INTRODUCTION

The facial nerve, also known as the seventh cranial nerve, combines motor, general sensory, special sensory, and autonomic (visceral) components. The intricate course of the facial nerve as it runs intracranially, intratemporally, and extratemporally is essential for any surgeon operating in the head and neck to understand. The facial nerve innervates the muscles derived from the second branchial arch and carries sensory and parasympathetic fibers of the nervus intermedius. The facial muscles, also known as mimetic muscles, function to protect the eye, maintain the nasal airway, provide oral continence, and articulate speech. Equally as important, these mimetic muscles provide humans the means for emotional expression and interpersonal communication. This chapter details an anatomic description of the facial nerve and musculature with a focus on anatomy and physiology as they relate to facial nerve disorder and treatment.

FACIAL NERVE

The facial nerve provides a diverse range of functions via efferent and afferent innervation to structures of the second branchial arch. The most well-associated function of the facial nerve is its innervation of striated muscles of facial expression. These functions will be the focus of this chapter. However, additional efferent motor fibers provide innervation to the stapedius muscle, the stylohyoid muscle, and the posterior belly of the digastric. Collectively, these motor fibers represent the special visceral efferents comprising the majority of the facial nerve fibers. The remaining efferent fibers of the facial nerve are general efferent fibers and form autonomic contributions. These autonomic nerves travel via the greater superficial petrosal nerve (GSPN) to the lacrimal gland and seromucinous glands of the nasal cavity and via the chorda tympani to the submandibular and sublingual glands. Traveling with this autonomic system, visceral afferent fibers supply visceral sensation to the mucosa of the nose, pharynx, and palate. Additional afferent inputs include special sensory fibers and somatic sensory fibers. Special sensory fibers for taste to the anterior two-thirds of the tongue, tonsillar fossa, and palate originate from the geniculate ganglion cell bodies and travel within the chorda tympani and GSPN. Somatic sensory fibers provide touch sensation to the external auditory canal and conchal skin of the auricle as well as proprioceptive information from the facial muscles (Fig. 1.1).

INTRACRANIAL

Facial muscle movement starts with a conscious or unconscious impulse in the motor cortex of the precentral gyrus of the cerebral hemispheres. The majority of cerebral fibers then project to the contralateral facial motor nucleus via the corticobulbar tract through the thalamus along the posterior limb of the internal capsule. However, a subset of cerebral fibers controlling movement of the frontalis and upper orbicularis oculi project to both the ipsilateral and contralateral facial motor nuclei. A central lesion will thus cause frontalis-sparing facial paralysis due to the bilateral contributions to the upper face. The precentral gyrus fibers synapse in the facial motor nucleus, residing in the pontine tegmentum. Postsynaptic fibers then travel dorsally within the brainstem, loop around the floor of the fourth ventricle at the facial colliculus, and exit the ventrolateral aspect of the brainstem at the caudal border of the pons in the cerebellopontine angle (Fig. 1.2).

Collectively known as the nervus intermedius, preganglionic fibers of the superior salivatory nucleus and sensory fibers from the nucleus of tractus solitarius exit the brainstem directly lateral to the facial nerve motor root. Together, the facial nerve motor root and nervus intermedius enter the internal auditory canal (IAC) at the porus acusticus. For the purposes of this chapter, the facial motor root and nervus intermedius will be collectively referred to as the facial nerve.

INTRATEMPORAL

Meatal

The facial nerve travels through the temporal bone via a bony channel, the fallopian canal. The first segment of the fallopian canal is the meatal segment or IAC. The facial nerve travels in the superior anterior aspect of the IAC. The transverse (falciform) crest separates the facial nerve from the cochlear nerve inferiorly and Bill’s bar, a lateral ridge of bone, and separates the facial nerve from the superior vestibular nerve posteriorly. Within the IAC, the nerve lacks a fibrous sheath
or endoneurium and is surrounded by a thin layer of arachnoid.  

