INTRODUCTION

Pterygium is an elevated, superficial, external ocular mass that usually forms over the perilimbal conjunctiva and extends onto the corneal surface. Pterygia can vary from small atrophic quiescent lesions to large, aggressive, rapidly growing fibrovascular lesions that can distort the corneal topography, and, in advanced cases, they can obscure the optical center of the cornea.[1]

Pterygium commonly grows from the nasal side of the conjunctiva. It is usually present in the palpebral fissure. It is associated with and thought to be caused by ultraviolet-light exposure (e.g. Sunlight), low humidity, and dust.[2]

Pterygium invades into the cornea, and consequently, may cause visual disturbance due to corneal curvature abnormalities. It causes blurred vision as a result of astigmatism which is usually irregular. Surgical removal of the pterygium leads to improvement of the pterygium induced impaired vision.[3]

Symptoms of pterygium include persistent redness, inflammation, foreign body sensation, tearing, dry and itchy eyes. In advanced cases the pterygium can affect vision as it invades the cornea with the potential of obscuring the optical center of the cornea and inducing astigmatism and corneal scarring. [4]

The indications for pterygium surgery are pterygium invading or threatening visual axis or visual impairment due to astigmatism or irritative symptoms and inflammation or restricted movements and cosmesis indications.[5]

Surgical excision with conjunctival autograft is widely considered to be the current criterion standard method for the surgical treatment of pterygium because of low recurrence and complication rates. The most commonly used method for securing the conjunctival autograft is with absorbable sutures, and studies using this technique have demonstrated improvements in spherocylinder power, astigmatism, and topographic irregularity postoperatively.[6]

Several studies have used computerized corneal topography systems to evaluate the corneal topography in eyes with pterygia. These studies have demonstrated that pterygia commonly induce focal corneal flattening and ‘‘with-the-rule’’ astigmatism. In addition, pterygium dimensions have been significantly correlated with spherical power, astigmatism, surface regularity index, and surface asymmetry index.[7] Postulated causes for the observed topographic changes include mechanical distortion of the cornea due to direct fibrovascular traction by the pterygium or indirect apparent ‘‘flattening’’ due to localized pooling of the tear film at the apex of the pterygium. Most of those

topographic changes in the cornea have been reported to be reversed by successful pterygium surgery, although eyes with advanced pterygia might not normalize completely.[8]

Wave front analysis is a more accurate method for detailed evaluation of optical system of the eye. Imperfections in the refractive surface of the anterior and posterior cornea and the lens can be detected through this method. The estimation of the optical quality of the eye provided by the wave front analysis is extended beyond the description of spherical and cylindrical refractive errors, and it can measure higher order aberrations (HOA). Therefore, it is believed that wave front analysis can provide a better assessment of the pterygium induced irregular astigmatism, its effects on the eyesight and impacts of surgery on restoration of normal vision.[9]

AIM OF THE STUDY

The aim of the study is to evaluate the effect of pterygium surgery on corneal topography by comparing wave front analysis before and one month after the surgical treatment.

Anatomy and Physiology of Conjunctiva

Gross Anatomy

The conjunctiva is a thin transparent mucous membrane that extends from the eyelid margins anteriorly, providing a lining to the lids, before turning sharply upon itself to form the fornices, from where it is reflected onto the globe, covering the sclera up to its junction with the cornea. It thus forms a sac that opens anteriorly through the palpebral fissure. Conjunctiva is conventionally divided into the following regions; marginal, tarsal, orbital (these three collectively form the palpebral conjunctiva), bulbar and limbal (fig. 1).[10]

