THE ANATOMY OF THE ORBITA WALL AND THE PRESEPTAL REGION: BASIC VIEW

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SUMMARY: Orbita is a very important region as it is a frequent area of interest in plastic and reconstructive surgery for medical and cosmetic purposes. Detailed and accurate knowledge of anatomy of this region is crucial as the type of surgical procedure differs depending on the location of the pathology. Thus knowing the anatomy of the preseptal region and the orbita walls in details may help in choice of the operation technique of this region and provide better results.

Key words: Orbit, orbital septum, periorbita, anatomy

INTRODUCTION

In the history of Medicine, the information about the orbita and eyeball dates back to the Civilizations of Mesopotamia and Egypt. In the 15th century the layers of the eyelid was defined in the correct order in the book of Muhammed bin Mahmud-i Sirvani entitled "Mürsid (Eye Diseases)" (1). Orbita is a very important region and its walls are composed of different bones (2,3). It is frequently the focus of interest of plastic and reconstructive surgeons for medical and cosmetic purposes (2,3). Cadaver dissection, histological sectional studies along with the advancement of imaging methodology (e.g. MRI) allowed for understanding of the anatomy of this region details (4,5).

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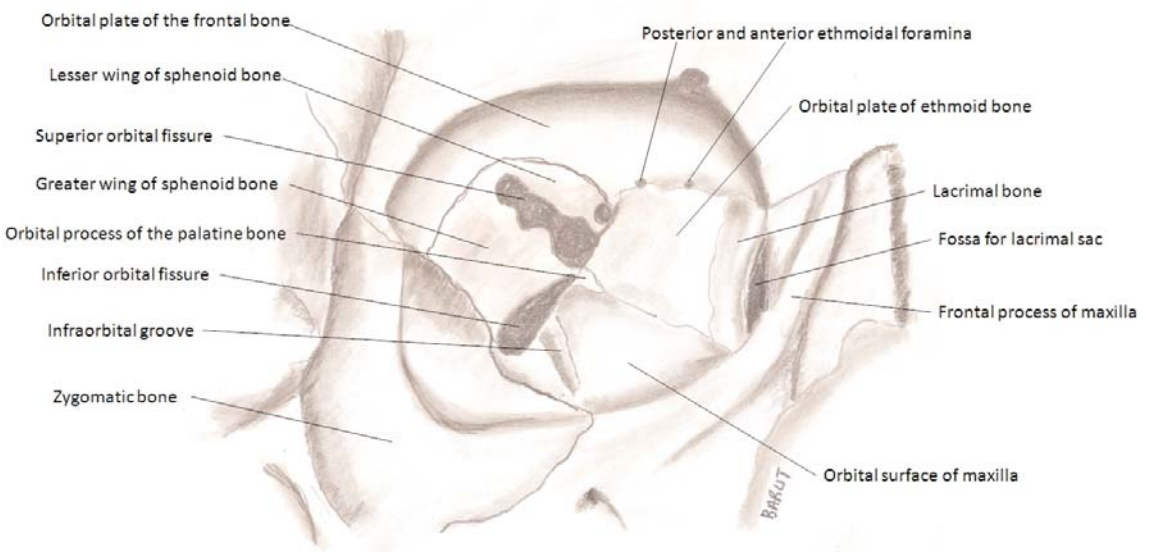
ORBIT AND ITS WALLS

Orbit, is pyramidal shaped cavity with volume of about 27 ml (6). The medial walls are nearly parallel to each other, whereas the outer wall extends from lateral to medial and from anterior to posterior so that they intersect at the apex of the orbit. The base of the orbit is the orbital opening and its edge is called as orbital margin. The orbital margin can be divided into: the supraorbital margin, infraorbital margin, lateral and medial margins respectively (7). Bony structures which constitute orbit is shown in Figure 1.

Superior wall: The roof of the orbit is formed by the orbital plate of the frontal bone (8). This part, contains a large and flat cavity called lacrimal fossa in the lateral part and a spur called trochlear spine in the medial part. Posteriorly, there is the lesser wing of the sphenoid bone. Optic canal lies between the two roots of the lesser wing at the apex of the orbit (7,8).

Figure 1: Bony structures which constitue the right orbit.



Inferior wall: This wall which is also referred as the floor of orbit is narrower than the superior wall. Most of it is formed by the orbital surface of the maxilla whereas the outer part is formed by the orbital surface of the zygomatic bone. A small region in the hindmost part is formed from the orbital process of the palatine bone (7,8). The groove extending forward from the posterior and medial parts is called infraorbital groove. This groove extends as infraorbital canal within the maxilla and opens on the anterior surface of maxilla as the infraorbital foramen (7). The best surgical intervention choice for floor fractures is closely related to the anatomical location of the fracture in the orbital floor and it determines the type of the surgical intervention (9).