**Labyrinthine**
Exiting the IAC, the facial nerve turns gently anteroposteriorly within the otic capsule bone between the cochlea and superior semicircular canal into the labyrinthine segment. This portion is on average 3 to 6 mm in length—the shortest and narrowest section of the fallopian canal. In this segment, the facial nerve is at its thinnest and particularly vulnerable to injury. The vascular supply is a watershed between the terminal arterioles of the vertebrobasilar system (via the labyrinthine branch of the anterior inferior cerebellar artery [AICA]) and the external carotid artery (via the petrosal branch of the middle meningeal artery). There is also a lack of epineurium vascular plexus along the labyrinthine segment.

At the distal end of the labyrinthine segment, the nerve travels superior to the cochlea and opens into the geniculate fossa. The geniculate fossa is separated from the middle fossa floor by a thin layer of bone, which is dehiscent in about 25% of cases. Here the first fibers leave the facial nerve as the GSPN. The GSPN carries preganglionic parasympathetic innervation to the lacrimal gland and nasal mucosa. These fibers join the deep petrosal nerve from the carotid plexus to become the Vidian (or pterygoid) nerve. The thin bone above the geniculate and anterior attachment of the GSPN exerting intraneural traction place the nerve at increased risk of traumatic injury at this location. After the geniculate fossa, the facial nerve makes an acute posterior and slightly inferior turn, nearly 180 degrees, to enter the tympanic segment or horizontal segment.

**Tympanic (Horizontal)**
The tympanic segment is located along the medial wall of the anterior attic, travels superomedial to the cochleariform process, and forms the superior wall of the oval window niche posteriorly. On average 8 to 11 mm in length, dehiscence of the horizontal fallopian canal occurs in up to 20% of patients, with 80% above the oval window and 12% anterior to the cochleariform process. At the pyramidal eminence, the facial nerve makes a second genu anteroinferior to the lateral semicircular canal and enters the mastoid or vertical segment.

**Mastoid (Vertical)**
Greater anatomic variability is seen in the vertical segment prior to exiting the stylomastoid foramen than any other segment of the fallopian canal. In this...
The facial nerve becomes more superficial as it travels within the mastoid bone. Between 9 and 18 mm in length, the mastoid segment contains the chorda tympani and stapedial branches (Fig. 1.3). The chorda tympani has a variable take off from the mastoid segment but typically exits 6 mm above the stylomastoid foramen. Coursing superiorly nearly parallel to the facial nerve, the chorda angles anteriorly as it enters the mesotympanum. It exits the temporal bone via the petrotympanic fissure and joins the lingual nerve to convey taste information to the anterior two-thirds of the tongue and supplies preganglionic parasympathetic innervation to the submandibular, lingual, and minor salivary glands. This final segment ends at the stylomastoid foramen, which is lined by the aponeurosis of the posterior belly of the digastric muscle. This aponeurosis directly supplies blood to the facial nerve as it exits the fallopian canal.

**EXTRATEMPORAL**

The facial nerve exits the stylomastoid foramen covered in tough connective tissue. At the stylomastoid foramen, the posterior auricular branch exits the facial nerve and supplies general sensory innervation to the posterior ear canal and concha, as well as motor innervation to the auricular muscles and occipitalis muscle. The digastric branch supplying motor innervation to the posterior belly of the digastric muscle and the
Stylohyoid branch to the stylohyoid muscle also exit the facial nerve prior to its entrance into the parotid gland. Within the parotid, the facial nerve branches into a larger zygomaticotemporal division and a smaller cervicomandibular division at the pes anserinus and terminates in five classic branches: temporal, zygomatic, buccal, mandibular, and cervical. In reality, the branching pattern of the facial nerve is highly variable with multiple communications and the majority of variations existing among the zygomaticobuccal divisions. Through the parotid gland, the nerve runs at the level of the retromandibular vein and separates the superficial and deep lobe of the parotid gland. As it exits the parotid, the nerve has on average 8 to 15 branches making up the five divisions. The nerve runs deep to the superficial musculoaponeurotic system (SMAS) and innervates the majority of facial muscles from their deep surface. The mentalis, buccinator, and levator anguli oris are innervated on their superficial surface as these are the deepest layer of facial muscles.

