Assessment of Tear Meniscus Changes Before and After Dacryocystorhinostomy Using Anterior Segment Optical Coherence Tomography

Thesis

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List of Abbreviations

Abb.	Full term
ASOCT	Anterior segment optical coherence tomography
CT	Computed tomography
DCG	Dacryocystography
DCR	Dacryocystorhinostomy
DS-DCG	Digital subtraction dacryocystography
ex-DCR	External dacryocystorhinostomy
IM	Inferior meatus
LCT	Lateral canthal tendon
LTM	Lower tear meniscus
LTMV	Lower tear meniscus volume
MCT-a	Medial canthal tendonanterior limb
MCT-p	Medial canthal tendonposterior limb
MRI	Magnetic resonance imaging
MS	Maxillary sinus
NLD	Nasolacrimal duct
NLDO	Nasolacrimal duct obstruction
NLS	Nasolacrimal sac
NS	Nasal septum
OCT	Optical coherence tomography
PANDO	Primary acquired nasolacrimal duct obstruction
TM	Tear meniscus
TMA	Tear meniscus area
TMH	Tear meniscus height
TMV	Tear meniscus volume

INTRODUCTION

The lacrimal system is essentially a system of fluid pools and channels connecting them. It is responsible for secretion and drainage of tears. [1]

The causes of tearing can be classified into one of three main categories: hypersecretion, lacrimal pump failure, and lacrimal drainage obstruction. Each main category has its own subcategories. Lacrimal secretion and drainage imbalance can lead to accumulation of too much lacrimal fluid in the lacrimal pools resulting in bothersome symptoms. [1]

Hypersecretion may be primary or reflex. The etiology of primary hypersecretion is unknown at this time. It can be associated with eating, the so called, 'crocodile-tears syndrome.'' Also known as gustatory hyperlacrimation, [2–4]. Reflex hypersecretion is more common than primary hypersecretion, and is usually found in response to ocular surface irritation. Common causes include trichiasis, superficial foreign bodies, eyelid malpositions, eyelid margin disease, and trigeminal nerve irritation [1].

Lacrimal pump failure from a number of causes including punctal or eyelid ectropion, orbicularis oculi weakness, and facial nerve palsy may fail to push the tears to the drainage system [1].

Lacrimal drainage obstruction includes upper system obstructions, such as punctal or canalicular obstruction and stenosis that lead to a lack of flow from the eye pool to the lacrimal sac pool. It also includes lower lacrimal drainage obstructions, such as nasolacrimal duct obstruction, in which the fluid cannot move from the sac pool to the nasal pool. Last, obstructions within the lacrimal sac itself such as tumors or dacryoliths are possible. [5]

Acquired nasolacrimal duct obstruction is most commonly idiopathic (primary acquired NLDO), other causes may include naso-orbital trauma, sinus surgeries, granulomatous diseases such as Wegner granulomatosis and sarcoidosis or infiltration by nasopharyngeal tumors (secondary NLDO). [1]

In treatment for obstruction of the lacrimal drainage system, tear meniscus (TM) is one of the most important clinical indices for therapeutic evaluation, which can be assessed with slit-lamp examination and fluorescein dye disappearance test as a semi quantitative measurement. However, it is obvious that all lacrimal functions are not of the same flow, and more sophisticated tests are needed to quantitate lacrimal function. [6]

Recently, anterior segment optical coherence tomography (AS-OCT) has enabled non-invasive and quantitative estimation of the TM. AS-OCT can measure tear meniscus height (TMH), tear meniscus area (TMA) and tear meniscus volume (TMV). Anterior segment OCT has been reported as a useful way to measure the severity of dry eye and to evaluate the efficacy of treatments. [6]

In the present study, we evaluated TM change in dacryocystorhinostomy (DCR) with quantitative measurement of TMH, TMA, and TMV using AS-OCT in patients with primary acquired NLDO.

AIM OF THE WORK

The aim of this work is to evaluate if measurement of tear meniscus by anterior segment OCT is a reliable method of assessment of improvement after DCR, compared to other known methods which include dye disappearance test and lacrimal passages irrigation.