Medial wall: This wall consists of the frontal process of the maxilla, lacrimal bone, orbital plate of the ethmoid (this is referred as lamina papyracea in clinical practice) and the body of the sphenoid bone respectively (10). Song et al. reported that 70 % of the blow-out fractures occured in the medial wall, and 37% occured in the lower wall (11). They stated that the area of the lamina papyracea per ethmoidal cell in medial wall fractures was significantly higher than lower wall fractures. Three vertical sutures are present on the medial wall. These are lacrimomaxillary, ehtmoidolacrimal and spheno-ethmoidal sutures (7). In the upper part frontomaxillary, frontolacrimal, fronto-ethmoidal and sphenofrontal sutures are present in anteroposterior direction. The anterior point of frontolacrimal suture is called dacryon. This is one of the morphometric points used in the evaluation of skull asymmetry (12). The holes on the fronto-ethmoidal suture are called anterior and posterior ethmoidal foramina. The fossa on the anterior part of the medial wall is the fossa for lacrimal sac. This is restricted by anterior and posterior lacrimal crests. This fossa is in continuation with the nasolacrimal canal inferiorly (7).

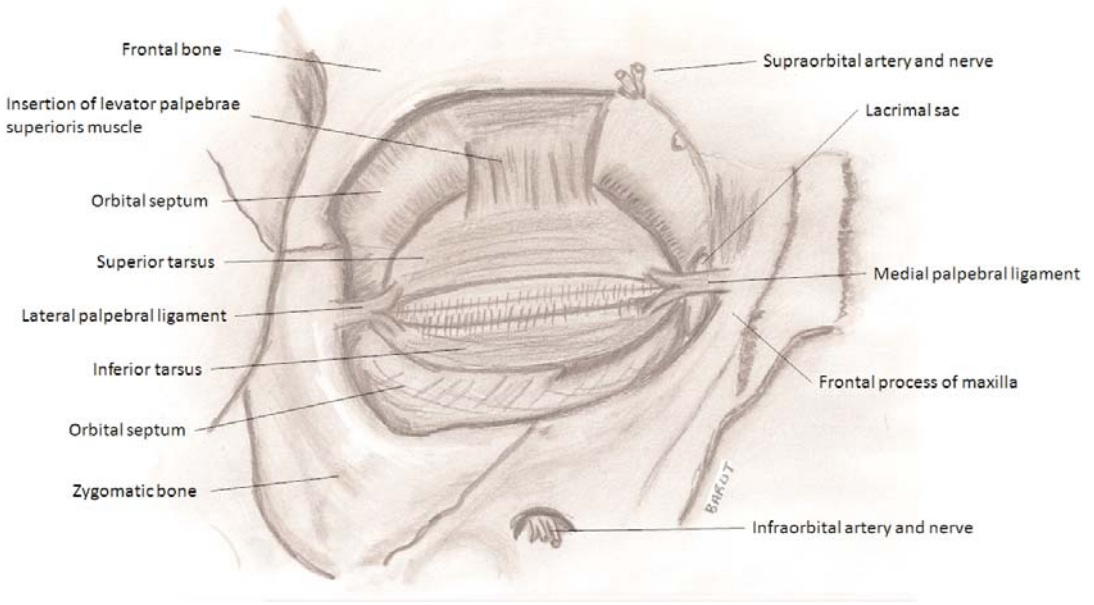
Lateral wall: Consists of the frontal process of the zygomatic bone anteriorly and the orbital surface of the greater wing of the sphenoid bone posteriorly (8). The lateral and inferior walls are separated by the inferior orbital fissure whereas the lateral and superior walls are separated by the superior orbital fissure (7). According to the measurements of Zengin *et al.* (13) surgery can easily be carried out on this wall to a distance of 30 mm.

FASCIAL STRUCTURES WITHIN THE ORBIT

Periorbita

The periost of the orbit is called periorbita (14). Periorbita continues with the dura mater and the sheath of optic nerve through the optic canal and superior

Figure 2: Connective tissue within the right orbit.



orbital fissure posteriorly. Anteriorly it attaches to the orbital margin and continues with the periost of lining the outer surface (14).

