

Introduction

Ophthalmology has been on the forefront of laser surgery with a growing number of people electing to skip the knife and choose the laser instead. Laser plays a huge role in modern ophthalmology as it is a great tool for precise surgical procedures of the eye. Laser in ophthalmology is used to both alter human tissue (coagulate, cut, ablate, remove, shrink, and stretch the ocular tissue) and activate drugs when treating ocular diseases (*Ryan Frank, 2009*).

Oculoplastic surgery is a specialized plastic surgery around the eyelids and face. It is also called oculo-facial surgery as the eyelids are continuous with the forehead, cheeks, and deals with the related lacrimal system and orbits (deeper structures surrounding the eyeball). Surgery is primarily for abnormalities of the eyelids and their surrounding tissues, including their position and contour, in order to maintain, restore or improve function and appearance. Oculoplastic surgeons also do aesthetic treatments and surgery on normal eyelids and surrounding tissues to improve or change their perceived beauty, including blepharoplasty surgery (*Jane M. Olver, 2011*).

The ophthalmological applications of laser technology are under constant evaluation as new equipment and approaches are

developed, and older techniques are refined. In coming years, laser techniques may become the norm for oculoplastic surgery because they offer the surgeon a rapid and bloodless dissection, continuous process and benefit the patient by providing rapid recovery with diminished swelling and bruising (**Chen, 2001**).

In dacryocystorhinostomy, Lasers with several different wavelengths have been used to perform osteotomy as part of the procedure, mostly as part of a transnasal approach: Holmium: Yttrium-Aluminum-Garnet (Ho: YAG) laser, potassium-titanyl-phosphate (KTP) laser, Neodymium: YAG (Nd: YAG) laser, Erbium: YAG (Er: YAG) laser, and diode laser. Advantages of laser surgical technique over mechanical dacryocystorhinostomy techniques include: Precise cutting and removal of tissue by ablation, minimal trauma to adjacent tissue, and mainly, possibility to perform the procedure endoscopically (**Drnovsek-Olup and Beltram, 2010**).

Transcanalicular diode laser-assisted DCR is a fast and relatively easy alternative surgical method, which avoids a facial skin scar, to treat primary acquired nasolacrimal duct obstruction (PANDO). The functional success rate is higher in the first months but decreases to about 60 % at the end of first year and

remains the same at the second-year follow up (*Kaynak et al., 2014*).

Vascular lesions ranging from telangiectasia to port wine stains can now be safely and effectively treated using a variety of lasers in the 488–638 nm range. Hemoglobin in red blood cells best absorbs electromagnetic radiation at approximately 577 nm (*Woodward and Dawn, 2006*).

The safety and efficacy of the pulsed-dye laser for the treatment of the often socially debilitating port-wine stain (PWS) capillary malformation is one of the greatest and most satisfying applications of laser medicine (*Wasserman and Chuang, 2011*).

In venous lymphatic malformation, the CO₂ laser has been used for subtotal excision. With good hemostasis from tissue vaporization and less surgical trauma to surrounding tissue. This laser has also been effective with anterior lesions, specifically with conjunctival involvement (*Katowitz and Kazim, 2007*).

Laser blepharoplasty represents an improvement over traditional blepharoplasty in terms of surgical operating time, hemostasis, intraoperative bruising, and visualization of anatomic details. Specialized instrumentation and approaching in a stepwise manner help to avoid complications (*Chen, 2001*).

The carbon dioxide (CO₂) laser or Erbium: yttrium-aluminum-garnet (YAG) is frequently used for upper and lower eyelid blepharoplasty as it is considered the treatment of choice over chemical peels and dermabrasion for photoaged skin (**Woodward and Dawn, 2006**).

The main difference between the two technologies is that the CO₂ application is more efficacious in tightening the lower eyelid skin (**Hamilton, 2011**).