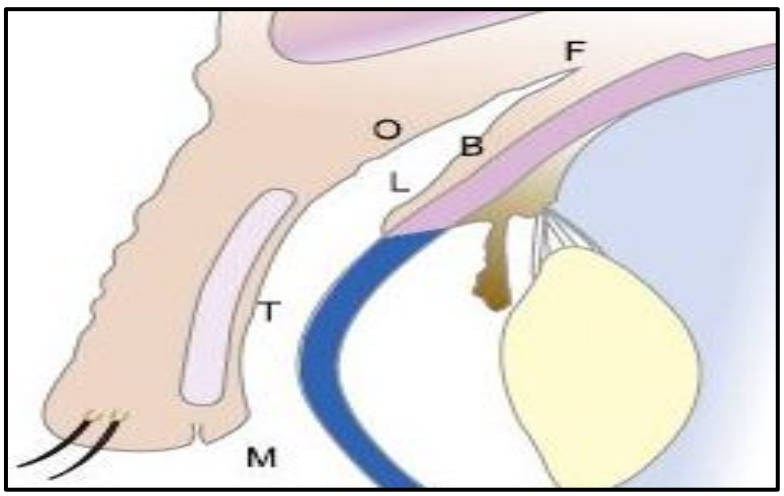

Fig. (1): Schematic representation of a mid-sagittal section through the eyelid and conjunctival sac showing the different conjunctival regions. M = marginal; T = tarsal; O = orbital; B = bulbar; L = limbal; F = forniceal. [10]

The static dimensions of the conjunctival sac in the primary position are as the following; the marginal zone extends from a line immediately posterior to the openings of the tarsal glands and passes around the eyelid margin, from where it continues on the inner surface of the lid as far as the sub tarsal fold (a shallow groove that marks the marginal edge of the tarsal plate) (fig.2).[11]

The tarsal conjunctiva is highly vascular and is firmly attached to the underlying fibrous connective tissue. From the convex border of the tarsal plate, the orbital zone extends as far as the fornices. Over this region the conjunctiva is more loosely attached to underlying tissues, and so readily folds. Elevations of the conjunctival surface in the form of papillae and lymphoid follicles are commonly observed in this region.[11]

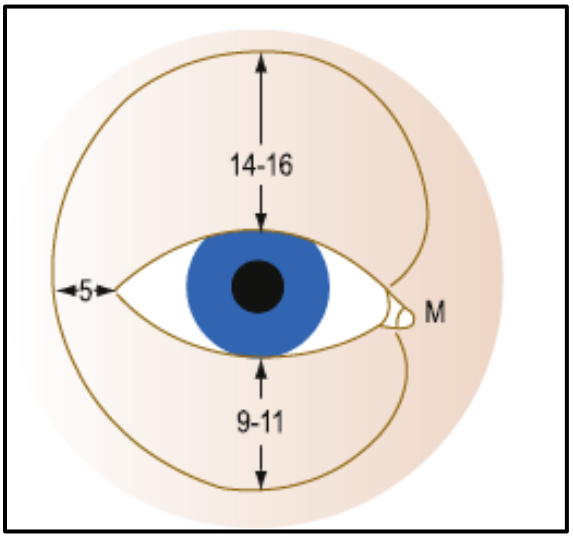

Fig. (2): Static dimensions of the conjunctival sac in millimeters.[10]

M = medial canthus.

The transparency of the bulbar conjunctiva readily permits the visualization of conjunctival and episcleral blood vessels. Here, the conjunctiva is freely movable owing to its loose attachment to tenon's capsule (the fascial sheath of the globe). As the bulbar conjunctiva approaches the cornea, its surface becomes smoother and its attachment to the sclera increases. The limbal conjunctiva extends approximately 1-1.5 mm around the cornea. Its junction with the cornea is ill defined, particularly in the vertical meridian, owing to a variable degree of conjunctival / scleral overlap.[10]

The limbus has a rich blood supply, and in the majority of individuals a radial array of connective tissue elevations – the palisades of Vogt – can be seen adjacent to the corneal margin. Palisades are most prominent in the vertical meridian, and their visibility is enhanced in pigmented eyes (fig. 3).[11]