**Temporal Division**

The temporal division, also known as the frontal division or fronotemporal branch, consists of three to four branches traveling obliquely in between the temporaloparietal fascia and the superficial layer of the deep temporal fascia. Branches entering the frontalis muscle at the level of the supraorbital ridge are located up to 3 cm above the lateral canthus. Branches entering the upper orbicularis oculi run along the undersurface for 3 to 4 mm before entering the muscle to innervate it. One common estimate of the frontotemporal branch is Pitanguy’s line, defined by a line draw from 0.5 cm inferior to the tragus to 1.5 cm superior and lateral to the eyebrow. Numerous cadaveric studies have attempted to further define the course and branching patterns. Ishikawa demonstrated that three to four branches of the FTN were consistently found between 3.8 and 6.0 cm posterior to the lateral canthus along the superior zygomatic arch in both straight-line and curved trajectories.

**Zygomaticobuccal Division**

The zygomaticobuccal division consists of five to eight branches with significant overlap of muscle innervations. These nerves innervate the midfacial muscles spanning the lip elevators to the lower orbicularis oculi. Connections between the lower branches and marginal mandibular division also exist. Dorafshar et al. describe “Zucker’s point” as a reliable surface landmark for identifying the zygomaticobuccal nerve as it exits the parotid. The authors found that the midpoint of a line drawn from the root of the helix to the oral commissure predicted the nerve location within an average of 2.3 mm.

**Marginal Mandibular Division**

The marginal mandibular division consists of one to three branches beginning up to 2 cm below the ramus.
of the mandible and arcing upward to cross the mandible halfway between the angle and mental protuberance. Branches lie on the deep surface of the platysma and cross superficial to the facial vessels 3.5 cm from the parotid edge. There are separate branches to the depressor angularis, depressor labii inferioris (DLI), and mentalis, and variable superior ramus supplying upper platysma and lower orbicularis oris.

**Cervical Division**
The cervical division consists of one branch leaving the parotid and running on the deep surface of the platysma. The point of entry into the muscle is 2 to 3 mm caudal to the platysma muscle branch of the facial vessel. It enters the muscle at the junction of its cranial and middle thirds.

**MICROSCOPIC ANATOMY**
The microanatomy of the facial nerve reveals a heterogenous organization that explains in part the difficulty of facial nerve repair. As described by Capter et al., the facial nerve lacks fascicular organization as well as epineural or perineural covering from its exit at the brainstem to the geniculate ganglion. Prior to the geniculate ganglion, the nerve is surrounded only by an arachnoid sheath. A thin epineural sheath arises within the tympanic segment and thickens as the nerve travels towards the stylomastoid foramen. The perigeniculate facial nerve demonstrates one or two fascicular bundles that increase in number and decrease in size as the nerve travels distally through the fallopian canal. The number of fascicles and their spatial organization changes every 2 mm within the fallopian canal. At the stylomastoid foramen the nerve has on average 11 fascicles and up to 16. As individual fibers emerge, they are surrounded by perineurium and endoneurium. In the horizontal segment, the upper motor division has been reported to be more superficial (or lateral), whereas the lower motor division has been reported to lie deeper (or medial). The nerve bundles have a spatial organization as they traverse the mastoid segment: branches to the lower division lie within the anterior portion of the nerve and branches to the upper division course posteriorly within the epineurium. From the brainstem to the mastoid segment, an average of 7800 myelinated nerve fibers are maintained. A single neuron can innervate up to 25 muscle fibers.