In the ingrown eyelashes (trichiasis), argon laser offers the advantage of being a relatively simple, virtually painless method of destroying the eyelash follicle. It is especially useful when there is a need to limit contiguous tissue inflammation and destruction (**Sahni and Clark, 2001**).

Aim of the work

Review literature to discuss different types of lasers and their applications in oculoplastic surgeries.

The eyelids

The eyelids act to protect the anterior surface of the globe from local injury. Additionally, they aid in regulation of light reaching the eye; in tear film maintenance by distributing the protective and optically important tear film over the cornea during blinking; and in tear flow by their pumping action on the conjunctival sac and lacrimal sac.

Structures that must be considered in description of lid anatomy are:-

- 1) The skin and subcutaneous tissue.
- 2) The orbicularis oculi muscle.
- 3) The submuscular areolar tissue.
- 4) The fibrous layer: consisting of: (a) the tarsi, (b) the orbital septum, (c) the lid retractors.
- 5) The retroseptal fat pads.
- 6) The conjunctiva.

(Patel Bhupendra, 2013)

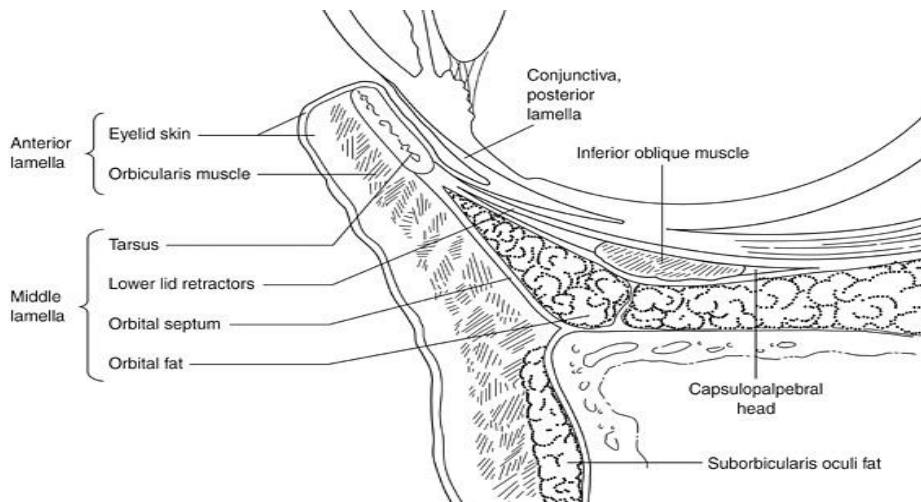


Figure (1): Lower eyelid anatomy. *(From American Academy of Ophthalmology. Orbit, Eyelids and Lacrimal System; Basic and Clinical Science Course, Section 7. San Francisco American Academy of Ophthalmology, 2000-2001).*

1) The skin is composed of a thin dermis and contains little subcutaneous fat. It is loosely adherent to the underlying orbicularis oculi muscle. The lash line is the most anterior line. Each hair follicle contains glands of Zeis and Moll, lie near the cilia and empty into the adjacent follicles. They secrete lipid that contributes to the superficial layer of the tear film and slows evaporation. Posterior to the lash line and anterior to the tarsus is the gray line, which also referred to as the muscle of Riolan and represents the pretarsal orbicularis muscle on the eyelid margin.

Four puncta are also visible near the medial canthal angle. (*Amato et al., 2006*).

2) The orbicularis oculi muscle is a thin sheet of concentrically arranged skeletal muscle fibers. It is the main protractor of the eyelids. It classically divided into three anatomic parts, the pretarsal orbicularis, the preseptal orbicularis (together are named palpebral orbicularis) and the orbital orbicularis. Voluntary squeezing of the orbital orbicularis closes the palpebral fissure and protects the globe and orbit from injury. Involuntary movements, such as blinking and the functioning of the lacrimal pump, result mainly from contraction of the palpebral portion. (*Amato et al., 2006*).