Orbital fat body

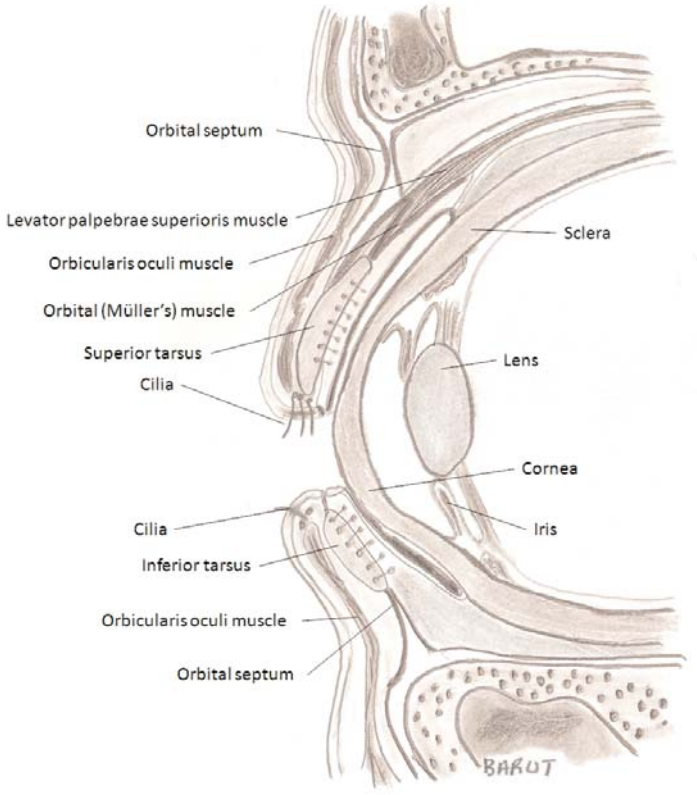
Fat-pad outside the Tenon's capsule is called orbital fat body (14). With aging, this fat-body may herniate (15).

Fascial sheath of eyeball: Tenon's capsule

The thin membrane which envelops the eyeball from the optic nerve to the corneoscleral junction is called the fascia bulbi: Tenon's capsule. Fascia bulbi is perforated by the tendons of the extraocular muscles and extends over these muscles as tubular sheaths called the muscular fasciae. The sheath of the superior oblique muscle reaches the fibrous pulley (trochlea) and the sheath of the inferior oblique muscle extends to the floor of the orbit. An expansion from the sheath of superior rectus blends with the tendon of levator palpebrae superior. An expansion from the rectus inferior attaches to the inferior tarsus. An expansion separated from medial rectus muscle attaches to lacrimal bone and a stronger expansion from lateral rectus attaches to zygomatic bone. These extensions are known as the check ligaments of the eyes as they limit the movements of the eyes (14). The inferior part of the fascia bulbi is thicker. This part is like a hammock, wide in the middle and narrow in the ends. The narrow ends attaches to zygomatic bone laterally and lacrimal bone medially. The eyeball is placed on the wide middle part. That is why it is also called the suspensory ligament of eyeball (14).

1. Levator palpebrae superioris: This flat and thin muscle arises from the orbital surface of the lesser wing of the sphenoid bone with a narrow tendon. It lies parallel to the superior wall of the orbit and broadens gradually towards the upper eyelid as an aponeurosis (Figures 2 and 3). It splits into three laminae. Its superficial lamina blends with the upper part of the orbital septum and passes in front of the superior tarsus, attaching to the skin of the upper eyelid and orbicularis oculi muscle (Figure 2). The medial lamina attaches to the upper edge and anterior face of superior tarsus. This lamina is mostly formed by smooth muscle fibers. Thus, the medial lamina is also referred as superior tarsal muscle (14). The deep lamina unites with the extension of the sheath of the superior rectus muscle attaches to the superior conjunctival fornix. There are smooth muscle fibers attaching to the inferior tarsus of the lower eyelid which are called inferior tarsal muscle.

Figure 3: Sagittal section of the eyelids and the anterior segment of the eye.



2. Orbital muscle (Müller's muscle): It consists of smooth muscle fibres. It covers the inferior orbital fissure (Figure 3). Hoffmann *et al.* (5) have reported the structural differences related to this muscle are found to be 92% on 26 cases studied.

PRESEPTAL SPACE

Orbital Septum

Orbital septum is a membranous structure which lies between the orbital opening and the superior tarsus and the inferior tarsus consecutively (8). It attaches to the tendon of levator palpebrae superioris and the upper edge of superior tarsus in the superior eyelid whereas it attaches to the inferior tarsus in the lower eyelid (Figures 2 and 3). Orbital septum which is thin medially attaches to lacrimal bone just behind lacrimal sac without attaching to the medial palpebral ligament. It is stated in the literature that its morphology may be different in 88% of cases (5).

High resolution MRI is an appropriate method to evaluate orbital septum precisely (5). Goldberg *et al.* (3) pointed out that the weakening of the septum may be the reason of orbital fatty prolapsus. Koornneef (16) investigated the anatomy and function of the orbital septum after he had realized a motility disorders in patients with blow-out fractures.