**VASCULAR ANATOMY**
The intracranial (brainstem and IAC) facial nerve receives blood supply from branches of the AICA arising from the vertebrobasilar system. The labyrinthine artery, a branch of the AICA, provides vascular input within the IAC segment. However, the remaining intratemporal segments receive blood supply through the middle meningeal artery, a branch of the maxillary artery from the external carotid. As described previously, the transition zone of vascular supply between the AICA and the external carotid centers on the labyrinthine segment and creates a watershed or weak zone of arterial supply.

The extrinsic vascular network consists of one or two main arterial trunks and accompanying vena comitantes running between the periosteum of the fallopian canal and the epineural sheath of the nerve. An intrinsic vascular network also exists within the epineurial sheath consisting of small arterioles, capillaries, and venules.

**FACIAL MUSCLES**
The striated muscles of facial expression derive from the second branchial arch mesoderm and reside within the SMAS layer. The SMAS layer continues superiorly with the galea aponeurotica and inferiorly with the platysma muscle. A total of 17 paired and 1 unpaired sphincter muscle constitute the facial musculature. These originate from the periosteum of the facial bones and insert into the skin, allowing for a limitless number of facial expressions (Fig. 1.5).

The facial muscles possess a three-dimensional relationship to one another and exist in four layers based on muscle origin as demonstrated by Freilinger et al. The orbicularis oculi, depressor anguli oris (DAO), and superficial aspect of the zygomaticus minor are most superficially located as the first layer. The platysma, risorius, zygomaticus major, deeper portion of the zygomaticus minor, and levator labii superioris alaeque nasi compose the second layer. The levator labii superioris and orbicularis oris represent the third layer. The deepest layer is composed of the levator anguli oris, the mentalis, and the buccinator—these three muscles are also the only muscles innervated from their superficial surface, as explained by this relationship.

Distinct from most skeletal muscles, facial muscles are flat, strap-like muscle sheets with interdigitations to the skin, short or absent tendons, and an absent fascial covering. A comprehensive list and description of facial muscles are detailed in Table 1.1. The most clinically relevant facial muscles are described in further detail in the following sections.

**FRONTALIS**
The frontalis muscle is a broad, thin, bilateral muscle originating from the galea aponeurotica near the coronal suture and inserting onto the superciliary ridge of the frontal bone and interdigitating with fibers of the orbicularis oculi, procerus, and corrugator supercilia. Densely adherent to the overlying skin, the frontalis glides over the underlying periosteum to provide brow elevation. The resting tone of the frontalis also prevents brow descent and ptosis. Left- and right-sided frontalis bellies fuse in the midline caudally, often as a fibrous junction. The frontalis and occipitalis bellies can be described as distinct muscle bellies or as parts of a single
occipitofrontalis muscle connected by an intermediate tendon within the galea aponeurotica.

**ORBICULARIS OCULI**

The orbicularis oculi muscle is a paired sphincter important in eyelid closure. The pretarsal, preseptal, and orbital subdivisions of the orbicularis oculi are defined by the anatomic level of the muscle. The pretarsal portion is closely adherent to the pretarsal skin, covers the tarsal plate and provides reflexive blink movement. The preseptal portion covers the orbital septum and is under more voluntary control. It is less closely adherent to the skin other than at the medial and lateral canthi. Both the preseptal and pretarsal components function together during blink. The orbital component forms a ring over the bony orbital margin and is recruited during forceful eye closure as well as brow depression. This component originates medially from the superomedial orbital margin, the maxillary process of the frontal bone, the medial...
### Table 1.1 Facial Muscles.