3) Submuscular areolar tissue consists of variable, loose connective tissue below the orbicularis oculi muscle. The lid may be split into anterior and posterior portions through this potential plane, which is reached by division at the gray line of the lid margin. In the upper lid, this plane is traversed by fibers of the levator aponeurosis, some of which pass through the orbicularis to attach to the skin to form the lid crease. In the lower eyelid, this plane is traversed by fibers of the orbitomalar ligament. (*Tanzi, 2014*)

4) The fibrous layer: consisting of: (the tarsi, the orbital septum, the lid retractors)

A) The tarsal plate is part of the posterior lamellae of the eyelid and provides the structural framework of the eyelid. It is composed of condensed fibrous and elastic tissue but contains no cartilage. Measuring approximately 25 mm horizontally and 1 mm in width. The superior tarsal plate is approximately 9 to 10 mm in vertical height, the inferior tarsal plate measures 4 to 5 mm in central vertical height. Both are anchored to the orbital bones by their connections to the medial and lateral canthal tendons. The upper tarsus contains approximately 30 meibomian glands, and the lower tarsus contains approximately 20. The oil-secreting glands are aligned vertically, and their orifices are seen at the eyelid margin just posterior to the gray line and anterior to the mucocutaneous junction. The posterior surface of both tarsal plates is covered by conjunctiva. Only 4 to 5 mm of tarsus is needed for upper eyelid stability, when the tarsus is used in eyelid reconstruction.

B) The orbital septum is a thin, fibrous, multilayered sheath that arises from the anterior periorbita (periosteal lining of the orbit) at the arcus marginalis. It separates the eyelids from the orbit and serves as an important anatomic barrier to infection,

hemorrhage, and edema. Inflammatory or infectious processes anterior to the septum are considered preseptal, whereas similar findings posterior to the orbital septum are considered orbital.

C) The eyelid retractor muscles include the levator palpebral superioris (LPS) muscle, a skeletal muscle innervated by The oculomotor nerve (third cranial nerve) and the superior tarsal muscle, called Muller's muscle, in the upper eyelid and the capsulopalpebral fascia (CPF) and the inferior tarsal muscle (ITM) in the lower eyelid, smooth muscle, which sympathetically innervated and also act to open the upper and lower eyelids. (*Amato et al., 2006*).

5) Fat within the orbit and eyelids serves as a protective cushion for the globe and facilitates movement of the globe. (*Amato et al., 2006*).

6) The conjunctiva is composed of nonkeratinizing stratified squamous epithelium and forms the posterior layer of the eyelids. It is a transparent mucous membrane lining the eye socket from the eyelid margin to the corneal scleral limbus. It contains mucous-secreting goblet cells and aqueous-producing glands of Krause and Wolfring (accessory lacrimal glands). These glands are mainly localized in the subconjunctival tissue in the upper

eyelid between the superior tarsal border and the fornix. Few glands are found in the lower eyelid at the inferior fornix. Mucin-secreting goblet cells are scattered throughout the conjunctiva and are concentrated in the crypts of Henle just above the tarsal border. The caruncle, lies at the medial commissure and contains multiple sebaceous glands and hair follicles. (*Amato et al., 2006*).

The lacrimal system

The lacrimal system has a dual function: a **secretory** and an **excretory** component contributing to the formation and drainage of tears respectively.

- **Secretory system:** Three groups of glands comprise the basic secretors that produce the tear film.
 - **The first group** consists of the goblet cells, which produce the inner mucoprotein layer of the tear film.
 - **The second group** consists of the main and accessory lacrimal glands, these glands produce the middle aqueous layer of the tear film.
 - **The third group** is the oil-producing meibomian glands in the tarsus and the palpebral glands of Zeiss and Moll. These produce the superficial lipid layer, which is essential in slowing evaporation and stabilizing the tear film. (*Amato et al., 2006*).
- **Excretory system (Lacrimal drainage system)**

The nasolacrimal drainage system serves as a conduit for tear flow from the external eye to the nasal cavity. It consists of: -

a) The puncta

b) The canaliculi

c) The lacrimal sac

d) The nasolacrimal duct .

