INTRODUCTION

Anatomy of the Lower Eye Lid

Precise anatomic knowledge of the eyelid is a prerequisite for both reconstructive and cosmetic lower eyelid surgery in order for it to be performed appropriately. The gross anatomy of the lower eyelid is analogous to that of the upper eyelid, however, the lower eyelid has a more simplified structure with less dynamic movement.[1]

The eyelid is divided into 3 lamellae **(Figure 1)**: anterior, middle, and posterior. The anterior lamella includes the skin and orbicularis oculi muscle. The middle lamella is defined as the combination of the orbital septum, orbital fat, and suborbicularis fibro-adipose tissue. The posterior lamella includes the lower lid retractors, tarsal plate, and conjunctiva.[1]
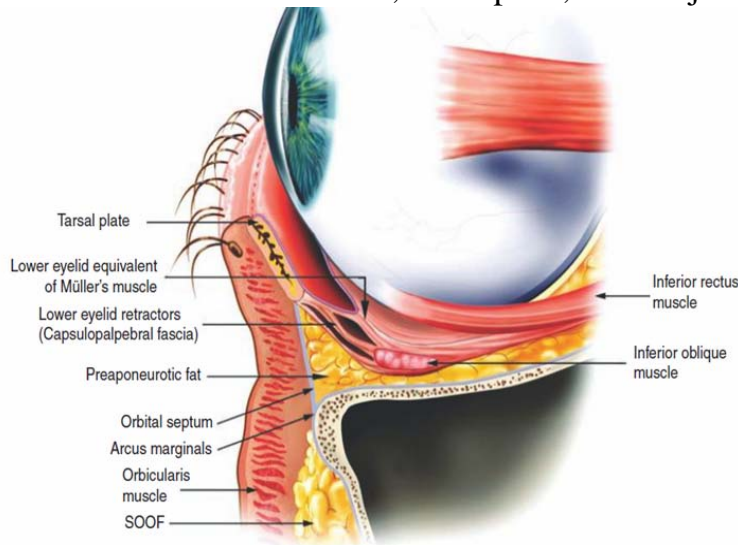

Figure (1): The anatomy of the lower eyelid and adjacent structures.[2]

The lower lid position has to be evaluated in association with the spherical surface of the globe. The lower lid tends to follow the intercanthal line (the shortest line that can be drawn on the globe surface from the medial to the lateral canthal attachments). Note that medially at the lacrimal punctum, the intercanthal line is directed backward close to the globe's surface to join the posterior limb of the medial canthal tendon, while the lid margin forms an angle parallel to the anterior limb *(Figure 2).*[3]
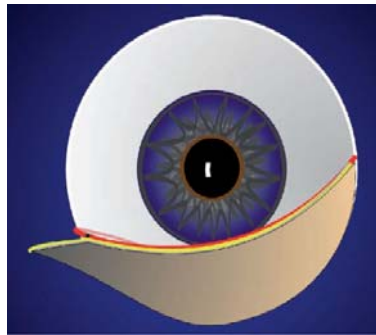

Figure (2): Lower lid position. (The intercanthal line (red line) runs close to the globe's surface from the lateral canthus to the lacrimal punctum, where it continues into the posterior limb of the medial canthal tendon creating an angle with the lid margin (yellow line)).[3]

Eyelid Margin

The lid margin is about 2 mm thick and 30 mm long, the lateral 5/6 of the eye lid margin is called the ciliary portion, it has a squared edge, the medial 1/6 is called the lacrimal portion. About 5 mm from the medial angle there is a small elevation called the papilla lacrimalis, leads into the lacrimal canaliculi.[4]

The eyelid margins contain a number of lashes that are arranged in rows, totaling 90 to 160 lashes on the upper eyelid and about 75 to 80 in the lower eyelid. Their length varies from 8 to 12 mm in the upper and from 6 to 8 mm in the lower lid. Eyelash follicles are free of erector pili muscle.[5]

