum and levator aponeurosis, as well as the muscle sheaths, and attach to the medial and lateral orbital walls. The medial attachment is to the lacrimal bone (posterior lacrimal crest), whereas the lateral attachment is to the lateral orbital wall at Whitnall's tubercle.[8,9]

ORBITAL FAT

The fat of the orbit consists of extraconal and intraconal disbursements. The abundance of fat facilitates the movement of muscles and maintains the projection of the eye in the orbit. It also serves as a cushion. The intermuscular portion of orbital fat contributes significantly to the maintenance of globe position. The extramuscular fat is liberally dispersed throughout the anterior orbit. This fat is contained by the periorbita. This extramuscular fat does not seem to contribute to the position of the globe, and it is this fat that is reduced during blepharoplasty.

Although it is postulated that the loss of the extra-muscular fat, as occurs with orbital fractures, may result in enophthalmos, Manson and colleagues' work suggests that the loss of the interconal fat is more likely to cause enophthalmos.[8,9] Furthermore, their work suggests that the enophthalmos occurring after orbital trauma is more likely caused by inadequate restoration of orbital anatomy and subsequent changes in the shape of the orbital contents secondary to scarring and loss of support of the suspensory system (Fig. 6).

LACRIMAL GLAND

The lacrimal gland is located in the superior lateral portion of the orbit and is situated in the lacrimal recess of the roof of the orbit. This gland is contained with the periorbita and is suspended inferiorly by Whitnall's capsule. The gland receives innervation from the lacrimal branch of the first division of the fifth nerve and also receives secretory parasympathetic fibers coming from the zygomatic branch via the facial nerve ganglion (Fig. 7).[4]

MUSCLES OF EXTRAOCULAR MOVEMENT

The extraocular muscles are responsible for eye movement. These extraocular muscles include the 4 rectus muscles, the superior oblique, and the inferior oblique. With the exception of the inferior oblique, all other muscles originate at the annulus of Zinn and travel anteriorly to insert into the globe. Although the levator superioris is considered a muscle of extraocular movement and it attaches to the annulus of Zinn, its function is lid elevation, not globe movement.

LEVATOR SUPERIORIS AND SUPERIOR OBLIQUE

The levator superioris also originates at the annulus of Zinn, and its action is to elevate the upper lid. Its innervation is the oculomotor nerve (III). The superior oblique also rises at the annulus of Zinn and is unique in that it attaches via a trochlea to the orbit on the medial side of the roof, and its tendon extends posteriorly from the trochlea and laterally to insert on the lateral side of the posterior globe. Its action allows the globe to rotate inferiorly. Its innervation is the trochlear nerve (IV).

INFERIOR OBLIQUE

The inferior oblique is another muscle of extraocular movement whose attachment is to the medial orbital rim. It runs obliquely across the orbital floor over the inferior orbital fissure to insert into the globe behind its equator. Its action allows the eye to move superiorly. Its innervation is the oculomotor nerve (III).

RECTUS MUSCLES

The superior, medial, inferior, and lateral rectus muscles run from the annulus of Zinn anteriorly to insert into the globe. The rectus muscles function to allow the globe to move in the directions they are named for. The medial, inferior, and superior rectus muscles, as well as the inferior oblique and levator superioris, are innervated by the oculomotor nerve (III). The smooth muscle portion of the inferior and superior lid (Mueller's muscles) is supplied by sympathetic fibers coming from the superior cervical ganglion (see Fig. 4). The lateral rectus is innervated by the abducens nerve (VI), which has the longest intracranial route of any of the cranial nerves. All of these nerves enter the orbit through the superior orbital fissure. The long intracranial pathway of the abducens nerve (VI) makes it the most vulnerable to injury with trauma.