<table>
<thead>
<tr>
<th>MUSCLE</th>
<th>ACTION</th>
<th>ORIGIN/INSERTION</th>
<th>DESCRIBED DIMENSION</th>
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<tbody>
<tr>
<td><strong>MUSCLES OF THE SCALP</strong></td>
<td></td>
<td></td>
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<tr>
<td>Frontalis</td>
<td>Raises forehead and eyebrow and draws scalp backwards</td>
<td>O: Galea aponeurotica near the coronal suture I: Superciliary ridge of the frontal and occipital bone (frontalis and occipital)</td>
<td>Width: 60.9 +/- 8.7 mm&lt;sup&gt;19&lt;/sup&gt; Height: 31.7 +/- 7.5 mm&lt;sup&gt;19&lt;/sup&gt;</td>
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<tr>
<td>Occipitalis</td>
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<tr>
<td>Auricularis Anterior</td>
<td>Draws auricle forward and upward</td>
<td>O: Galea aponeurotica I: Auricular cartilage</td>
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<tr>
<td>Auricularis Superior</td>
<td>Draws auricle upwards</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Auricularis Posterior</td>
<td>Draws auricle backwards</td>
<td></td>
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<tr>
<td>Temporoparietalis</td>
<td>Tightens scalp, raises auricle and temple</td>
<td>O: Galea aponeurotica I: Auricularis muscles</td>
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<tr>
<td><strong>MUSCLES OF THE EYELIDS</strong></td>
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<tr>
<td>Orbicularis Oculi</td>
<td>Sphincter muscle of eyelid, eye closure</td>
<td>O: Frontal bone, maxillary bone, medial palpebral ligament I: Lateral horizontal raphae</td>
<td>Length: 65 +/- 5.6 mm&lt;sup&gt;15&lt;/sup&gt; Width: 60 +/- 9.6 mm&lt;sup&gt;15&lt;/sup&gt;</td>
</tr>
<tr>
<td>Corrugator Supercilii</td>
<td>Draws eyebrow inferior and medial (vertical forehead wrinkles)</td>
<td>O: Medial orbital rim and frontal bone I: Frontalis, orbicularis oculi and skin&lt;sup&gt;20&lt;/sup&gt;</td>
<td>Length: 38–53 mm&lt;sup&gt;15&lt;/sup&gt;</td>
</tr>
<tr>
<td>Depressor Supercilii</td>
<td>Depressor of eyebrow</td>
<td>O: Frontal process of maxilla above medial canthal tendon I: Dermis superior to the medial canthal tendon</td>
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</tr>
<tr>
<td><strong>MUSCLES OF THE NOSE</strong></td>
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<tr>
<td>Procerus</td>
<td>Draws medial eyebrow downwards (transverse wrinkles of nose)</td>
<td>O: Caudal nasal bone I: Skin of glabella and medial brow</td>
<td>Length: 47 +/- 7.5 mm&lt;sup&gt;15&lt;/sup&gt;</td>
</tr>
<tr>
<td>Nasalis</td>
<td>Transverse: depresses cartilaginous part of nose and draws ala toward the septum Alar: enlarges nasal aperture</td>
<td>O: Maxilla over lateral incisor I: Procerus/Glabellar skin and lower lateral cartilage</td>
<td>Length: 42 +/- 2.5 mm&lt;sup&gt;15&lt;/sup&gt;</td>
</tr>
<tr>
<td>Depressor Septi Nasi</td>
<td>Draws ala downwards, constricts aperture</td>
<td>O: Incisive fossa of maxilla I: Nasal septum</td>
<td>Length: 37.83 +/- 4.38 mm&lt;sup&gt;13&lt;/sup&gt;</td>
</tr>
<tr>
<td><strong>MUSCLES OF THE MOUTH</strong></td>
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<tr>
<td>Levator Labii Superioris</td>
<td>Raises the medial aspect of upper lip</td>
<td>O: Inferior orbital rim and maxilla I: Orbicularis oris of upper lip</td>
<td>Length: 47 +/- 7.5 mm&lt;sup&gt;15&lt;/sup&gt;</td>
</tr>
<tr>
<td>Levator Labii Superioris</td>
<td>Raises the medial aspect of upper lip</td>
<td>O: Medial angle of orbital rim I: Levator labii superioris</td>
<td>Males: 33.67 +/- 4.13 mm&lt;sup&gt;13&lt;/sup&gt;</td>
</tr>
<tr>
<td>Alaque Nasi</td>
<td>Raises the medial aspect of upper lip and dilates the nostril</td>
<td></td>
<td>Females: 35.5 +/- 6.69 mm&lt;sup&gt;13&lt;/sup&gt;</td>
</tr>
<tr>
<td>Levator Anguli Oris</td>
<td>Elevates angle of the mouth</td>
<td>O: Maxillary canine fossa I: Orbicularis oris of upper lip and modiolus</td>
<td>Length: 61.6 +/- 7.6 mm&lt;sup&gt;13&lt;/sup&gt;</td>
</tr>
<tr>
<td>Zygomaticus Major</td>
<td>Elevates angle of the mouth upward and backward</td>
<td>O: Zygomatic Arch I: Modiolus</td>
<td>Length: 65.6 +/- 3.8 mm&lt;sup&gt;15&lt;/sup&gt;</td>
</tr>
<tr>
<td>Zygomaticus Minor</td>
<td>Elevates upper lip backward, upward, and outward</td>
<td>O: Zygomatic Arch I: Modiolus</td>
<td>Length: 51.8 +/- 7.4 mm&lt;sup&gt;15&lt;/sup&gt;</td>
</tr>
<tr>
<td>Risorius</td>
<td>Retracts angle of the mouth laterally</td>
<td>O: Parotid fascia I: Modiolus</td>
<td></td>
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</tbody>
</table>