Superior and Inferior Tarsi

They are a thin plate-shaped structures made of tight connective tissue. These 2,5 cm long structures lie within the eyelids and determine their form (14). Superior tarsus is bigger than the inferior tarsus and the height of its central part is 10 mm (8). Depending on its morphology, Negasso *et al.* (17) have classified the superior tarsus into 3 types: sickle, triangular and trapezoid. Superficial fibers of the tendon of levator palpebrae superioris attaches to the anterior surface of the superior tarsus. The height of the central part of the inferior tarsus

is 4 mm. Free edges of both tarsi are adjacent to each other and these edges are thick and plain. Their distant edges are thin and convex and are attached to the orbital septum (14). The structures which connect the ends of tarsi to the bony orbit are called lateral and medial palpebral ligaments (Figures 2 and 3). These enable the eyelids to open and close like a hinge. The fibers of palpebral part of orbicularis oculi blend with the superfiacial part of lateral palpebral ligament to form lateral palpebral raphe (14).

Fasciae

The thin leaf-shaped fibrous connective tissue of the body is called fascia. Structure of fasciae within different parts of the body differs evidently. In general, fascial system consists of three parts: 1. superficial fascia (subcutaneous tissue), 2. deep fascia and 3. subserosa. Superficial fascia lies between the skin and the deep fascia in the whole body and consists of two layers (7): Superficial and deep layers. In the neck region, the surface lamina of the superficial fascial is thin and loose, and within the deep layer there lies the fibers of platysma. The deep fascia around the neck is known as cervical fascia and it consists of two layers; superficial (or investing layer) and posterior layer. Investing layer is covered with platysma in the anterior and lateral parts of the neck (18). The investing layer moves up to the face and attaches to the lower part of body of the mandible, thus there isn't any deep fascia in the facial region (18,19). In 1976, Mitz and Peyroni (20) have defined SMAS (Superficial musculoaponeurotic system) in the zygomatic region of the face and emphasised the surgical importance of it.. SMAS is a structure which is composed of fibrous and muscle tissues and is related with platysma. In the upper part, it ends attaching to orbicularis oculi circularly at the infra-orbital margin. Medially, it envelops the zygomaticus major as two layers. Fatty tissue lies deep to it. As SMAS attaches to the anterior lacrimal crest medially it constitutes an origin for the orbital septum (8,21). In the study of Kikkawa *et al*., (21) SMAS is stated to be a regulator and distributor for the muscles in the eye.

Orbicularis oculi:

It consists of palpebral, orbital and lacrimal parts (8,14). There are strong crescent-shaped structures made of connective tissue inside the eyelids which are called superior and inferior tardi. The lateral ends of these tarsi attach to zygomatic and lateral palpebrale ligaments whereas the medial ends attach to the frontal process of maxilla via medial palpebral ligament. Lateral palpebral raphe lies superficialy to the lateral palpebral ligament (14). Lateral palpebral raphe is a weak structure which is formed by the blending of muscle fibers (palpebral part) from the upper and lower eyelids. In the study of Goold *et al.* (22) which was carried out on cadavers, it was stated that there have been cases in which these structures do not exist. Sometimes, there may be fat tissue or lacrimal gland lobules between these two parts. Palpebral part is thin and pale and lies inside the eyelid. The fibers of this part which originate from the medial palpebral ligament inserts into the peripheral part of the lateral palpebral raphe. The part which is peripheral to the palpebral part is the orbital part. Orbital part is thicker and dark colored and originates from the medial palpebral ligament medially and ends in the same structure by forming a ring laterally without attaching to anything. The upper part of the orbital part blends with the corrugators supercilii and frontal part of occipitofrontal bone. Lacrimal part which is 6 mm wide and12 mm heigh is a small and thin part that is not visible from the outside. It lies in the posterior part of the medial. palpebral ligamet and lacriaml sac. This part originates from the posterior lacrimal crest of lacrimal bone and its nearby part. It surrounds the lacrimal sac posteriorly and laterally respectively. It ends in the medial palpebral ligament and the medial end of both tarsi (14). Sometimes the lacrimal part is not evident. It is crucial for surgical interventions to know the anatomic location of the suborbicularis oculi and the retroorbicular oculi fat tissues (23,24).

Corrugator supercilii:

This thin and long muscle lies in the medial half of the eyebrows deep to the orbicularis oculi and the frontal part of occipitofrontal bone. It originates from

the medial end of the superciliary arch and extends supero-laterally between the orbital and the palpebral parts of orbicularis oculi and inserts into the skin at the superior part of the central part of the superciliary arch (14).

Depressor supercilii:

It lies medialy to the corrugator supercilii and extends superiorly to the skin of the eyebrow medial to the palpebral part of orbicularis oculi (14).

CONCLUSION

Orbita and the anatomy of the structures related to it are important. It is necessary to carry on studies in the near future to imply new surgical approaches by refreshing the existing knowledge and improving it.

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