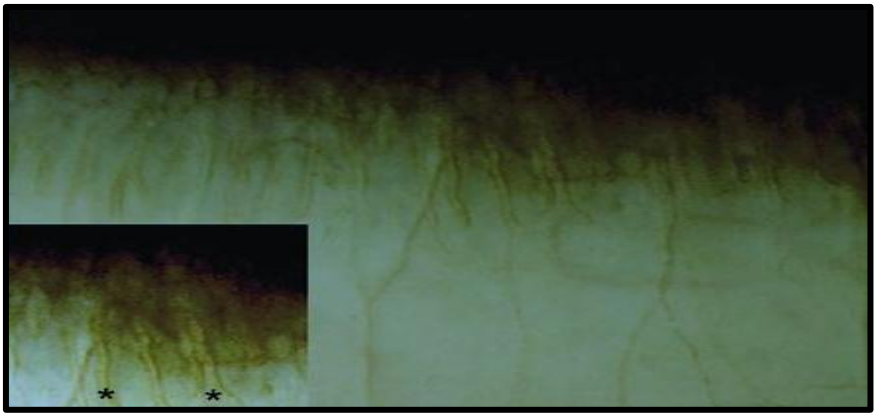

Fig. (3): High-power slit-lamp view of the conjunctival palisades of Vogt at the lower limbus (**asterisks**).[10]

Microscopic Anatomy

In histological section, two distinct layers can be resolved: an epithelium containing a variable number of goblet cells, and a vascular stroma that consists of a superficial lymphoid layer and a deep fibrous layer. The appearance of the conjunctiva shows a marked regional variability.[12]

Epithelium

The conjunctiva of the eye consists of an epithelial layer composed of stratified squamous and stratified columnar epithelium.[13]

The mucocutaneous junction is posterior to openings of the tarsal glands, i.e. at the junction of 'dry' and 'moist' regions where the marginal strips of tear fluid end. Here the skin changes abruptly to non-keratinized squamous cells in about five strata, all nucleated. The basal epithelium retains papillae. The deepest layer is of cylindrical cells, as in epidermis, with intermediate layers of polyhedral cells, the most superficial being flat but indented. Squamous cells are gradually replaced by columnar and cubical cells in the direction of the conjunctival sac. The number of the layers is also reduced, but deepest cells remain cylindrical. Goblet cells, absent at the mucocutaneous junction, begin to appear and are very numerous beyond the subtarsal fold.[14]

Approaching the tarsus, the epithelium thins to 2– 3 layer of columnar cells with scattered goblet cells. The epithelium of the orbital zone is slightly thicker (2–4 cells) with more numerous goblet cells. The number of goblet cells declines over the bulbar conjunctiva and at the limbus the epithelium is again stratified squamous, and goblet cells are absent. The limbus contains a unique array of connective tissue ridges (the palisades of Vogt), which project into the overlying epithelium (fig. 4). Clinical and experimental evidence suggests that the palisades are the repositories of stem cells and therefore act as the regenerative organ of the corneal epithelium. The conjunctival epithelium additionally contains several non-native cell types, including dendritic cells, melanocytes and lymphocytes.[15]

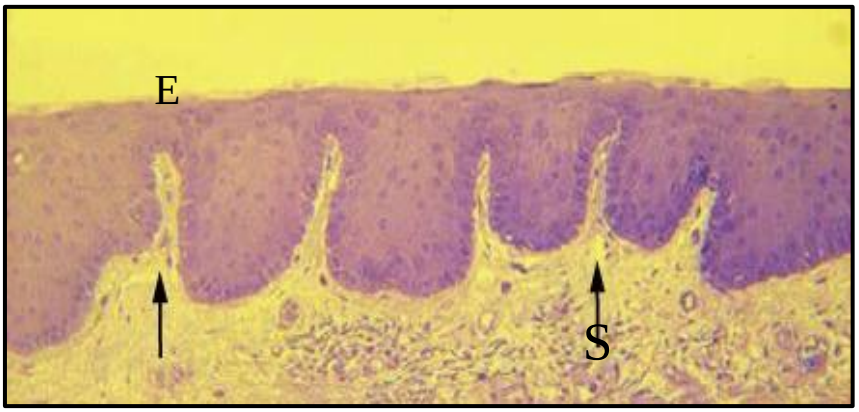

Fig. (4): Histological section through the palisade region. Connective tissue ridges can be seen projecting into the overlying epithelium **(arrows).**[10]

