Successful lacrimal surgery begins with a thorough history and preoperative clinical examination, both of which guide the surgeon to the correct diagnosis and appropriate management. A thorough understanding of the anatomy of the lacrimal system will further facilitate the chance of a successful surgical outcome.

The following components of the lacrimal drainage system anatomy will be discussed in detail:

1. Embryology
2. Osteology
3. Nasal and paranasal sinuses
4. Secretory system
5. Excretory system

**Embryology**

Familiarity with lacrimal system embryology is necessary to understand congenital abnormalities of the nasolacrimal drainage system. The orbital walls are embryologically derived from neural crest cells. Ossification of the orbital walls is completed by birth except at the orbital apex. The lesser wing of the sphenoid is initially cartilaginous, unlike the greater wing of the sphenoid and other orbital bones that develop via intramembranous ossification. The membranous bones surrounding the lacrimal excretory system are well developed at 4 months of embryologic age and ossify by birth.

The lacrimal gland begins development at the 22- to 25-mm embryologic stage as solid epithelial buds arise from the ectoderm of the superolateral conjunctival fornix.\(^1\)\(^-\)\(^5\) Mesenchymal condensation around these buds forms the secretory lacrimal gland. The early epithelial buds form the orbital lobe in the first 2 months, whereas the secondary buds, which appear later in the 40- to 60-mm stage, develop into the palpebral lobe.\(^1\)\(^-\)\(^3\) Canalization of the epithelial buds to form ducts occurs, on average, at the 60-mm stage, but may be seen in as early as the 28.5-mm stage.\(^1\)\(^,\)\(^3\)\(^,\)\(^5\) The developing tendon of the levator palpebrae
superioris muscle divides the gland into two lobes around the tenth week of development. The lacrimal gland continues to develop until 3–4 years after birth.

The excretory system begins its development at an earlier stage. In the 7-mm embryo, a depression termed the naso-optic fissure develops, bordered superiorly by the lateral nasal process and inferiorly by the maxillary process. The naso-optic fissure or groove gradually shallows as the structures bordering it grow and coalesce. Before it is completely obliterated, however, a solid strand of surface epithelium thickens along the floor of the rudimentary fissure extending from the orbit to the nose. The thickened cord of epithelium becomes buried to form a rod connected to the surface epithelium at only the orbital and nasal ends. This separation from the surface typically occurs at 43 days of embryologic age. The superior end of the rod enlarges to form the lacrimal sac, and gives off two columns of cells that grow into the eyelid margins to become the canaliculi.

Canalization of this nasolacrimal ectodermal rod begins at the fourth month or the 32- to 36-mm stage of development, proceeding first in the lacrimal sac, the canaliculi, and lastly in the nasolacrimal duct. The central cells of the rod degenerate by necrobiosis, forming a lumen closed at the superior end by conjunctival and canalicular epithelium and closed at the inferior end by nasal and nasolacrimal epithelium. The superior membrane at the puncta is usually completely canalized when the eyelids separate at 7 months of gestation, and therefore is normally patent by birth. In contrast, the inferior membrane frequently persists in newborns, resulting in congenital nasolacrimal obstruction. Abnormalities of development in this region, occurring typically after the fourth month of gestation, can result in congenital absence of any segment of the nasolacrimal system, supernumerary puncta, and lacrimal fistulæ.

Osteology

Whitnall described the orbital rim as a spiral with its two ends overlapping medially on either side of the lacrimal sac fossa. The medial orbital rim is formed anteriorly by the frontal process of the maxillary bone rising to meet the maxillary process of the frontal bone. The lacrimal sac fossa is a depression in the inferomedial orbital rim, formed by the maxillary and lacrimal bones. It is bordered by the anterior lacrimal crest of the maxillary bone and the posterior lacrimal crest of the lacrimal bone. The fossa is approximately 16-mm high, 4- to 9-mm wide, and 2-mm deep, and is narrower in women. The fossa is widest at its base, where it is confluent with the opening of the nasolacrimal canal. On the frontal process of the maxilla just anterior to the lacrimal sac fossa, a fine groove termed the sutura notha or sutura longitudinalis imperfecta of Weber, runs parallel to the anterior lacrimal crest (Figure 1.1). It is a vascular groove through which small twigs of the infraorbital artery pass through to supply the bone and nasal