BLOOD SUPPLY

The orbit and its contents have a rich blood supply coming from both the internal and the external carotid systems. In general, the globe and orbital contents are supplied from the extensions of the internal carotid via the ophthalmic artery. The ophthalmic artery gives rise to the lacrimal artery, the anterior and posterior ethmoidal arteries, the supraorbital artery, and the ciliary arteries. The eyelids are also supplied by the internal carotid system via the palpebral arteries and branches of the supraorbital artery. The anterior facial artery, an extension of the external carotid, also supplies portions of the eyelids, as does the infraorbital artery, a terminal branch of the internal maxillary artery (Fig. 8).[4]

VENOUS AND LYMPHATIC DRAINAGE

Venous drainage of the orbit is via the superior and inferior ophthalmic vein running through the superior orbital fissure. There are also communications with the facial vein and pterygoid plexes via the inferior orbital fissure. Of significance is the proximity of the cavernous sinus and the potential for infection to spread from the face to the intracranial contents via the venous drainage system close to the orbit.

Descriptions of the lymphatics of the orbital and periorbital region continue to evolve. The orbit has long been considered only sparsely drained, which is in contrast to the rich lymphatics of the eyelids and bulbar conjunctiva. More contemporary review now supports the presence of some orbital lymphatics, particularly in the lacrimal gland. The eyelids drain laterally into the preauricular nodes and medially into the submandibular nodes.[1]

Surgical Approaches to the Orbit

Access to the orbital contents without osteotomy can proceed from the anterior orbit using either transcutaneous or transconjunctival approaches. Lid creases form the basis for designing most transcutaneous incisions, with the coronal incision being a notable exception. For any orbital surgery, the cornea should be protected by placement of a corneal shield or tarsorrhaphy suture over eye lubricant. Incision design should be completed before distorting tissue with local anesthetic.

In the upper lid, the periorbital skin is thin and the supratarsal fold provides a highly cosmetic crease in which to hide an incision. For this reason, the upper blepharoplasty approach is commonly used in this area. The incision is made through the skin and orbicularis muscle at the level of the upper lid crease. A plane can be developed between the orbicularis oculi and orbital septum to allow control of entry into the orbit. The incision through the periosteum versus the orbital septum depends on the surgical indication. Alternatively, the incision can be hidden in the hair-bearing skin of the lateral brow with a similar area of exposure, but a less cosmetic result.

To expose the superior orbit more broadly with more robust exposure of the medial and lateral walls or to provide access for orbital osteotomies, the coronal incision is the most versatile and cosmetic. This approach consists of an incision at the vertex of the head and postauricular extensions bilaterally. If significant exposure of the root of the zygoma is anticipated, the inferior extension is moved to the preauricular position. Dissection in the subpericranial plane is prudent inferiorly from the hairline across the orbital rims to protect the facial and supraorbital nerves.

For access to the inferior and lateral orbit, the most often used cutaneous approaches are the subciliary and subtarsal approaches. The subciliary incision is created approximately 2 mm inferior and parallel to the free margin of the lower lid. Dissection to the preseptal plane may proceed through the orbicularis directly or in a stepped manner. Final access to the bony orbit is accomplished by incising the periosteum over the infraorbital rim. The subtarsal approach moves the incision inferiorly to between 6 and 7 mm below the free lid margin while following a lower lid skin crease. Here, the skin is incised and the dissection is stepped through the orbicularis oculi to the septum orbitale and taken down to the infraorbital rim. The periosteum is then incised. Exposure is similar for both approaches, but opinions vary regarding the amount of risk relative to ectropion and cosmetic outcome.

Transconjunctival approaches have gained favor for access to inferior and lateral orbit as well as the medial wall, given their cosmetic appeal. The transconjunctival approach often may need to be combined with a lateral canthotomy to obtain comparable access to the transcutaneous approaches. The inferior fornix transconjunctival incision is made through the lower lid conjunctiva after protection of the cornea and injection of local anesthetic. Retraction sutures in the lid margin are helpful adjuncts. This incision is made approximately 2 to 3 mm inferior to the tarsus, which is anterior to the depth of the fornix. This incision should remain lateral to the lower lacrimal punctum. Dissection to the infraorbital rim may proceed either preseptally or postseptally, understanding that postseptal dissection entails an increase in the obtrusiveness of the orbital fat. Once at the infraorbital rim, the periosteum is incised to gain access to the orbital floor. This incision should be located along the anterior inferior rim to prevent unintended disinsertion of the inferior oblique muscle. No attempt is needed to reattach the lower lid retractors or even to suture the conjunctival wound, although this reattachment can be performed in a loose fashion with fine resorbable suture. If a lateral canthotomy is required, resuspension of the lower lid tarsal plate via the lateral canthal attachment is required.