Chapter 1

ANATOMY OF THE LACRIMAL SYSTEM

Secretory system

Lacrimal Gland and Accessory Glands

The primary lacrimal gland is located in the superotemporal orbit in a shallow lacrimal fossa of the frontal bone. The gland is composed of numerous acini (lobular clusters of secretory cells) that drain into progressively larger tubules and ducts. The acini are made up of a basal myoepithelial cell layer with inner columnar secretory cells. Contraction of the myoepithelial cells helps force secretions into the tubules and drainage ducts. [7]

The gland measures 20 × 12 × 5 mm and is divided by the lateral horn of the levator aponeurosis into a larger orbital lobe, and a lesser palpebral lobe below. [8,9]

Two to six secretory ducts from the orbital lobe of the lacrimal gland pass through the palpebral lobe or along its fibrous capsule, joining with ducts from the palpebral lobe to form 6–12 tubules that empty into the superolateral conjunctival fornix 4–5 mm above the tarsus. [7,11]

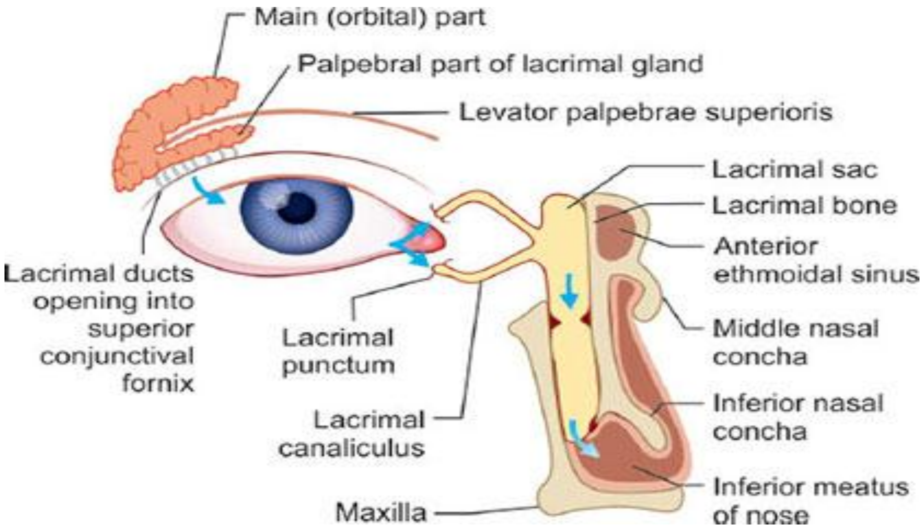

Figure (1): The two main parts of the lacrimal gland (the orbital and the palpebral parts) separated by levator palpebrae superioris apponeurosis. [10]

Accessory lacrimal glands, located in the conjunctival fornices and along the superior tarsal border, are comprised of:

- Accessory glands of Krause: 20–40 in the superior conjunctival fornix and 10–20 in the lower conjunctival fornix.
- Accessory glands of Wolfring: located in the upper lid superior tarsal border. [8,12]

The lacrimal gland receives innervation from cranial nerves V and VII, as well as from the sympathetics of the superior cervical ganglion. [13]

Parasympathetic secretomotor innervations to the lacrimal gland is more complex. Parasympathetic secretomotor fibers originate in the lacrimal nucleus of the pons, and travel a long course within the nervus intermedius, the greater suprficial petrosal nerve, deep petrosal nerve, and the vidian nerve to finally synapse in the pterygopalatine ganglion. [13]

Postganglionic parasympathetic fibers leave the pterygopalatine ganglion via the pterygopalatine nerves to innervate the lacrimal gland. [14]