The sebaceous glands of Zeis open into each follicle. And the modified sweat gland of Moll open into the follicles or onto the eye lid margin. Just in front of the posterior edge of the margin of the lid are the orifices of the tarsal glands (Meibomian glands), they are about 20 to 25 in each lid and can be seen as yellowish lines on the inner surface of the everted eyelid, the orifices of the tarsal glands mark the site of junction between the skin and the conjunctiva.[4]

A grayish line **(Figure 3)** or slight sulcus can sometimes be seen running along the eyelid margin between the eyelashes and orifices of the tarsal glands this represent the line of demarcation between the anterior lamellae formed by skin and orbicularis muscle and the posterior lamellae formed by tarsus and conjunctiva.[4]
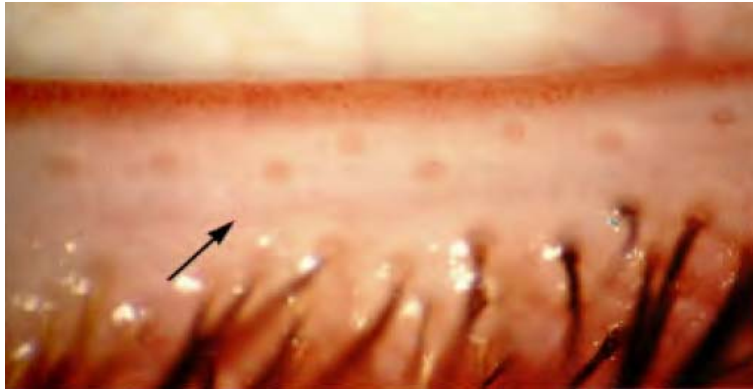
Figure (3): The eye lid margin and the gray line is arrowed. [6]

Structure of The eyelid;

1) Skin and Subcutaneous areolar tissue

The thinnest skin in the body (about one mm) and is almost transparent. A well-placed incision within this skin usually results in minimal scarring. The skin is attached to the periosteum of the lower orbital margin forming the malar fold laterally and the naso-jugal fold medially which limits effusion and escape of orbital fat *(**Figure 4**)*. The skin is also attached to the medial and lateral palpebral ligaments. The subcutaneous areolar tissue is loose and contains no fat. It is absent near the ciliary margin, palpebral sulci and at the canthi.[7]
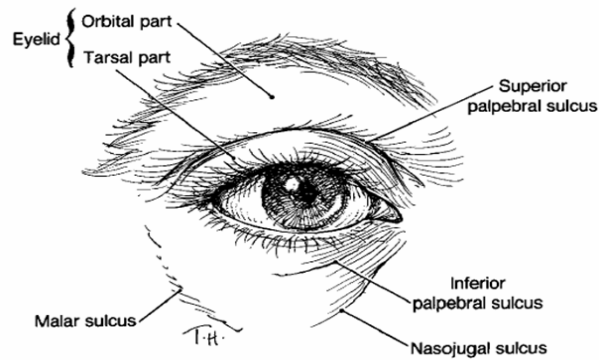
Figure (4): Superficial anatomy of the eyelids. [8]

2) *Orbicularis Oculi Muscle*

Orbicularis oculi **(Figure 5)** is the palpebral sphincter. It is an elliptical sheet extending from the lids, where it surrounds the palpebral fissure, to the brow, temple and cheek. It consists of two main parts: Palpebral; orbital.

The orbital part of the orbicularis muscle surrounds the orbital rim and is responsible for forced eyelid closure. The palpebral part is artificially divided into a pretarsal muscle, in front of the tarsal plate, and a preseptal muscle, in front of the orbital septum in each lid.

Each pretarsal muscle arises from the lateral canthal tendon and inserts by two heads. The superficial head forms the superficial part of the medial canthal tendon, and the deep head inserts on to the bone of the posterior lacrimal crest, forming the posterior limb of the medial canthal tendon. When the muscle contracts it closes the lid and pulls the lacrimal puncta medially into the lacus lacrimalis.