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The medial canthal apparatus, lacrimal drains-age system, and inferior oblique muscle require consideration with transconjunctival access to the medial orbit. Accordingly, a transcaruncular approach can be used concurrently with or in isolation from the inferior fornix approach to expand surgical access. The incision is placed between the plica semilunaris and caruncle and extended into the superior and inferior fornices. Dissection is directly toward the posterior lacrimal crest just posterior to Horner's muscle. Once at the posterior lacrimal crest, an incision through the periorbita is accomplished for access to the medial orbital wall.

The medial orbital rim and wall may also be approached with a curvilinear incision placed anterior to the medial canthus on the frontal process of the maxilla, extending superiorly to the nasofrontal suture and inferiorly to the inferior rim. This incision can be made as a continuous incision with the inferior lid incision if necessary. The limitation with this approach is the medial canthal attachment at the frontal process of the maxilla. If the canthus is detached for access, meticulous care must be taken to anchor it when closing. The most predictable anchor is transnasal canthoplexy. A middorsal nasal incision may also be used to approach the medial orbital wall, but its limitation is similar to the medial curvilinear incision.[11,12]

Acknowledgments

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KEY POINTS

- The orbits are conical structures dividing the upper facial skeleton from the middle face and surround the organs of vision.
- The walls, apex, and base of the orbit are curvilinear and are perforated by foramina and fissures, which have several irregularities where ligaments, muscles, and capsules attach.
- When considering the size and shape of the orbit, it is a well-designed and protective structure, which shields the ocular globes.
- The floor of the orbit is most vulnerable to fracture when there is direct force exerted on the ocular globe because it is thin and unsupported.
- The orbit and its contents have a rich blood supply coming from both the internal and the external carotid systems.
- Access to the orbital contents without osteotomy can proceed from the anterior orbit using either transcutaneous or transconjunctival approaches.

Fig. 1.
Avulsion of the eye occurred as a result of a deceleration injury in which the patient also sustained severe midfacial fractures. This is an example of deceleration forces exceeding the strength of the lid retractors, suspensory and check ligaments, and the natural shape of the orbit where the internal diameter exceeds the diameter of the orbital rims. (Patient treated at Parkland Memorial Hospital, Dallas, TX, under the direction of Dr R.V. Walker.)

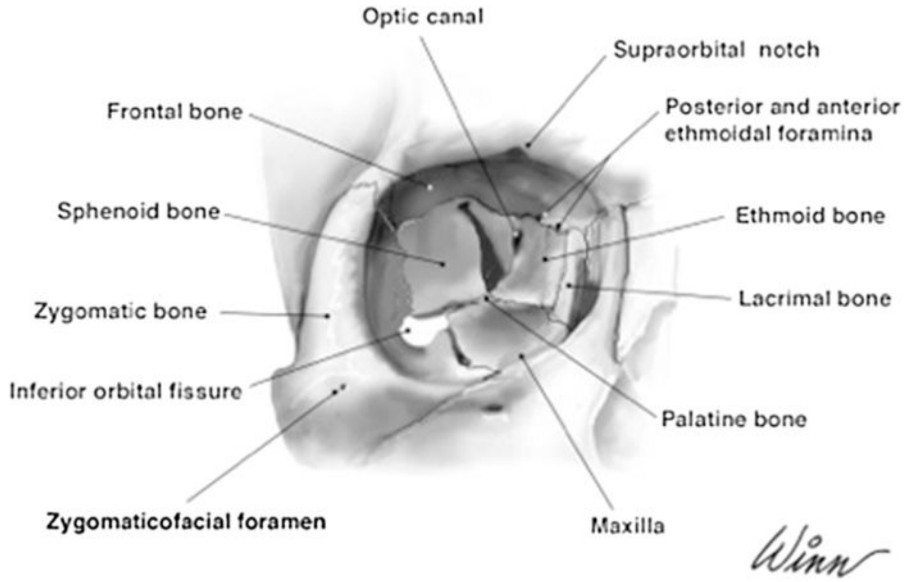

Fig. 2.
The 7 bones of the orbit. (*From* Rougier J, Tessier P, Hervouet F, et al. Chirurgie plastique orbito-palpébrale. Paris: Elsevier Masson SAS; 1977. Copyright © Société Française d'Ophtalmologie. All rights reserved; with permission.)

