Eye for detail

Dr Sotirios Foutsizoglou on understanding the anatomy and function of the orbicularis oculi

The orbicularis oculi forms part of the muscles of facial expression. It develops from mesenchyme of the second pharyngeal arch and supplied by its nerve, the seventh cranial nerve (CN VII). The orbicularis oculi is the sphincter of the eyelid and resides almost entirely within a fibromuscular sheet, best known as the superficial musculoaponeurotic system. Its fibres attach primarily to the medial orbital margins and medial palpebral ligament (medial canthal tendon), sweeping in concentric circles around the orbital margin and eyelids. Laterally, the muscle fibres do not have a direct bony attachment, but are stabilized to the orbital rim by a ligamentous connection at the lateral canthus.

Primary actions of the Orbicularis Oculi

- The orbicularis oculi (palpebral part) is the main protractor of the eyelids. Contraction of its fibres narrows the palpebral fissure (i.e. the aperture between the eyelids);
- Its upper portion is a brow depressor;
- Superomedially, as part of the glabellar complex, it contributes to the formation of the vertical glabellar frown lines and causes adduction and depression of the surrounding soft tissue along with the corrugator supercilii (mainly) and, to a lesser extent, the depressor supercilii muscles;
- Its lower part draws the cheek/mid-face towards the medial canthus. Remember that the orbicularis retaining ligament along the inferior orbital rim separates the lower lid from the midcheek. The lateral third, which extends around the inferolateral rim up to the lateral orbital thickening, is a firm unyielding ligamentous structure. However, in the middle third of the rim, between the insertion of the arcuate expansion to the orbital rim and the direct attachment of the orbicularis to the medial rim. This part of the orbicularis retaining ligament is a filmy, distensible, double layered membrane, up to 15mm long and often containing fat. This is the highly mobile part which allows upward movement of the top of the cheek on strong squinting and it also provides minimal resistance to the bulging of fat from the central lower lid fat compartment over the inferior orbital rim into the upper midcheek.[1]

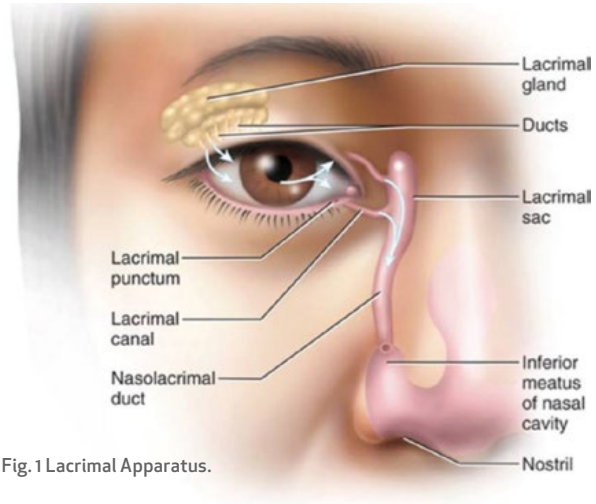

Fig. 1 Lacrimal Apparatus.

- Its lateral fibres cause a radiating folding of the skin which may develop into the permanent "crow's feet" wrinkles of older age.
- It assists the flow of lacrimal fluid (tears) by bringing the lids together, closing the palpebral fissure in a lateral to medial direction, gently pushing the lacrimal secretions near the lacrimal caruncle in the lacrimal lake at the medial angle of the eye.
- It is involved in lacrimal drainage. Contraction of the pretarsal muscle shortens and closes the canaliculi, whereas the preseptal muscle pulls on the lacrimal diaphragm, resulting in a negative pressure within the lacrimal sac. Upon relaxation, tears pass to the nasal cavity through the nasolacrimal duct (Fig 1).[2]

Anatomy of the Orbicularis Oculi

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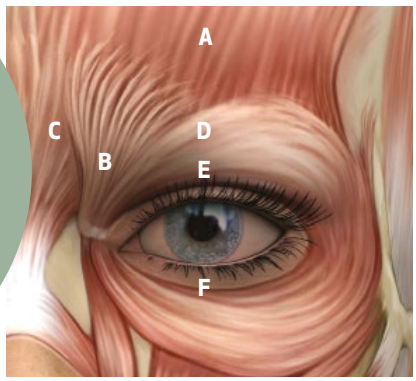

Fig 2. Orbicularis Oculi. Orbicularis oculi muscle anatomy. (A) Frontalis, (B) corrugator superciliaris, (C) procerus, (D) orbital orbicularis, (E) preseptal orbicularis, (F) pretarsal orbicularis

The palpebral portion of the orbicularis oculi is thin and close to the skin, regulating the palpebral opening and acting largely involuntarily during blinking (pretarsal). The orbital portion is thicker, with mostly horizontal and oblique fibres.