*Continued*
canthal tendon, the frontal process of the maxilla, and the inferomedial margin of the orbit. Within the most superficial layer of facial muscles, the orbital subdivision laterally overlies the temporalis fascia, the origins of the zygomaticus major, and levator labii muscles.

**LIP ELEVATORS**

The perioral muscles contributing to lip elevation and smile are of particular interest to patients and surgeons in facial rehabilitation. The main lip elevators are the zygomaticus major, the levator labii superiors, and levator anguli oris (Fig. 1.6).

The zygomaticus major is the most superficial of the three and originates from the zygomatic bone in front of the zygomaticotemporal suture. It runs to the angle of the mouth where superficial fibers form the modiolus together with the DAO, the risorius, the orbicularis oris, the buccinator, and the levator anguli oris. The modiolus represents the interdigitation of all the perioral muscles. The deeper insertion of the zygomaticus major fuses with the levator anguli oris and the medial fibers line on the buccinator muscle. The caudal fibers continue into the DAO. The zygomaticus muscle elevates the commissure superiorly and laterally at an approximately 45-degree angle.

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**Table 1.1** Facial Muscles—cont’d

<table>
<thead>
<tr>
<th>MUSCLE</th>
<th>ACTION</th>
<th>ORIGIN/INSERTION</th>
<th>DESCRIBED DIMENSION</th>
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</table>
| Depressor Labii Inferiors | Draws lower lip downward and laterally           | O: Mandible inferior to mental foramen  
I: Modiolus, orbicularis oris, skin of lower lip                          | Length: 29 +/- 4.9 mm<sup>15</sup>                                             |
| Depressor Anguli Oris    | Depresses angle of the mouth                      | O: Mandible inferior to mental foramen  
I: Modiolus, orbicularis oris                                               | Length: 48 +/- 5.1 mm<sup>15</sup>                                             |
| Mentalis                | Raises and protrudes lower lip, wrinkles skin of the chin | O: Anterior mandible  
I: Chin skin                                                                 |                                            |
| Orbicularis oris         | Sphincter function of lips, closure of lips       | Neither bony nor tendinous origin, integration with perioral muscles            |                                            |
| Buccinator              | Compresses/flattens the cheek                     | O: Maxilla, pterygomandibular raphe, mandible  
I: Modiolus                                                                 | Length: 56 +/- 7.4 mm<sup>15</sup>                                             |
| Platysma                 | Tightening of the neck, downward pull on lower lip | O: Supraclavicular skin  
I: Continuous with SMAS                                                        |                                            |

<sup>1</sup> I, Insertion; O, Origin; SMAS, superficial musculoaponeurotic system.