Each preseptal muscle similarly inserts by a superficial and deep head. The superficial heads form the superficial part of the medial canthal tendon and the deep heads insert into the lacrimal fascia on the lateral side of the lacrimal sac. When the muscle contracts the lacrimal fascia is pulled laterally, creating a relative vacuum in the lacrimal sac at the same time as the pretarsal muscle pulls the puncta medially into the lacus lacrimale. Tears enter the lacrimal sac. When the muscles relax the lacrimal fascia returns to normal and tears pass down the nasolacrimal duct.[9]

A third part of the orbicularis oculi is a recognizable entity, the pars lacrimalis (tensor tarsi), often named Horner's muscle. It is a thin layer attached behind the lacrimal sac to the upper posterior lacrimal crest and the lacrimal fascia passing anterolaterally, it divides into two slips around the canaliculi and blends with the pretarsal and ciliary parts of orbicularis oculi in both lids.

The pars ciliaris (muscle of Riolan), is formed of fine striated muscle fibres in the dense tissue of the palpebral margins. Medially the ciliary and lacrimal parts are continuous.[9]
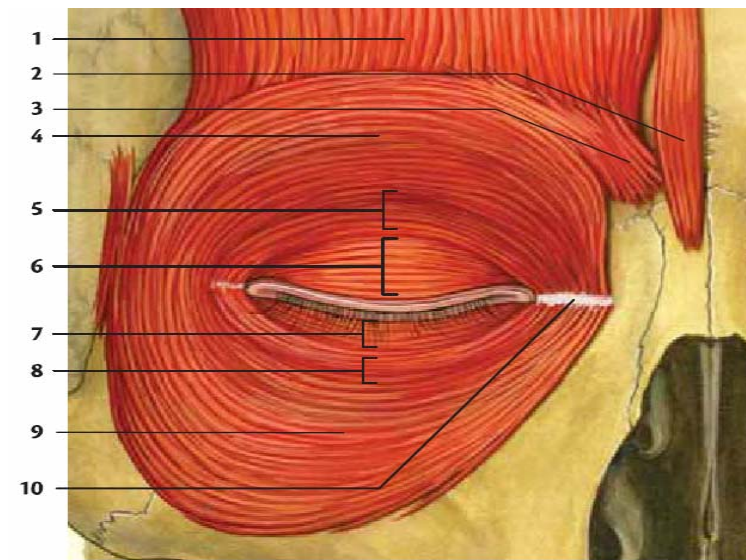
Figure (5): Anatomy of Orbicularis oculi muscle and its relations: 1) Frontalis muscle. 2)Procerus muscle. 3)Corrugator supercilii muscle. (4-9):Orbicularis muscle. 4)Superior orbital portion. 5)Suprior preseptal portion. 6) Superior pretarsal portion. 7) Inferior pretarsal portin. 8) Inferior preseptal portion. 9) Inferior orbital portion. 10) Medial canthal ligament.[10]

3) *The orbital septum*

The orbital septum **(Figure 6)** is a fibrous multi-layered membrane of variable thickness, which arises from the arcus marginal, a line of periosteal condensation, along the superior and inferior orbital margins. The orbital septum is continuous with the inner layers of the periorbita. Within the orbit the periorbita lines the bony orbital walls and is composed of an outer layer of periosteum and an inner layer continuous with the orbital fascia*.* [2]

In the lower eyelid the inner fascial layer extends into the eyelid as the orbital septum. Laterally the orbital septum inserts into the lateral canthal tendon and also passes behind the tendon inserting onto the lateral retinaculum together with the lateral horn of the levator aponeurosis. In the superomedial aspect of the orbit the orbital septum extends inferiorly and posteriorly along the posterior lacrimal crest. Here it inserts just posterior to Horner's muscle and the posterior limb of the medial canthal tendon. The orbital septum passes around the lip of the lacrimal foramen where it fuses to the lacrimal sac fascia. The inferior orbital septum joins the superior orbital septum medially at the anterior lacrimal crest.

