Introduction

This talk will focus on the understanding of superficial facial musculature. On the topic of facial plastic and reconstructive surgery, this topic is a basic but instrumental topic to master in order to perform surgery of the face. The effects of botulinum toxin will also be discussed as its effects on muscles help understand the animation of the face. In addition, some procedures will also be mentioned to better grasp this topic.

Botulinum Toxin

Botulinum toxin is a neurotoxin produced by the bacterium Clostridium botulinum. Its effects are at the neuromuscular junction (NMJ) where it prevents release of acetylcholine. First, the 100kD heavy chain domain of the toxin mediates specific and irreversible binding to the cholinergic receptor site on the presynaptic membrane of the motor axon terminal. The toxin is then internalized. The disulphide bond is then cleaved and the 50 kD light chain is translocated across the endosomal membrane. This light chain then cleaves the synaptosome associated protein (SNAP-25), preventing exocytosis mediated acetylcholine release.

Botulinum toxin injection into facial musculature is one of the most common procedures in the US as it decreases the appearance of hyperfunctional lines on the face. Hyperfunctional facial animation lines are the effect of repetitive local muscular action on the skin as opposed to rhytids or wrinkles, caused by skin laxity that is a result of age-induced changes in collagen framework of the dermis. The effects last for 3-4 months. Although tested only in non-human mammals, the LD50 in humans is estimated to be 2500-3000 units. The most commonly brand used in the US is Botox© by Allergan and comes in vials of 100 units; so overdosing of botulinum toxin is fairly rare. Obtaining a good history is always necessary to prevent any allergic reactions to botulinum toxin.

Muscles of the Scalp

The epicranius or occipitofrontalis is composed of 2 bellies, the frontalis and the occipitalis. It is connected in between by aponeurosis. The 2 layers of tissue above this are the
skin and subcutaneous tissue; the 2 layers below are the loose areolar tissue or “danger space” and the periosteum. The frontalis muscle originates at the superciliii corrugators, procerus and orbicularis oculi muscles. These muscle fibers are intertwined and there are no attachments to bone. It inserts into the galea aponeurosis and innervated by the temporal branch of the facial nerve. Its function is to furrow the forehead, raise the eyebrows and widen the eyes.

The frontalis muscle can cause horizontal hyperfunctional facial lines on the forehead. Botulinum toxin is commonly injected in this muscle in the aging face to decrease the appearance and progression of these lines. Marks for injection can be made 1 - 1.5 cm apart across the forehead. Inject of 2.5 – 5 units at each site. Injection too close to the brow may cause brow ptosis or even levator ptosis. Laterally, the injection should be raised away from the brow to leave some functional frontalis muscle. If there are several rows of hyperfunctional lines, a second row of injections may be done.

The occipitalis muscle originates at the mastoid process and superior nuchal line posteriorly. It inserts onto the gale aponeurosis. It is innervated by the posterior auricular branch of the facial nerve, being 1 of 2 muscles innervated by this branch. Its function is to retract the scalp.

The temporoparietalis muscle originates on the temporalis fascia superiorly and anteriorly to the upper margin of the auricle. It is superficial to the temporalis fascia. It inserts into the skin and fascia on and near the galea. It is innervated by the temporal branch of the facial nerve, which is located deep the temporoparietal fascia and superficial to the superficial layer of the deep temporal fascia. Its function is to tense the scalp, retract the temples, widen the eyes and elevate the auricles.

Muscles of the Ear

There are 3 major extrinsic muscles of the ear and 6 intrinsic muscles, which do not have much function. The auricularis anterior muscle originates on the anterior temporal fascia and inserts onto the spine of the helix. It is innervated by the temporal branch of the facial nerve and provides anteriosuperior displacement of the helix. The auricularis superior muscle originates on the temporal fascia and inserts on the upper part of the cranial surface of the auricle. It is innervated by the temporal branch of the facial nerve and provides superior displacement of the auricle. The auricularis posterior muscle originates on the mastoid tip as 2-3 fascicles and inserts on the cranial surface of the convexity of the concha. It is innervated by the posterior auricular nerve and posteriorly displaces the auricle. The intrinsic muscles include the helicus major, helicus minor, tragus, antitragicus, transverse auriculae and obliquus auriculae muscles. There was been a case report of a 5 year-old female being able to move her tragus from being ptotic to being elevated, resulting in narrowing of the external acoustic meatus.