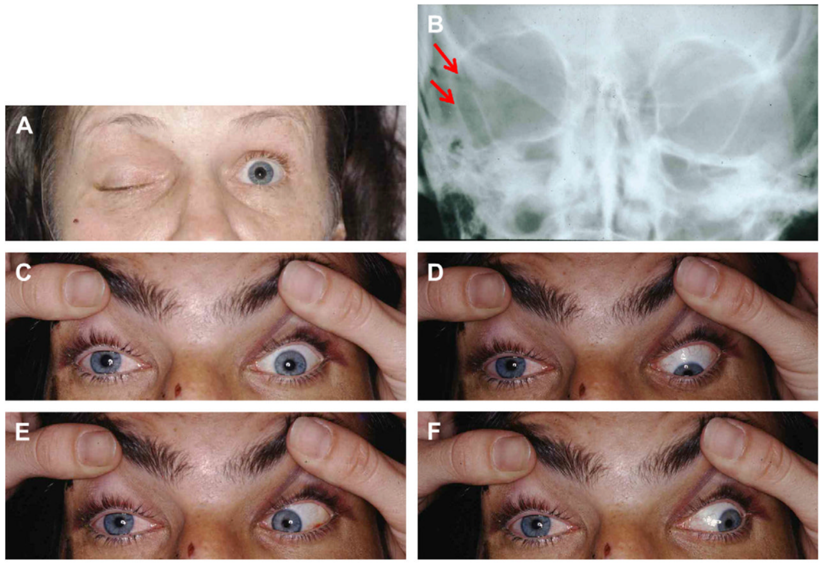

Fig. 3.

Superior orbital fissure syndrome consists of ptosis, proptosis, pupillary dilation, and ophthalmoplegia. (*A*) Ptosis associated with the condition. (*B*) Radiograph demonstrating a fracture extending into the superior orbital fissure (*arrows* demonstrate orbital fracture). (*C*) Pupillary dilation of the right eye in another patient with superior orbital fissure syndrome. (*D*, *E*, *F*) Ophthalmoplegia. (Patient treated at John Peter Smith Hospital, Ft. Worth, TX, under the direction of Drs Bruce Epker and Larry Wolford.)

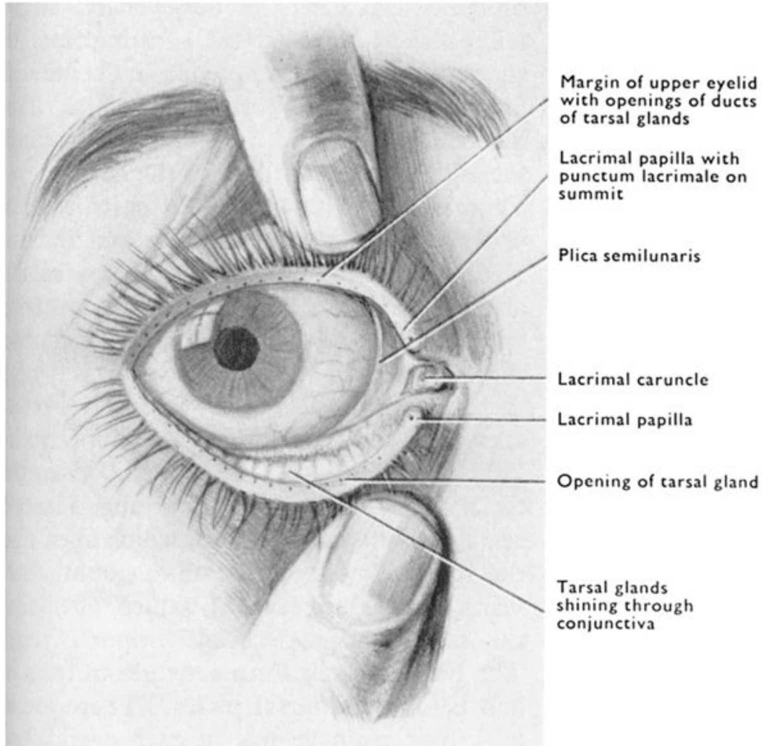

Fig. 4.