In the lower eyelid, the orbital septum fuses with the capsulopalpebral fascia a few millimeters below the inferior aspect of the tarsal plate. This common fascial sheet then inserts into the lower edge of the inferior tarsal plate.[2]
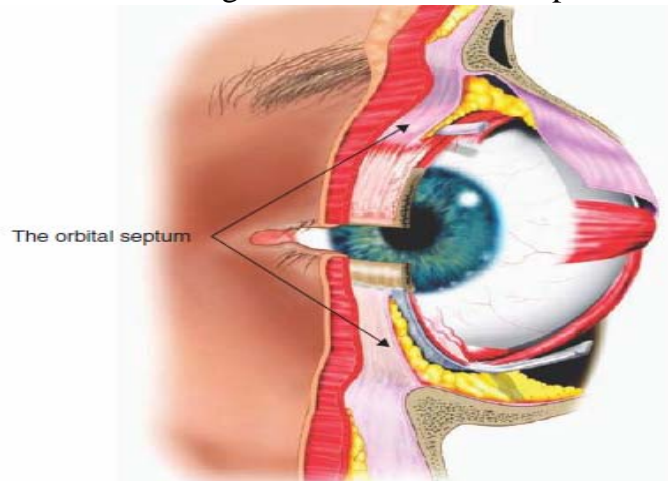

Figure (6): The orbital septum and its relationship to the periorbita and Periosteum.[2]

4) *Preaponeurotic fat*

Orbital fat **(Figure 7)** lies posterior to the orbital septum and anterior to the capsulopalpebral fascia in the lower lid. In the upper eyelid, there are 2 fat pockets: nasal and central. In the lower eyelid, there are 3 fat pockets: nasal, central, and temporal. These pockets are surrounded by thin fibrous sheaths that are forward continuations of the anterior orbitoseptal system.[11]
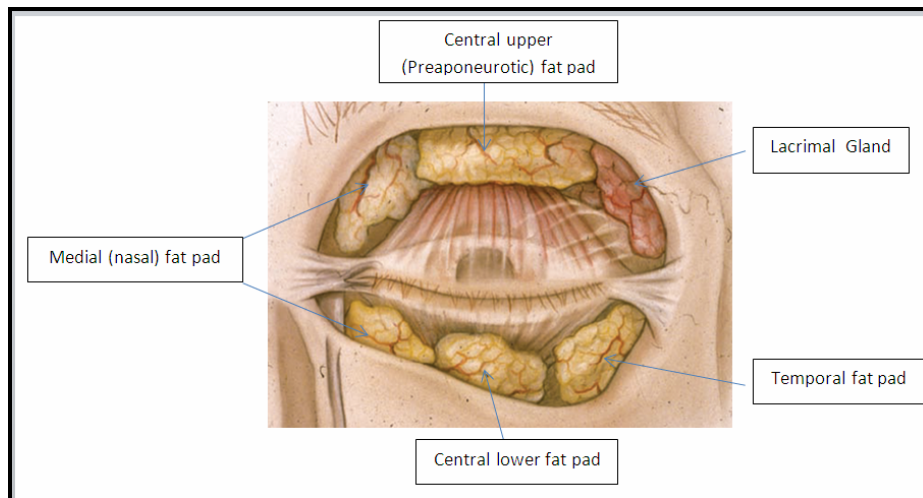

Figure (7): Preaponeurotic fat pads of the upper and lower eyelids**.**[12]

5) *Lower eyelid retractors (LER)*

LER **(Figure 8)** is a fascial extension from the terminal muscle fibers and tendon of the inferior rectus muscle, originating as the capsulopalpebral head.