Muscles of the Eyelid

The corrugator superciliii muscle originates on the medial end of the superciliary arch of the orbit as 3 or 4 thin, rectangular, panel-like muscles. Its bone origin has a wide base spanning across 0.6 cm from the midline and supraorbital notch/foramen. The muscle panels travel in an
oblique parallel course and interdigitates with the frontalis. It is innervated by the temporal and/or zygomatic branch of the facial nerve. It displaces the brow inferomedially and creates vertical skin creases. Botulinum toxin is commonly injected in this muscle along with the procerus, which causes horizontal skin creases in the glabellar area. 20 units of botulinum can be evenly distributed along 5 injection sites, 2 in each corrugator and 1 in the procerus for vertical and horizontal lines across the eyebrows. A study by de Ru showed how botulinum toxin being injected into corrugator muscle can decrease the headache cause hypothetically by entrapment of the supratrochlear nerve.

The depressor supercilii muscle originates on the frontal portion of the maxillary bone of the bony medial orbital rim slightly posterior and superior to the posterior lacrimal crest, approximately 2-5 mm below the frontomaxillary suture line. Along the superior course, the muscle passes over the origin of the superior corrugator muscles and inserts on the dermis 14-15 mm superior to the medial canthal tendon. It, along with the procerus and supercilii corrugators, all participate in glabellar lines. It is innervated by the temporal and/or zygomatic branch of the facial nerve. It functions to depress the medial brow.

The orbicularis oculi muscle is composed of 2 parts, palpebral part and orbital part. The palpebral part originates on the medial palpebral ligament and inserts on the lateral palpebral raphe. The orbital part originates medially and inserts laterally to the palpebral part. Medially, the muscle is deep to the medial canthal tendon. It is innervated by the temporal and/or zygomatic branch of the facial nerve. The palpebral part performs light closure of the eyelids. The orbital part provides more forceful closure along with medial displacement of the eyelids, which compresses the globe and lacrimal sac, initiating flow of tears into the nasolacrimal duct. Hyperactivity of the lateral orbicularis oculi muscle can cause radial lines stemming from the lateral canthus, commonly called “crow’s feet.” Injections with botulinum toxin can help treat these lines. Injections should be at least 1 cm from the lateral canthus and not past the midpupillary line. Doing so may compromise orbicularis oculi closure of the eyelids and interfere with pumping of tears causing epiphora, respectively. Injections too inferiorly may weaken zygomaticus muscles and change the smile.

**Muscle of the Nose**

The procerus muscle originates on the lower end of the nasal bones and upper parts of the upper lateral nasal cartilage. It inserts on the forehead skin and interdigitates with the frontalis muscle. It is innervated by the angular nerve, which are terminal branches of the zygomatic and/or buccal branch of the facial nerve. Its function is to displace the medial angle of the eyebrows inferiorly, which also causes horizontal facial skin creases.

The transverse nasalis muscle originates on the maxilla, superior and lateral to the incisive fossa. It inserts on the opposite muscle and procerus. It is innervated by the buccal branch of the facial nerve. Its function is to depress the cartilaginous part of the nose and draws the ala towards the nasal septum, decreasing the cross-sectional area of the nares. Hyperactivity of this muscle can cause radial lines along the dorsum of the nose as far down to the lower border of the lower lateral cartilage of the ala, also called “bunny lines.” Injections of botulinum toxin can give superior to the nasofacial groove to avoid the levator labii superioris alaeque nasi.
muscle to avoid ipsilateral lip ptosis. Superiorly, care should be taken to avoid the angular artery and vein.

The alar part of the nasalis originates on the maxilla above the lateral incisor and medial to the transverse nasalis. It inserts on the lower part of the alar cartilage. It is innervated by the buccal branch of the facial nerve. Its function is to dilate the nares and prevent collapse during breathing.

The dilator naris Vestibularis originates on the external skin of the alar lobule and inserts on the vestibular skin of the alar lobule. It connects the external and vestibular skin of the alar lobule and radiates along the dome-shaped nasal vestibule. It is innervated by the buccal branch of the facial nerve. It functions to dilate the vestibule.