The anatomy of the medial aspect of the palpebral fissure. (Reprinted from Romanes GJ. Cunningham's textbook of anatomy. 10th edition. Oxford Press; 1962. Fig. 957, p. 803; with permission.)

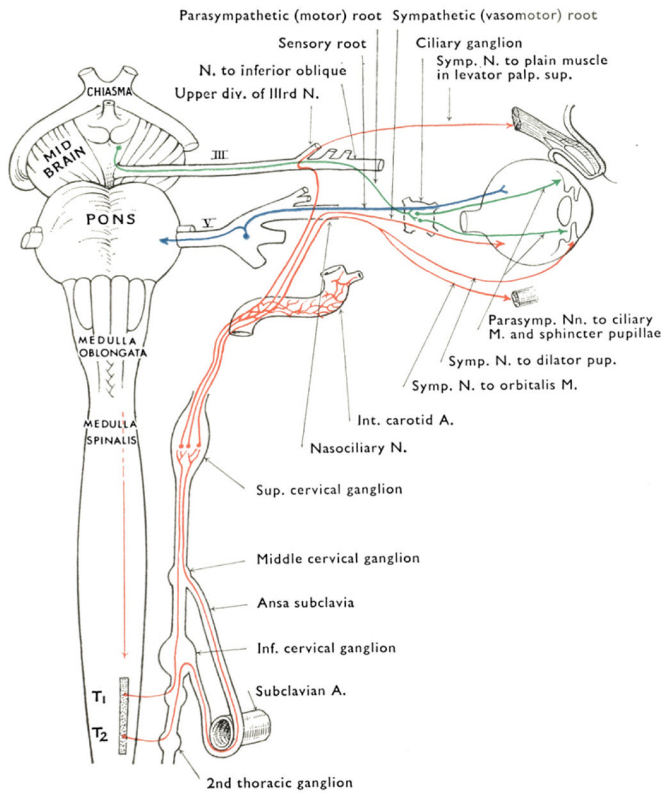

Fig. 5.

Sympathetic innervation of the orbital contents arising from the superior cervical ganglion and entering the orbit via the first division of the trigeminal nerve and the oculomotor nerve. A., artery; div., division; Inf., inferior; M., muscle; N., nerve; palp. sys., palpabrae superioris; Sup., superior; Symp., sympathetic. (*Reprinted from* Romanes GJ. Cunningham's textbook of anatomy. 10th edition. Oxford Press; 1962. Fig. 56, p. 692; with permission.)