- The palpebral part gently closes the eyelids – as in blinking or in sleep – to keep the cornea from drying. It is within the eyelid and is further subdivided into pretarsal and preseptal parts. The preseptal part is adhered to the tarsal plates and the preseptal part is more mobile overlying the orbital septum in both the upper and lower eyelids. Both the preseptal and pretarsal parts have superficial and deep components medially that are connected to the orbital wall at the medial canthus in a complex anatomical arrangement[1]. The palpebral portion is composed of semicircles of muscle fibres that run from the medial orbital margin and the medial palpebral ligament to the lateral palpebral raphe, where the superior and inferior fibres interdigitate with one another. The lateral palpebral raphe overlies the lateral palpebral ligament.[8]

- The orbital part strongly closes the lids, as in squinting, to protect against glare and dust. Contraction of the orbital part, whose fibres run vertically under the skin at the lateral angles of the eyelids, accentuates the lateral canthal rhytides or "crow's feet" (Fig 3). Superiorly, the >

orbital part overlies the lower frontalis and corrugator supercilii muscles, giving off a slip of muscle to form the depressor supercilii.[1] Inferiorly it overlies the origin of the elevators with a variable descent towards the upper lip.

- The lacrimal part draws the eyelids and lacrimal puncta medially, pressing the latter into the lacrimal lake (L. lacus lacriminalis) so that capillary action may drain lacrimal fluid from it.[4] The lacrimal part (tensor tarsi) is a small, thin muscle, about 6 mm in breadth and 12 mm in length, situated behind the medial palpebral ligament and lacrimal sac. It arises from the posterior crest and adjacent part of the orbital surface of the lacrimal bone, and passing behind the lacrimal sac, divides into two slips, upper and lower, which are inserted into the superior and inferior tarsi medial to the lacrimal punctum.

The myofibres of the orbicularis oculi are the smallest of all skeletal muscles and there are distinct microarchitectural differences within the muscle itself. The finest and shortest fibres are in the pretarsal region, progressively increasing in size away from the lid margin.[5] Of importance for BTX-A use is the location of the neuromuscular junctions, which seem to be concentrated at the canthal ends, more laterally. Each fibre has a single innervation and similar to the extraocular muscles, the motor units are small, consistent with fine motor control. The dominant fibre type (90%) is fast twitch, fatiguable with low vascularity suited to brief, rapid blink movements.[6]

Innervation: The orbicularis oculi muscle is innervated primarily by the zygomatic branch of the facial nerve, but the upper portion of the muscle is also partially innervated by the temporal branch of the facial nerve (VII).

Blood Supply: The arterial supply is derived from branches of the superficial temporal, angular, infra-orbital branch of the maxillary and ophthalmic artery.

Treating the orbicularis oculi with BTX-A

The application of BTX-A for aesthetic improvement was derived from keen observation of the appearance of facial soft tissue in patients who received the drug for a spectrum of disorders related to facial dystonia. BTX-A has become the gold-standard in non-surgical facial rejuvenation. To date, the three most popular areas treated with BTX-A are the glabella, forehead (still unlicensed), and periorbita. Understanding the underlying facial muscle anatomy allows precision as to how much toxin is injected and where it is injected. The sites of treatment for the lateral periorbita and canthal rhytids are usually lateral to the lateral canthus, 1-2cm outside the orbital rim. (Fig 4). The aim is to relax the orbital part of the orbicularis oculi without completely 'paralyzing' it, which could affect both the voluntary and involuntary eyelid function and the ability to fully close the eyes.[9] Periorbital injections must always be performed superficially (i.e. immediately subdermal or intradermally, whereby a wheal is observed) otherwise complications become more likely. Routine scheduled treatment sessions at four-month intervals can prevent the formation of static lateral periorbital wrinkles.

Please note that unlike the lateral canthal dynamic lines for which BTX-A works extremely well, infraorbital lines respond poorly to BTX-A. That is because the visible effects of midfacial aging is a summation of a complex interplay of soft tissue and skeletal changes such as attenuation of the retaining ligaments, decrease in muscle mass and tone, migration and atrophy of superficial fat compartments, skin thinning, resorption and remodeling of parts of the facial skeleton. In addition to the aforementioned, the skin loses its elasticity and becomes unable to accommodate the underlying volume loss. I like drawing a parallelism between the aged infraorbital skin and the deflated balloon after it has been blown up to its maximum capacity.