The lacrimal excretory system begins with a 0.3-mm opening on the medial portion of each eyelid, termed the punctum. The punctal opening widens into the ampulla, which is 2 mm in height and directed perpendicular to the eyelid margin, before making a sharp turn into the canaliculi. The canaliculi measure 0.5 to 1.0 mm in diameter and run parallel to the eyelid margins. The superior canaliculus measuring 8 mm in length, and the inferior canaliculus measures 10 mm (Fig.2).

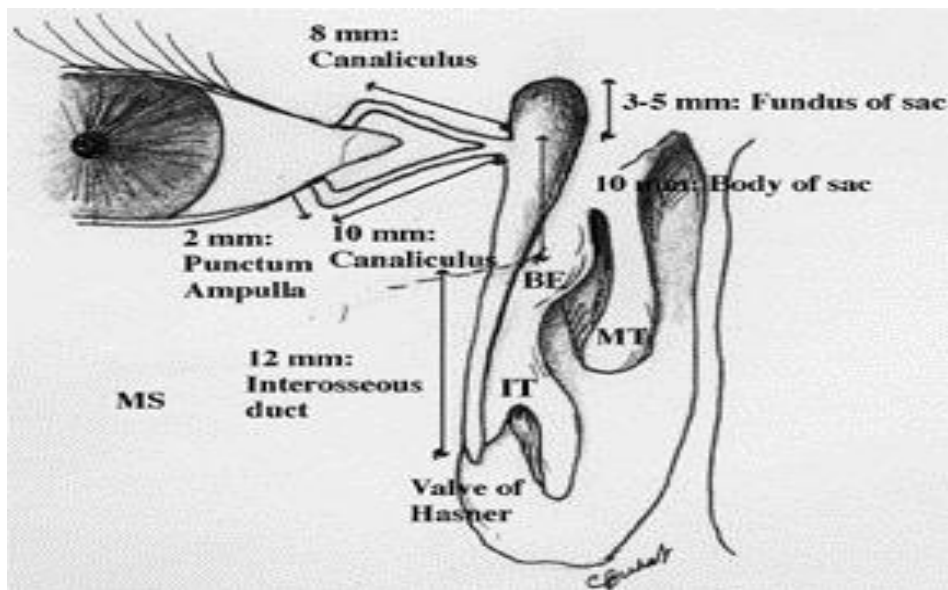


Figure (2): Approximate dimensions of the lacrimal excretory system. BE, bulla ethmoidalis; IT, inferior turbinate; MS, maxillary sinus; MT, middle turbinate. (Burkat et al., 2006).

The canaliculi are surrounded by superficial pretarsal orbicularis oculi muscle. The deep portion of the pretarsal orbicularis muscle is important in lacrimal outflow. It passes posterior to the lacrimal sac and inserts onto the upper posterior lacrimal crest. The orbital septum inserts along or just posterior to the inferior posterior lacrimal crest. The deep head of the preseptal orbicularis oculi muscle (Jones' muscle) attaches to the lacrimal sac and lacrimal fascia. The superior and inferior canaliculi merge to form a common canaliculus. (*Burkat et al., 2006*).

The lacrimal sac measures 12 to 15 mm vertically. The fundus of the sac extends 3 to 5 mm above the medial canthal tendon, and the body of the sac measures 10 mm in height (**Fig.2**). The lacrimal sac is ensheathed in the lacrimal fascia. In addition, is wrapped by the thick anterior and thin posterior limbs of the medial canthal tendon. Below the anterior limb, the inferior portion of the lacrimal sac is bound anteriorly only by the orbital septum. The sac rests in the lacrimal sac fossa, with its medial aspect tightly adherent to the periosteal lining of the fossa. The 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 (**Fig.3**). The fossa is approximately 16 mm high, 4 to 9 mm wide, and 2 mm deep. (*Burkat et al., 2006*).