The dilator naris anterior originates on the frontal surface of the lateral half of the lateral crus of the greater alar cartilage and accessory cartilage. The medial fibers descend anteromedially, and the lateral fibers descend slightly toward the skin of the nose. It inserts on the skin of the nose superior to the alar groove. It is innervated by the buccal branch of the facial nerve, and its function is to dilate the vestibule.

The depressor septi nasi muscle originates in the incisor fossa of the maxilla and inserts on the base and lateral surface of the medial crus of the lower alar cartilage. It is innervated by the buccal branch of the facial nerve. It draws the ala inferiorly and narrows the nares. Medially, it has attachments to the dermocartilagenous ligament, which is sandwiched by the medial crus of the lower alar cartilage. A study by Hwang et al showed that resection of the dermocartilagenous ligament along with lower lateral cartilage transdomal sutures increased the nasolabial angles in a range from 5 to 30 degrees, an average of 15 degrees, along with nose shortening.

**Levator Muscles of the Mouth**

The levator labii superioris alaeque nasi (LLSAN) muscle originates on the superior part of the frontal process of the maxilla and inserts in 2 places, the greater alar cartilage and skin of the nose and also the muscles of the upper lip. This muscle may have a deep layer, which can be encountered during surgery in this area. It is innervated by the buccal branch of the facial nerve. Its function is to dilate the nares and displace the upper lip superomedially.

The levator labii superioris (LLS) muscle originates from the lower margin of the orbit, superior to the infraorbital foramen. It inserts on the orbicularis oris between the LLSAN and the levator anguli oris muscle. It is innervated by the buccal branch of the facial nerve, and its function is to raise the upper lip. The LLSAN and the LLS can be injected with botulinum toxin to decrease gingival show, or “gummy smile.” The levators are prevented from contracting and the displacement superiorly of the upper lip is decreased. Ishida et al showed how combing a LLS Myotomy with an intranasal approach with frenectomy can permanently reduce gingival show. Their procedure in 14 patients resulted in an average of 3.31 mm of reduction of gingival exposure with a range from 1.59 mm to 4.83.

The levator anguli oris muscle originates in the canine fossa, inferior to the infraorbital foramen. It inserts onto the modiolus, along with the zygomaticus major and depressor anguli
oris. It is innervated by the buccal branch of the facial nerve, and its function is to displace the lip angle superiorly and results in deepening of the nasolabial furrow. Ewart et al showed in human cadavers that intraoral plication of this muscle can lead to elevation of the oral commissure, which has potential to help reanimate the face in combination with other procedures.

The zygomaticus minor muscle originates on the zygoma, posterior to the zygomatico-maxillary suture. It inserts on the upper lip, medial to the zygomaticus major. It is innervated the buccal branch of the facial nerve. Its function is to displace the lip superiorly and results in deepening of the nasolabial furrow.

The zygomaticus major muscle originates on the zygoma, anterior to the zygomatico-temporal suture. It inserts at the modiolus. It is innervated by the buccal branch of the facial nerve. Its function is to displace the angle of the mouth superior and posteriorly. This muscle is the primary muscle in lateral oral excursion and is a vector focus for reestablishing facial reanimation. Pessa et al showed that in 24% of the 50 cadavers dissected that this muscle was bifid. The distal end of the muscle had a normal insertion into the modiolus and a second inferior bundle that had a dermatocutaneous insertion. This correlation is hypothesized to form the cheek dimple.

The risorius muscle originates on the parotid fascia overlying the masseter muscle and inserts on the skin at the angle of the mouth. It is innervated buccal and/or mandibular branch of the facial nerve. Its functions are to displace the skin of the cheek posteriorly, stretch the lower lip, and displace the corners of the mouth inferiorly and laterally.

**Depressor Muscles of the Mouth**

The depressor labii inferioris muscle originates at the oblique line of the mandible between the mental foramen and the symphysis, also interdigitating with the platysma. It inserts on the skin of the lower lip and the orbicularis oris. It is innervated by the buccal and/or mandibular branch of the facial nerve. Its function is to displace the lower lip inferiorly and slightly laterally.