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**Fig. 1.6** Periorbital Muscles Including Lip Elevators and Depressors. (From Drake R, Vogl W, Mitchel A. *Gray’s Basic Anatomy*. 2nd ed. Philadelphia: Elsevier; 2018:413-596.)
The levator labii superioris arises from the lower margin of the orbit above the infraorbital foramen, more medially located compared to the zygomaticus major. Its medial and upper insertion helps form the nasolabial sulcus with partial insertion into this crease. Its lateral fibers descend superficial to the orbicularis oris and deeper fibers interdigitate with the modiolus. Medial levator labii superioris fibers reach the upper lip philtral columns and insert into the medial vermilion border as far as the peak of Cupid’s bow. The levator labii superioris elevates the lip vertically and laterally to expose the upper teeth and deepen the nasolabial fold (Video 1.1).

The levator anguli oris originates from the maxillae below the infraorbital foramen, fills the canine fossa, and runs vertically. It inserts into the modiolus and is in the deepest layer of facial muscles. The levator anguli oris serves to elevate the commissure vertically and medially.

The origins and insertions for the zygomaticus major, levator labii superioris, and levator anguli oris determine the vectors of pull. The relative strength of each muscle interdigitating in the modiolus and orbicularis oris determines the smile configuration unique to each patient.

**ORBICULARIS ORIS**

The orbicularis oris is the only unpaired muscle of facial expression and serves as a sphincter of the mouth essential for oral competence in both speech and the oral phase of swallow. Superficially, portions of the muscle fibers insert into the philtra columns as well as along the vermilion border to form the white roll. Superficial components of the muscle can contract independently to provide nuanced expression of the lips and the deeper component functions as the main constrictor. Upper and lower lip depressors interdigitate with the orbicularis oris and work in concert for lower facial expression.

**LIP DEPRESSORS**

The lower lip musculature is as functionally complex as the upper lip. An intricate three-dimensional assembly of muscular sheets control the shape of the mouth and position of the lips. The DLI, DAO, and platysma comprise the lower lip depressors (Fig. 1.7).

The DLI originates along the alveolar bone of the mandible inferior and lateral to the mental foramen. It travels laterally to insert into the orbicularis oris muscle along its deep surface and attaches to the vermilion and middle third lip skin through fibrous septa.\(^{14,15}\) The DLI acts to depress and lateralize the lower lip, evert the vermilion, and produce lower dental show.

The DAO arises from the mandible lateral and superficial to the DLI origin. It inserts directly into the skin at the labiomandibular crease medially and into the modiolus laterally. Its main action is to draw the corner of the mouth down and medial during frowning. When acting in conjunction with the platysma muscle, the DLI and DAO depress the entire lower lip producing a full denture smile. The mentalis muscle similarly originates from around the mental foramen but passes medially or inferomedially. The mentalis muscle is the deepest layer of the lower lip muscles and acts to raise the chin with an indirect action of lower lip elevation.

**MICROARCHITECTURE**

Most facial muscles exhibit muscle fiber density equal to other skeletal muscles such as the biceps and tibialis anterior.\(^{16}\) Fiber density varies between 1000 and 1400 fibers/mm\(^2\) for the majority of facial muscles, with the orbicularis oculi and oris having the highest density (over 2000 fibers/mm\(^2\)). The total number of muscle fibers varies between 5400 fibers (zygomaticus minor) and 9630 fibers (DAO). Muscle fiber size varies between facial muscles. The frontalis, orbicularis oris, and orbicularis oculi contain smaller muscle fibers (less than 400 μm\(^2\)). The zygomaticus major, DAO, buccinator, zygomaticus minor, DLI, and levator labii superioris contain intermediate muscle fibers (between 400 and 500 μm\(^2\)). The platysma, levator anguli oris, and risorius contain large muscles (greater than 500 μm\(^2\)).