Goblet and Other Secretory Cells

Goblet cells provide the mucous component of the tear film. They arise in the basal cell layers and migrate to the surface, there becoming fully differentiated. Mature goblet cells are larger than the surrounding epithelial cells and contain a peripherally placed nucleus. The cytoplasm is packed with membrane-bound secretory granules that discharge from the apical surface in an apocrine manner. The number of goblet cells shows a marked regional variation in density, and these cells are occasionally seen lining intraepithelial crypts (of Henle) (fig. 5).[14]

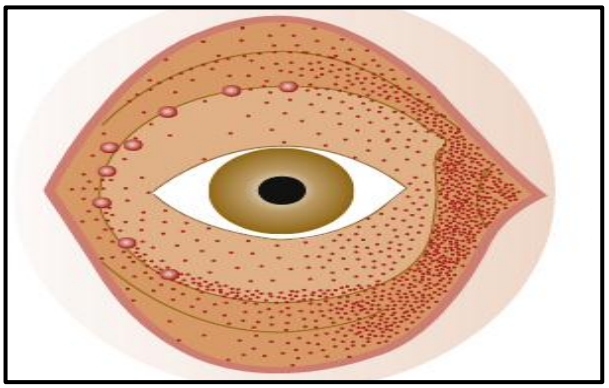

Fig. (5): Diagram showing the regional variation in goblet cell density. Goblet cell density is greatest over the caruncle, plica semilunaris and inferior nasal palpebral conjunctiva.[16]

The apices for many surface epithelial cells of the conjunctiva contain numerous carbohydrate-containing secretory vesicles, which are seen to migrate to the cell surface where they fuse with the plasma membrane. It is likely that this represents a mechanism for recycling the cell surface glycocalyx rather than a secondary source of secretory mucin. [17]

Conjunctival Stroma

The conjunctival stroma (substantia propria) is variable in thickness. It can be resolved into two distinct layers: a superficial adenoid layer and a deeper fibrous layer. The adenoid layer contains numerous lymphocytes with local accumulations in the form of lymphoid follicles. Follicles represent aggregates of predominantly B cells, which form part of the so-called conjunctiva-associated lymphoid tissue.[18] The adenoid layer also contains a large number of mast cells, which play a major role in ocular allergy. The deep fibrous layer is generally thicker than the adenoid layer and contains the majority of conjunctival blood vessels and nerves (fig. 6).[19]

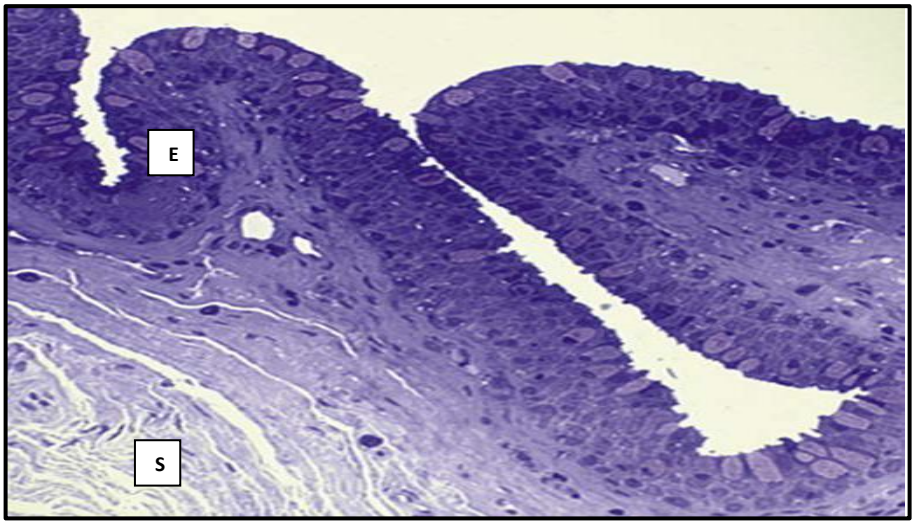

Fig. (6): Histological section through the bulbar conjunctiva. E= epithelium; S= stroma. Goblet cells can be seen in the epithelium (arrows). The stroma can be re solved into an adenoid layer (arrowhead) and a deep fibrous layer (asterisk). [10]

Innervation, Blood Vessels and Lymphatics

Innervations

The nerve supply to the conjunctiva is derived entirely from the first division of the trigeminal nerve. The nerves to the lid supply most of the conjunctiva.

