Chapter 2

The Conjunctiva: Anatomy and Physiology

J. Daniel Nelson, J. Douglas Cameron

Critical to maintaining the integrity of the eye, the conjunctiva is a mucous membrane that protects the soft tissues of the eyelid and orbit, allows extensive movement of the eye and is the main site for the production of the aqueous and mucous components of tears. The sebaceous glands of the eyelid produce the third component of the tear film. The conjunctiva also provides a source of immune tissue and antimicrobial agents to protect the ocular surface. Abnormalities of the conjunctiva may lead to restriction of ocular movement, deficiency of the tear film, and decreased host resistance to infection. In addition, the cornea may ultimately be adversely affected because of conjunctival disease.

Embryology

The conjunctiva arises from surface ectoderm and neural crest tissues in the region of the optic vesicle.[1] At 8 weeks (32- to 37-mm stage) the eyelids form from folds of the surface ectoderm and fuse together. The conjunctiva develops within the lid folds from surface ectodermal and neural crest tissue along the posterior surface of the lids and from similar tissues around the developing cornea. The conjunctival epithelium differentiates from the cutaneous epithelium and corneal epithelium as early as the tenth week and definitely by the twelfth (60- to 70-mm stage). Budding of the epithelium in the conjunctival fornices forms the lacrimal gland superotemporally and accessory lacrimal glands of Wolfring and Krause in the inferior and superior fornices (12 weeks, 50- to 55-mm stage). The caruncle arises as a sequestration of the medial lower eyelid to accommodate the development of the nasolacrimal duct. The caruncle is composed of tissues found both in the conjunctiva and skin; however, the surface epithelium is nonkeratinized. The plica semilunaris (semilunar fold) lies between the caruncle and globe. It is similar to the nicatating membrane of certain mammals but does not contain cartilage.

Anatomy

The conjunctiva extends from the corneoscleral limbus to the mucocutaneous junction on the eyelids. The conjunctiva reflects to form a fornix on three sides and an extendible plica medially. The redundant conjunctiva in this region allows for independent movement of the eye and eyelids. Conjunctival surface folds increase the surface area of the conjunctiva, decrease the area of contact, and reduce friction between the bulbar and tarsal conjunctiva (Fig. 2.1).

The larger superior fornix is maintained by fine smooth muscle slips passing from the deep surface of the levator palpebrae muscle to insert into the conjunctiva. These effectively prevent the superior forniceal conjunctiva from falling down and blocking vision during upward gaze. The temporal conjunctiva is attached by fine fibrous slips to the lateral rectus tendon, which maintains the position of the conjunctiva during horizontal gaze. A true fornix does not exist medially except in adduction. Fine fibrous strips from the medial rectus tendon insert deep into the plica and caruncle. With contraction of the medial rectus, these slips tighten and form a cul-de-sac medially as the eye adducts. The total surface area for the adult conjunctival sac including the cornea averages 16 cm^2 for one eye.

The plica semilunaris is a crescent-shaped fold of conjunctiva with its free lateral border lying 3–6 mm lateral to the caruncle. On adduction, a cul-de-sac of approximately 2–3 mm in depth is formed that mostly disappears on abduction. The epithelium contains goblet cells, Langerhans cells, and dendritic melanocytes. The substantia propria, or conjunctival stroma, is highly vascularized and may contain nonstriated muscle, sympathetic nerves, cartilage, and fatty tissue. The caruncle measures 4–5 mm horizontally and 3–4 mm vertically and is located at the most medial aspect of the interpalpebral fissure. The caruncle is attached to the medial rectus and moves with the plica semilunaris during movement of the globe. The caruncle is composed of pilosebaceous units, accessory lacrimal gland tissue, fibrofatty tissue, occasional smooth muscle fibers, and eccrine glands. Deep to the caruncle there may be several large sebaceous glands without cilia, similar to meibomian glands, which open onto the surface. At the mucocutaneous junction of the eyelid margin, there is an abrupt transition from the keratinized, stratified squamous epithelium to the nonkeratinized stratified squamous epithelium of the palpebral conjunctiva. Meibomian glands of the eyelid are seen easily through the transparent palpebral conjunctiva as yellow lobulated structures separated by vascular arcades in the tarsus of the upper and lower eyelids running perpendicular to the eyelid margin. Overlying the mucocutaneous junction is a hydrophobic strip of lipid secreted by the meibomian glands, which separates the dry anterior keratinized portion

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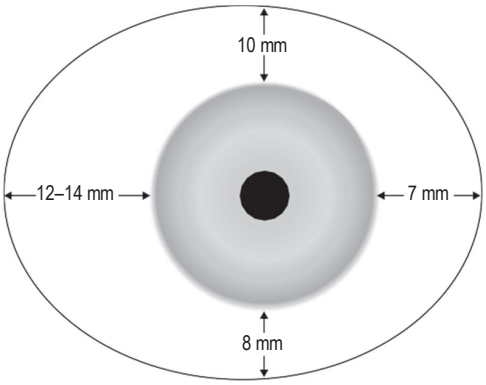


Fig. 2.1 Geography of the fornices. Distance from the corneoscleral limbus to the fornix.

of the eyelid from the wet posterior, nonkeratinized part. The exact position of the mucocutaneous junction is determined by the air–fluid interface of the tear film meniscus. Ectropion will cause the mucocutaneous junction to move posteriorly, while entropion will cause the mucocutaneous junction to move anteriorly.