Facial muscles also demonstrate a great variability in fast- versus slow-twitch fiber composition, likely related to the multitude of functions they exhibit. Predominantly tonic or slow-twitch muscles contain a high percentage of type 1 fibers and predominantly phasic or fast-twitch muscles contain a high percentage of type 2 fibers. Facial muscle compositions range from 14% to 67% type 1 muscle fibers.\(^{17}\) The most phasically composed facial muscle is the orbicularis oculi and the most tonically composed facial muscle is the buccinator (Table 1.2).

Facial muscles have a unique microarchitecture compared to other skeletal muscles in the body and a complex pattern of innervation. Most human skeletal muscles consist of muscle fibers up to 18 cm in length.
with a single motor end plate (MEP) in the middle of the fiber. These MEPs form a narrow band that traverses across the central zone of the skeletal muscles, known as a motor band. Facial muscles differ significantly from skeletal muscles in innervation pattern, location of motor bands, and arrangement of MEPs. These differences may be partially attributed to the elaborate branching pattern of the facial nerve. Within the parotid gland, the facial nerve divides into multiple branches with an elaborate network of anastomosis and interlaced branches before entering the facial muscles. Each facial muscle is innervated by multiple terminal branches of the facial nerve without an accompanying vascular pedicle. Happak et al. demonstrate that upon entrance into the muscle, round or oval-shaped clusters of MEPs are found in the immediate vicinity of the nerve entrance, described as motor zones. Unlike the central motor band architecture of skeletal muscles, motor zones are spread over facial muscles in a de-centralized fashion with considerable variability determined by pattern of facial nerve branching. The orbicularis oris, orbicularis oculi, and buccinator muscles demonstrate a great number of small MEP clusters spread evenly over the muscle. The zygomaticus major demonstrates a dominant motor zone with two to three additional smaller motor zones. The levator labii superioris contains two to four large motor zones in eccentric positions.

In experimental studies, facial muscle fibers demonstrate a “multiply innervated muscle fiber pattern” with multiple MEPs within a distance ranging from 25 to 500 μm on a single muscle fiber. This pattern of innervation is also found in laryngeal muscles, perhaps pointing towards a system capable of fine adjustments. It is not yet known if multiple end plates on a single facial muscle fiber are innervated mono- or polynervously. The plexus of the facial nerve and high branching pattern suggest a polynervous innervation could be present. Further studies are needed to understand the mechanisms of emotional expression and neural control.

### Table 1.2 Fiber Composition of Facial Muscles.

<table>
<thead>
<tr>
<th>MUSCLE</th>
<th>TYPE 1 (%)</th>
<th>TYPE 2 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orbicularis oculi</td>
<td>15/85</td>
<td></td>
</tr>
<tr>
<td>Zygomaticus major</td>
<td>28/72</td>
<td></td>
</tr>
<tr>
<td>Orbicularis oris</td>
<td>29/71</td>
<td></td>
</tr>
<tr>
<td>Levator labii superioris</td>
<td>31/69</td>
<td></td>
</tr>
<tr>
<td>Depressor anguli oris</td>
<td>37/63</td>
<td></td>
</tr>
<tr>
<td>Corrugator superioris</td>
<td>41/59</td>
<td></td>
</tr>
<tr>
<td>Depressor labii inferioris</td>
<td>46/54</td>
<td></td>
</tr>
<tr>
<td>Occipitofrontalis</td>
<td>57/43</td>
<td></td>
</tr>
<tr>
<td>Buccinator</td>
<td>67/33</td>
<td></td>
</tr>
</tbody>
</table>


### CONCLUSION

Facial nerve and muscle anatomy elegantly demonstrates the complexities of the head and neck region. Comprehensive understanding of the anatomic course and contributions of the facial nerve is critically important for physicians treating facial nerve disorders both surgically and medically. Further research and understanding of nerve and muscle microarchitecture is critical in understanding the nuances of facial movement and emotional expression.

### REFERENCES