The depressor anguli oris muscle originates on the oblique line of the mandible lateral and inferior to the depressor labii inferioris, also interdigitating with the platysma. It inserts at the corner of the mouth as a narrow fasciculus. It is innervated by the buccal and/or mandibular branch of the facial nerve. Its function is to depress the angle of the mouth and displace the angle medially when contracted simultaneously with the levator anguli oris. The transversus menti, present in about 50% of people based on a cadaver study by Weaver, are transverse muscle fibers that are continuous with and connects bilateral depressor anguli oris muscles.

The mentalis muscle is paired and originates in the incisor fossa of the mandible. It inserts on the skin of the chin. It is innervated by the buccal and/or mandibular branch of the facial nerve. Its function is to elevate and protrude lower lip and results can wrinkle the chin. This muscle may cause deep rhytids in the chin which can be treated with botulinum toxin injection.
The orbicularis oris muscle is a sphincter muscle of the mouth. The upper portion originates on the alveolar border of the maxilla, while the lower part originates on the mandible lateral to the mentalis. They insert at the angle of the mouth. This muscle is innervated by the buccal branch of the facial nerve. The muscle brings the lips close to the teeth and alveoli, brings the lips together and protrudes the lips forward. Hyperactivity of this muscle can result in radial lines around the mouth, also known as “lipstick lines” or “smoker’s line.” This lines are commonly treated with botulinum toxin in combination with lip fillers such as Restylane® or Juvederm®.

The platysma muscle originates on the superficial pectoral and deltoid fascia. It inserts on the inferior body of the mandible and into the skin and hypodermis. It is innervated by the cervical branch of the facial nerve. Its function is to depress the lower mandible and depress the lower lip. In the aging neck, banding and separation of the platysma occurs while the cervical skin loses elasticity. More submental fat becomes visible and the platysma separates anteriorly to become two diverging vertical bands. The anterior borders tighten and become visible when the neck is animated during speaking, exercise or playing musical instruments. Injections of botulinum toxin along these bands can decrease the appearance of these bands.

The buccinator, meaning trumpet player in Latin, is the principle muscle making up the bulk of the cheek. It originates on the pterygomandibular raphe and alveolar processes of the mandible and maxilla. The medial fibers decussate and merge with the upper and lower lip muscles. It is innervated by the lower buccal branch of the facial nerve. Its function is to compress the cheeks against the teeth for holding food; it also tenses and contracts the cheeks. This muscle forms the lateral wall of the oral cavity and is pierced by the parotids duct opposite the upper second molar. It is superficially covered by the buccopharyngeal fascia and mucous membrane of the oral cavity.

Superficial Muscular Aponeurotic System

The superficial muscular aponeurotic system (SMAS) was first described in 1976 by Mitz and Peyronie. It is an important concept of the superficial musculature of the face as the facial nerve and its branches are deep to this continuous layer. Also, important vessels including the facial artery and vein and their branches are also deep to the SMAS. The SMAS is superficial to the superficial layer of the deep cervical fascia that invests the sternocleidomastoid muscle and parotid gland. It is also superficial to the superficial layer of the temporalis muscle fascia. The SMAS is contiguous with the galea of the scalp superiorly. In the parotid gland area, the SMAS is attached for about 1-2 cm in the pretragal area; then anteriorly, the SMAS is independent of the parotid fascia. The branches of the facial nerve are deep to the superficial portion of the parotid gland. Anterior to the parotid, the SMAS is thinner and the facial nerve branches are directly deep to the SMAS. More care to this area anterior to the parotid gland is needed for dissection of the SMAS in procedures such as rhytidectomy because of the proximity of the facial nerve branches.

Conclusion

Knowledge of the facial muscles provides part of the basic foundation in procedures affecting the animation of the face. The facial muscle functions as well as the nerves and vessels supplying them and the relationship between different planes of the superficial face are important
for the surgeon to know in order to perform minor procedures such as botulinum toxin injection and also major procedures such as rhytidectomy.

RESOURCES


Se Ru, JA, Buwalda, J. Botulinum toxin A injection into corrugators muscle for frontally localized chronic daily headache or chronic tension-type headache.” J of Laryng & Oto. 2009; 123: 412-17.


Pictures depicting muscles of face from Grey’s Anatomy from Wikipedia.