These nerves comprise

- The infratrochlear branch of the nasociliary nerve,
- The lacrimal nerve,
- The supratrochlear and supraorbital branches of the frontal nerve, and Also, The infraorbital nerve from the maxillary division of the trigeminal nerve. The limbal area is supplied by branches from the ciliary nerves.

All nerves form a network in the conjunctiva and terminate either peripherally in various forms of specialized endings or on blood vessels and epithelial cells. The majority of nerve endings in the conjunctiva are free, unmyelinated nerve endings.[20]

Blood Vessels and Lymphatics

Arteries

The arterial supply derives from two sources: palpebral branches of the nasal and lacrimal arteries of the lid, and anterior ciliary arteries, both vessels are derived from the ophthalmic artery, which is derived from the internal carotid artery.[21]

The post-tarsal plexus of the lid, which is supplied by the marginal and peripheral artery of the upper lids, supplies the palpebral conjunctiva.

The perforating arteries from the marginal palpebral arcade pass through the tarsus, reaching the subconjunctival space in the region of the subtarsal sulcus to form the marginal and tarsal vessels.

The perforating vessels from the peripheral palpebral arcade perforate Müller's muscle and supply most of the forniceal conjunctiva. This arcade sends descending branches to supply the tarsal conjunctiva and also anastomoses with vessels from the marginal arcade and ascending branches that pass into the superior or inferior fornix to continue around the fornices to the bulbar conjunctiva as the posterior conjunctival arteries.

The second major source of supply, the anterior ciliary arteries, travel along the tendon of the rectus muscles and give off anterior conjunctival arteries just before piercing the globe. These arteries send branches to the pericorneal plexus and to the neighboring regions of the bulbar conjunctiva in the limbal area. In this region, there is free anastomosis in the subconjunctival and episcleral tissue between the anterior conjunctival vessels and terminal branches of the posterior conjunctival vessels, resulting in the zone of palisades of Busacca. Thus, the superficial and deep systems in the limbal area are closely connected (fig. 7).[20]

Fig. (7): High-power slit-lamp photograph showing the limbal vascular arcades. [10]

Veins

The conjunctival veins are more numerous than the arteries. [21]

For the most part, the major portion of the drainage from the tarsal conjunctiva and the bulbar conjunctiva is directed to anterior ciliary veins and into many peripheral conjunctival veins that connect to the eyelid's venous plexus, before joining the superior and inferior ophthalmic veins.

Some of the tarsal veins empty independently into the superior and inferior ophthalmic veins.

Lymphatics

The lymphatic channels in the conjunctiva are arranged in two plexuses:[20]

1) A superficial plexus consisting of small vessels placed below the capillaries; and
2) A deeper plexus consisting of larger vessels in the fibrous portion of the substantia propria.

These vessels are important in the mediation of immunologic reactions that occur in certain ocular diseases and surgical conditions. Laterally placed lymph vessels flow to the preauricular lymph nodes; medially placed vessels flow to the sub maxillary lymph nodes.

Important functions of conjunctiva

Many important functions are performed by the conjunctiva including: [22]

1) Protection of the soft tissues of the orbit and the eyelid.
2) Provision of the tear film's aqueous and mucous layers.
3) Facilitation of independent globe movement.

The conjunctiva also has enormous potential for combating infection for four reasons. [23]

1) It is highly vascular.
2) The different cell types contained in it can initiate and participate in defensive inflammatory reaction.
3) It has many immunocompetent cells that contribute a rich supply of immunoglobulins.
4) The microvilli and the enzymatic activity of the conjunctival cells enable that tissue to engulf and neutralize foreign particles, such as viruses.