The tarsal conjunctiva is tightly adherent to the substance of the tarsus to present a smooth surface to interface the anterior corneal surface. Consequently, there is no accessible subconjunctival tissue plane for dissection of the tarsal conjunctiva. Along the tarsal surface, 2 mm posterior to the lid margin, lies a shallow subtarsal groove less than 1-mm deep. The subtarsal groove is situated parallel to the eyelid margin for most of the length of the tarsus. In this region there is transition from the nonkeratinizing stratified epithelium of the lid margin to the more cuboidal epithelium of the tarsal conjunctiva (Fig. 2.2). Between the eyelid margin and the tarsal groove are multiple ridges and grooves that communicate with goblet cell-lined invaginations of the conjunctival epithelium (the pseudocrypts of Henle) (Fig. 2.3). Few crypts are present at birth; most develop at puberty. After age 50 years the crypts are found in about one-third of specimens.[2] The crypts are more numerous in the nasal conjunctiva and around the plica. Accessory lacrimal glands are located in the forniceal conjunctiva (glands of Krause) and in the palpebral conjunctiva above or within the tarsus (glands of Wolfring) (Fig. 2.4).

The bulbar conjunctiva is smoother and more loosely adherent to underlying tissues than the tarsal conjunctiva. At the corneoscleral limbus there is a series of fibrovascular ridges perpendicular to the corneal margin (palisades of Vogt). These arcades are formed by the epithelial rete ridges and the stromal condensations beneath them and may become accentuated to form peripheral corneal neovascu- larization (corneal pannus).

Histology

The conjunctival surface is composed of stratified nonkeratinizing epithelium and varies in thickness and appearance from the eyelid margin to the limbus. Unlike any other stratified squamous epithelium, goblet cells are dispersed

Fig. 2.2 Histologic section through the upper eyelid. Meibomian glands (1) and the mucocutaneous junction (2) can be seen.

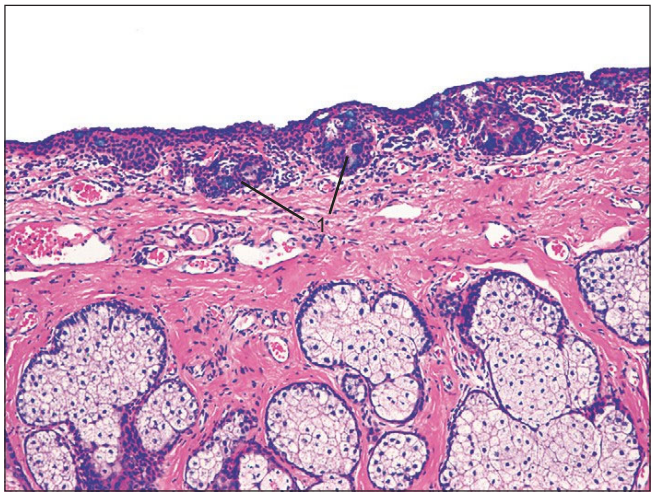


Fig. 2.3 Histologic section of tarsal conjunctiva showing the pseudocrypts of Henle (1).

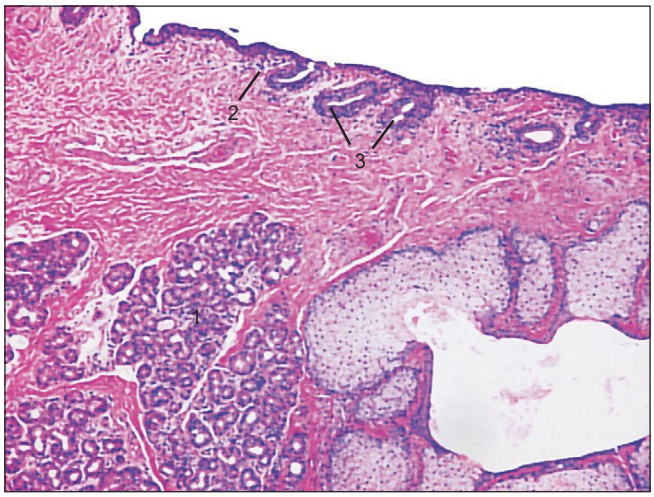
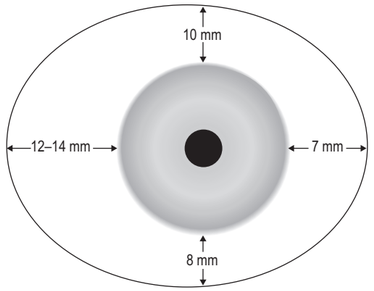


Fig. 2.4 Histologic section through the superior tarsus demonstrating the glands of Wolfring (1), lymphocytes in the adenoid layer (2), and pseudocrypts of Henle (3).



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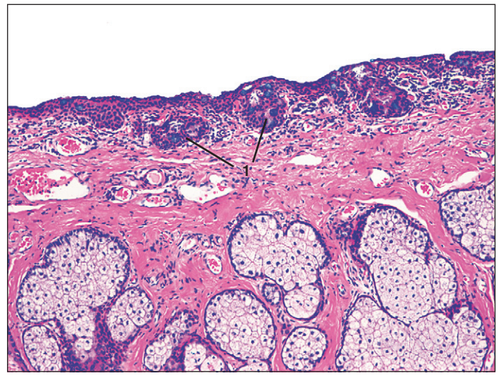

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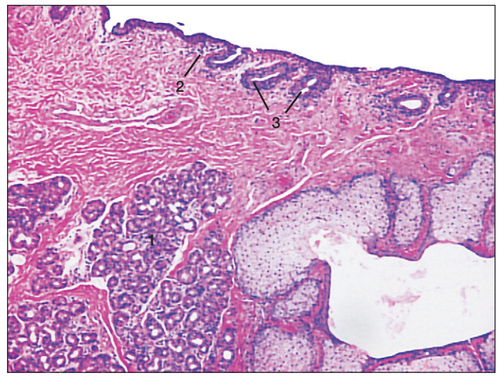

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