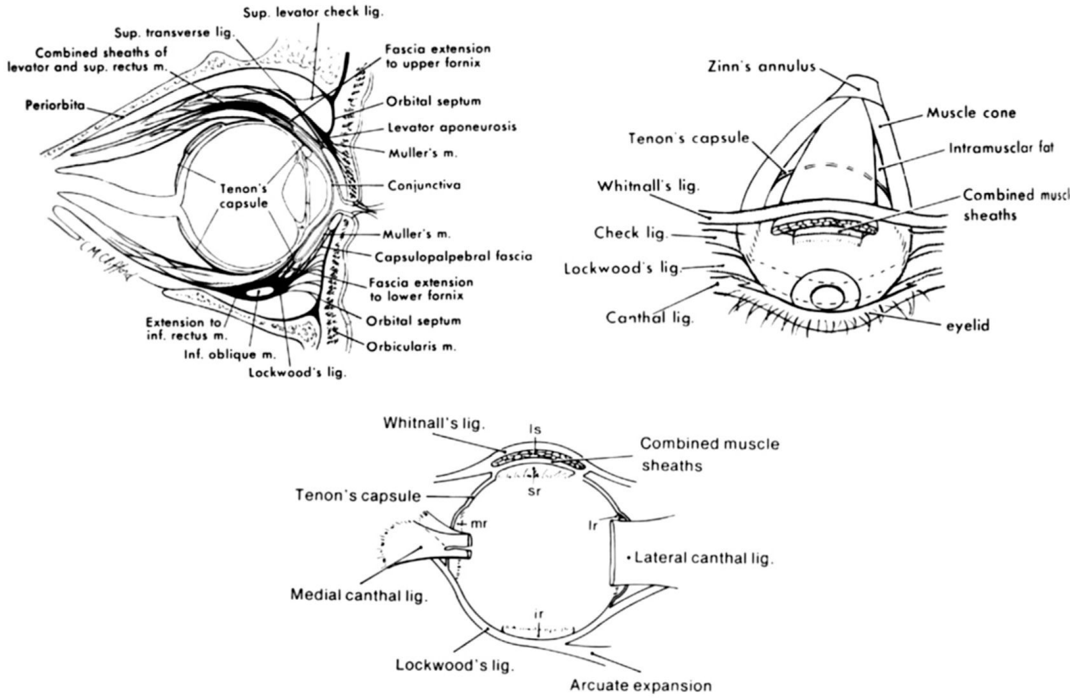

Fig. 6.

The orbit and eyelids. Notice the elaborate labyrinth of muscles, tendons, ligaments, and fascia, which contribute to the movement, suspension, and containment of the ocular globe. Inf., inferior; lr, lateral rectus; ir, inferior rectus; ls, levator superiorus; lig., ligament; m., muscle; mr, medial rectus; sup., superior. (*Reprinted from* Manson P, Clifford CM, Su CT, et al. Mechanisms of global support and posttraumatic enophthalmos: I. The anatomy of the ligament sling and its relation to intramuscular cone orbital fat. Plast Reconstr Surg 1986;77(2):193–202. Fig. 6, p. 198; with permission from Williams Wilkins Publishing Co.)

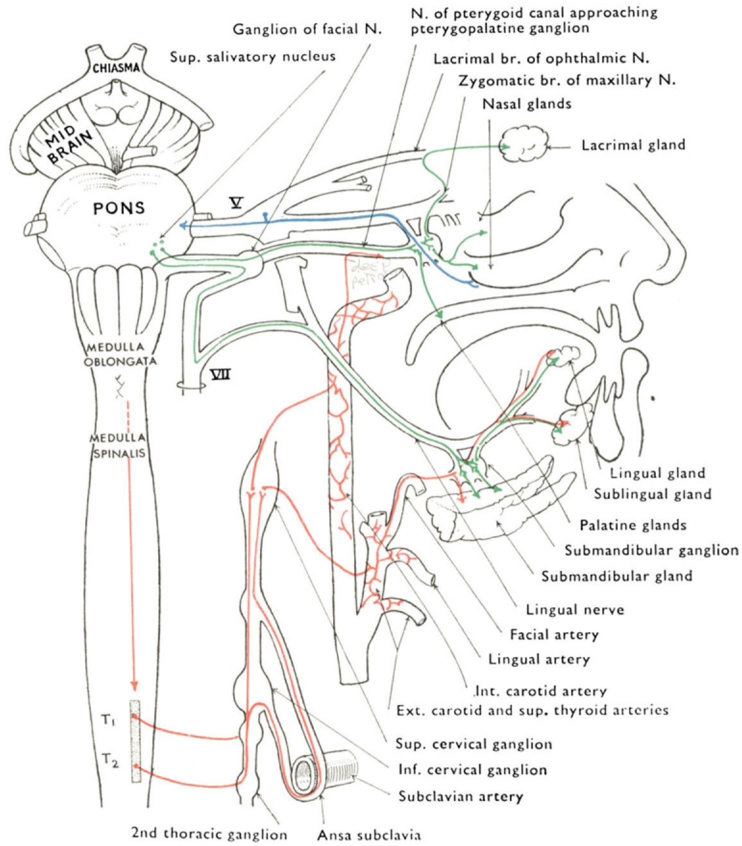

Fig. 7.

The secretory innervation of the lacrimal gland via parasympathetic fibers arising from the facial nerve ganglion. br., branch; Inf., inferior; Int., internal; N., nerve; Sup., superior. (*Reprinted from* Romanes GJ. Cunningham's textbook of anatomy. 10th edition. London: Oxford Press; 1962. Fig. 868, p. 703; with permission.)