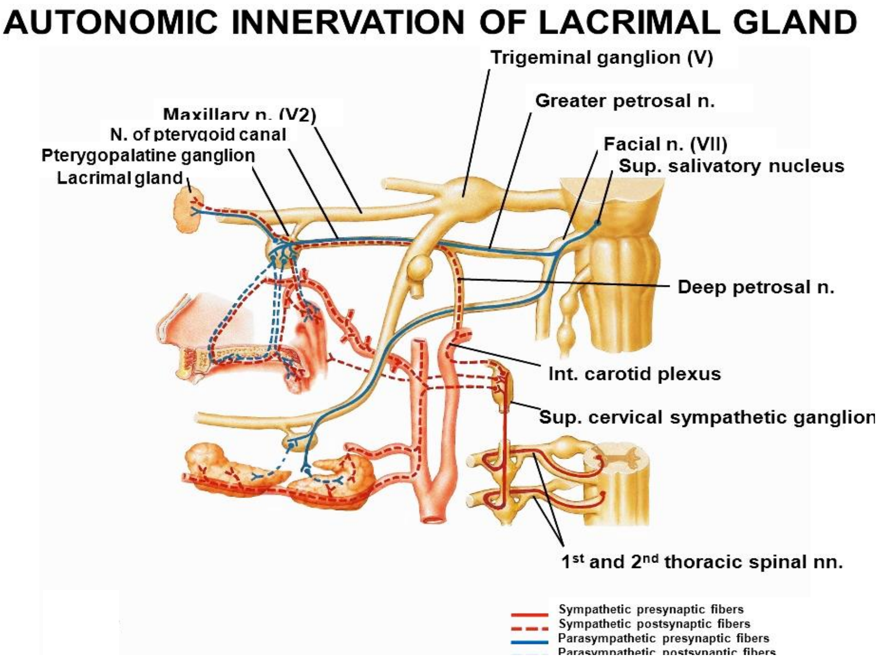

Figure (2): Sympathetic and parasympathetic innervations to the lacrimal gland. [15]

The lacrimal gland receives arterial supply from the lacrimal artery, with contributions from the recurrent meningeal artery and a branch of the infraorbital artery. The intraorbital venous drainage travels adjacent to the artery and drains into the superior ophthalmic vein. [16]

Excretory System (Lacrimal Drainage System)

The lacrimal excretory pathway begins at a 0.3 mm opening on each medial eyelid termed the punctum. [11] The punctal opening widens into the ampulla, which is 2 mm in height and oriented perpendicular to the eyelid margin, before making a sharp turn into the canaliculi which run parallel to the eyelid margins. The canaliculi, measuring 8–10 mm in length and 0.5–1.0 mm in diameter, are lined with stratified squamous epithelium and surrounded by orbicularis muscle (Fig. 3). The superior and inferior canaliculi merge into a common canaliculus before entering the nasolacrimal sac in more than 90 % of individuals. [11,17]

The superficial pretarsal orbicularis oculi muscles envelope the canaliculi as they traverse the medial eyelids and medial canthal region.

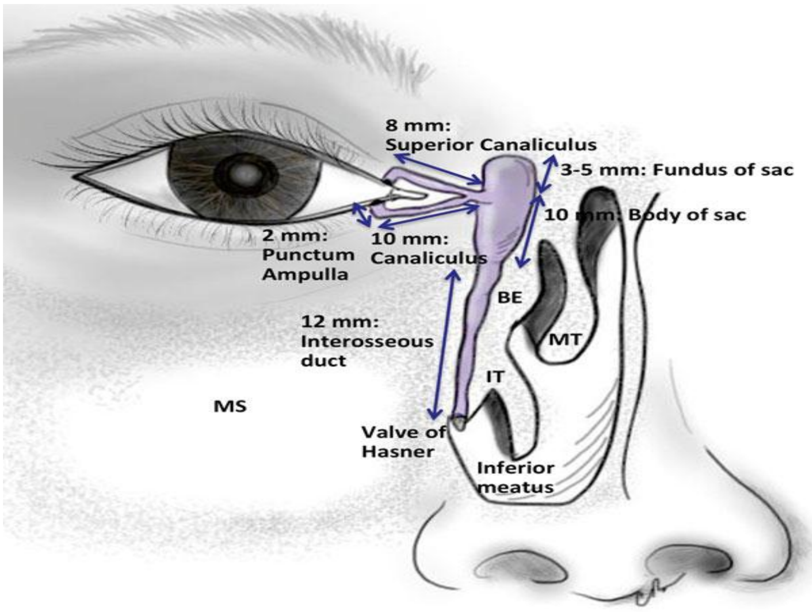

Figure (3): Approximate dimensions of the lacrimal excretory system (BE bulla ethmoidalis, IT inferior turbinate, MS maxillary sinus, MT middle turbinate). [18]