Fig 3. Treating "crow's feet" wrinkles with BTX-A

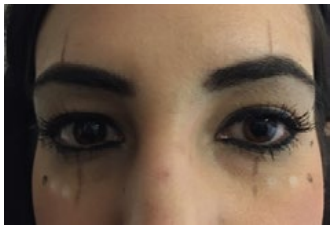

Fig 4. Treating periorbital lines with BTX-A. Note the 3 main injection sites (black dots); the superior injection site will provide a lift of the tail of the eyebrow. The lateral brow is ideally positioned slightly higher than the medial brow. White dots are optional injection sites in the infraorbital region lateral to the mid-pupillary line (vertical black line running through the middle of the pupil). Treating dynamic lines under the eyes with BTX-A requires a very small number of units (e.g. 2-3U of Botox) and extremely superficial injections – the muscle is just under the skin and both the muscle and skin are very thin in that area. An accurate injection technique will minimize a potential diffusion of the toxin into the elevators (e.g. zycomaticus major, minor, etc) causing a transient unilateral facial palsy.

TIP 1

The frontalis inserts into the dermis of the lower forehead. At the level of its insertion, the frontalis interdigitates with fibres of the orbicularis oculi. As the frontalis contracts and pulls on the orbital portion of the orbicularis, it indirectly elevates the brow via the orbicularis dermal insertions.[3] Therefore injecting the orbicularis oculi along the medial two thirds of the eyebrow may result in flattening of the eyebrow arc. The aforementioned risk does not exist when injecting a small amount of toxin superficially into the orbital part of the orbicularis oculi under or at the tail of the natural eyebrow to relax the main brow depressor in that area, for a subtle eyebrow lift, as there is no frontalis support (Fig 4).

TIP 2

Facial skeletal changes such as thinning of the superciliary arch – a prominent ridge, deep to the eyebrows, that extends laterally on each side from the glabella – contributes to brow ptosis, a major macroscopic age-related change affecting the periorbital region. Using a filler in a linear retrograde deep injection – over the periosteum- across the lateral third of the eyebrow can provide a restoration of the prominence of the ridge along with a subtle improvement of the downward malposition of the eyebrow (see protocol).

- BTX-A in the glabella and crow's feet
- Definition of the zygomatic arch and midfacial volume restoration
- Correction of the anatomical tear trough, palpebromalar groove and lateral lid/cheek junction
- Filler in the lateral brow (e.g. 0.5cc of Volift in the lateral eyebrow will lift the brow by 0.25cm)
- Voluma for temple hollowing

Periorbital Rejuvenation Protocol

TIP 3

Warn patients with 'malar bags', lower eyelid lymphoedema, lower eyelid bags that may experience a worsening of the appearance of these conditions. Reduction of the effect of the lymphatic pump and reduction of muscle tone to the preseptal orbicularis muscle can lead to a periorbital oedema that can last up to 4 weeks.[10]

TIP 4

For mild to moderate upper eyelid ptosis 1-2 units of BTX-A can be used in the pretarsal orbicularis at the extreme medial and lateral apect (i.e. two injection sites).

When treating the orbicularis oculi with BTX-A think of largely avoidable complications such as bruising, brow ptosis, "Mr Spok's" eyebrow, exacerbation of pre-existing upper eyelid ptosis compensated for by the action of frontalis, eyebrow asymmetry and malposition, lower eyelid ectropion or retraction, diffusion of the toxin into the mouth elevators, worsening of bulging of the lower eyelid pretarsal region on animation, persistent infra-orbital oedema and exacerbation of lower eyelid "bags".

Accurate preinjection assessment, precise injection technique, correct plane of injection and amount of toxin, and sound anatomical knowledge are of critical importance for a natural, complication-free and aesthetically pleasing outcome. **AM**

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Dr Sotirios Foutsizoglou developed a particular interest in anatomy during his time working in plastic and reconstructive surgery in the NHS. He became heavily involved in teaching anatomy and physiology to medical students and junior doctors and has worked as an anatomy demonstrator for Imperial College. Since 2012, in his role as the lead trainer of KT Medical Aesthetics Group, he has been training practitioners in facial anatomy and advanced non-surgical treatments and procedures. He has written and lectured on facial anatomy and complications associated with injectables both nationally and internationally.