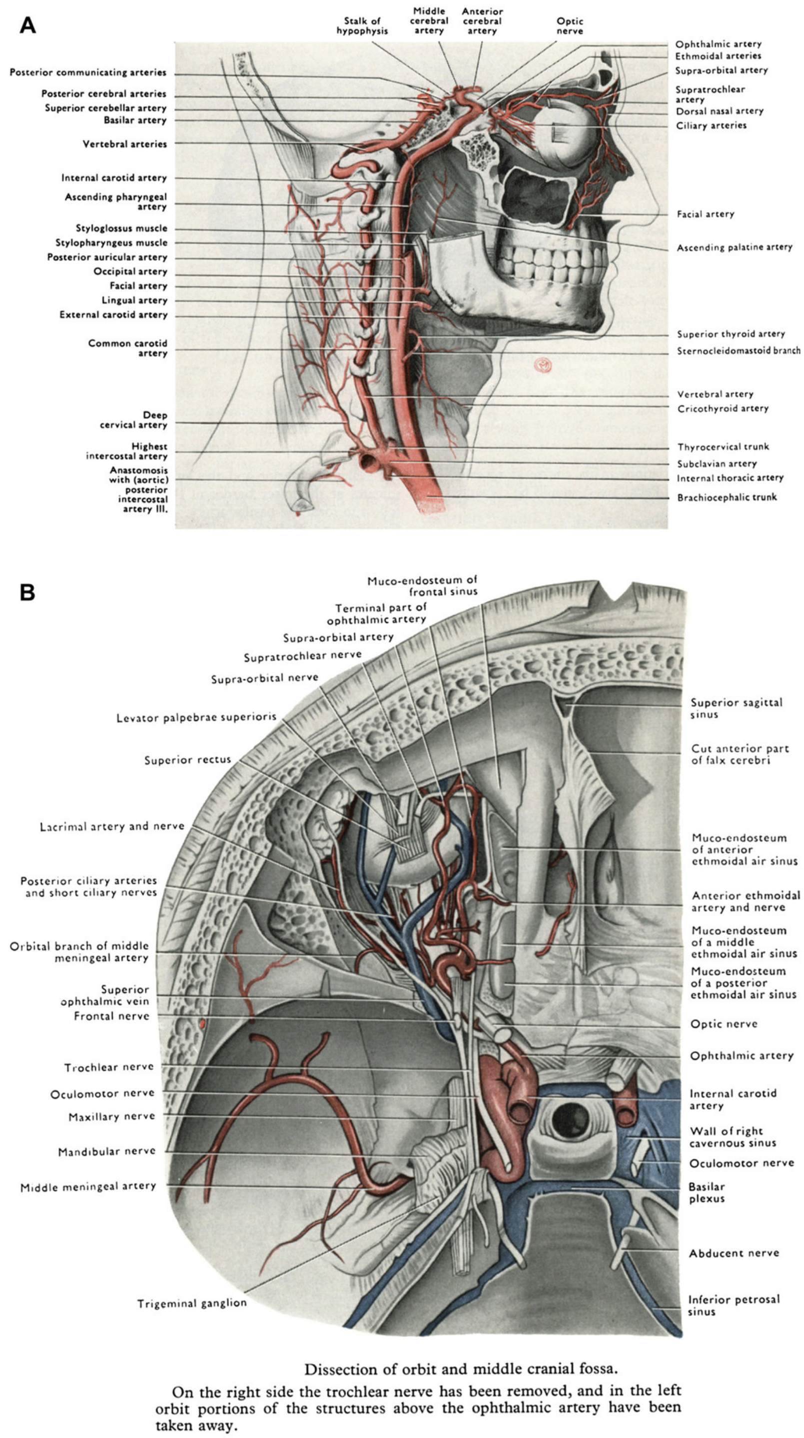

Fig. 8.

(*A*, *B*) Arterial blood supply of the orbit and its contents. (*Reprinted from* Romanes GJ. Cunningham's textbook of anatomy. 10th edition. Oxford Press; 1962; with permission.)