As it passes anteriorly from its origin, it splits into 2 portions to pass around the inferior oblique muscle sheath. As they continue to pass forward reunites as the inferior transverse ligament (Lockwood ligament)**.**[13]

The lower eyelid retractors consist of 2 double layers The anterior layer originates from Lockwood's ligament inferiorly and extends superiorly as a portion of the capsulopalpebral fascia with no smooth muscle component. This portion of the eyelid retractors is contiguous with the orbital septum and suborbicularis fascial layer with fingerlike projections that extend into the anterior lamella The fingerlike projections through the preseptal orbicularis oculi muscle likely contribute to the lower eyelid crease. The posterior portion of the lower eyelid retractors contains smooth muscle fibers and makes up the deep portion of the capsulopalpebral fascia that extends near the inferior border of the tarsus.The smooth muscle fibers taper and terminate approximately 2.5 mm below the inferior tarsal border**.**[14]

LER has medial and lateral horns, the lateral horn a little thicker than the medial horn. LER pull the lower eyelid inferoposteriorly and stabilize the lower eyelid in an appropriate position. It's an analogous anatomical structure to the upper eyelid retractors (Müller muscle and the levator aponeurosis).[15]
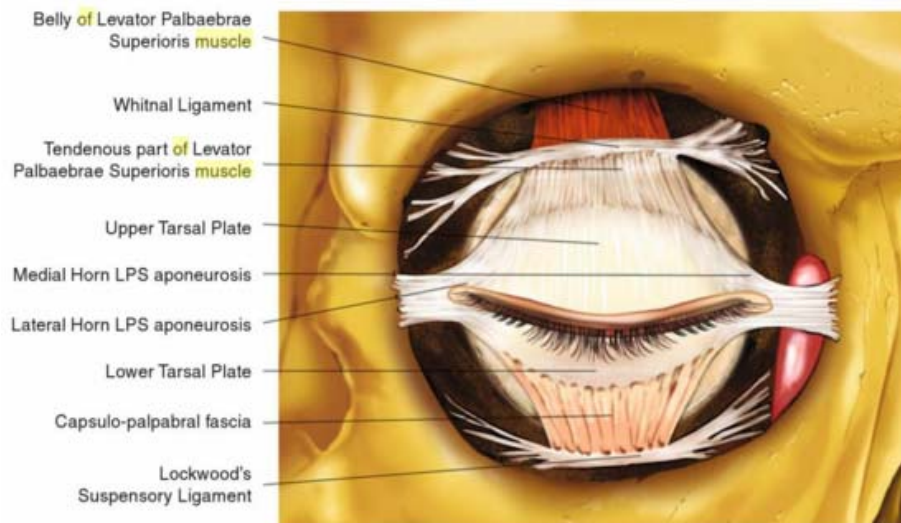
Figure (8): Major retractors of the upper and lower eyelid.[13]

6) *The Tarsal plates*

Tarsal plates is semilunar shaped, thin and elongated plates of firm dense fibrous tissue 2.5 cm long, and the vertical heights are 10 mm at the superior tarsus and 4 mm at the inferior tarsus. [16]

The tarsal plates act as the skeleton of the eyelids, providing semirigid support. The upper and lower tarsal plates are similar in length (29 mm) and thickness (1 mm). The Meibomian glands are modified holocrine sebaceous glands and are oriented vertically in parallel rows through the tarsus. The upper lid contains 25 meibomian glands, and the lower lid contains 20. [17]

Canthal tendons;

The medial canthal tendon *(MCT)* has 2 origins from the anterior and posterior lacrimal crests fuse just temporal to the lacrimal sac and then again split into an upper limb and a lower limb that attach to the upper and lower tarsal plates. The attachment of the tendon to the periosteum overlying the anterior lacrimal crest is diffuse and strong; the attachment to the posterior lacrimal crest is more delicate but important in maintaining apposition of the eyelids to the globe, allowing the puncta to lie in the tear lake. [11]

The lateral canthal tendon *(LCT)* attaches at the lateral orbital tubercle on the inner aspect of the orbital rim. It splits into superior and inferior branches that attach to the respective tarsal plates. LCT usually inserts 2 mm higher than does MCT, giving the normal horizontal palpebral fissure an upward slope medial to lateral. Insertion of the LCT inferior to the MCT causes a downward (anti mongoloid) slant.[11]

7) *The Conjunctiva*

The conjunctiva is a mucous membrane that covers the posterior surface of the eyelids. The palpebral portions lie immediately posterior to the tarsal plates and the sympathetic muscles of Muller and continue into the fornices, where they join the bulbar conjunctiva. [10]

Vascular Supply to the Eyelids;

Vascular supply to the eyelids is extensive. The posterior eyelid lamellae receive blood through the palpebral arterial arcades **(Figure 9).**

In the upper eyelid, a marginal arcade runs about 2 mm above the eyelid margin and a peripheral arcade extends along the upper border of tarsus between the levator aponeurosis and Müller's muscle. These vessels are supplied medially by the superior medial palpebral vessels from the terminal ophthalmic artery and laterally by the superior lateral palpebral vessel from the lacrimal artery.[18]

The lower lid arcade receives blood from the medial and lateral inferior palpebral vessels.

The venous drainage system is somewhat less well defined than the arterial system. Drainage is primarily into several large vessels of the facial system **(Figure 10).**

Lymphatic drainage from the eyelids is restricted to the region anterior to the orbital septum. Drainage from the lateral two-thirds of the upper eyelid and the lateral one-third of the lower eyelid is inferior and lateral into the deep and superficial parotid and submandibular lymph nodes. Drainage from the medial one-third of the upper eyelid and the medial two-thirds of the lower eyelid is medially and inferiorly into the anterior cervical lymph nodes.[18]

Extensive excision of subcutaneous eyelid tissues or deep incisions in the inferolateral eyelid or in the deep conjunctival fornix can result in protracted lymphedema due to disruption of these vessels.[18]

Figure (9): Arterial supply of the eyelids.[18]
(a) Medial palpebral artery;
(b) lateral palpebral artery;
(c) superior peripheral arcade;
(d) superior marginal arcade;
(e) inferior marginal arcade;
(f) angular artery.

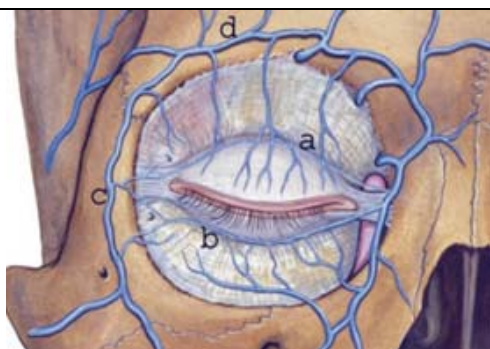**Figure (10):** Venous supply of the eyelids.[18]
(a) Superior venous arcade;
(b) inferior venous arcade;
(c) angular vein;
(d) superior palpebral vein.

Nerve Supply of the Eyelids

The sensory innervation of the eyelids is provided by branches of the ophthalmic and maxillary divisions of the trigeminal nerve. The medial aspect of the lower eyelid is supplied by the infratrochlear nerve. The central aspect is supplied by infraorbital nerve, a branch of the maxillary nerve and the lateral aspect of the lower eyelid is supplied by the zygomaticofacial branch of the maxillary nerve.[2]

The motor supply to the orbicularis muscle comes from the facial nerve via its temporal and zygomatic branches and frequently also contains anastomotic connections from the buccal branch. Muller's muscle receives diffuse sympathetic branches primarily via the internal carotid system along various orbital nerves and arteries.[10]