Part Two: Face

Chapter 18: Anatomy

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In this first chapter on anatomy a few remarks are appropriate regarding the general approach to the anatomy of the head and neck that is used in this and subsequent chapters. In each chapter the essential anatomic terms, relations, and concepts of the particular topographic region are reviewed. The goal of these chapters is to provide a reasonable review of the pertinent anatomy rather than duplicate existing encyclopedic texts of anatomy. It follows, therefore, that the definition of "essential" is the individual author's and that the reader may find certain subjects fragmentary or omitted.

Facial Muscles

The muscles of the face differ from the usual concept of muscles as joint movers. The role of the facial muscles is to move the skin and in effect regulate the apertures of the orbit, nasal cavity, and oral cavity. A simplified view is that one end of the muscle is attached to bone and the other is attached to skin. This arrangement produces tension lines on the skin that are directed at right angles to the plane of the muscle fiber. These tension lines (Langer's cleavage lines) deepen with the aging process as the skin loses its elasticity. Obvious examples are the "frown lines" of the forehead, the nasolabial fold, and the "crow's-feet" of the orbital region. These cleavage lines can provide camouflage for surgical incisions or in fact may be the reason for the surgery.

Scalp and forehead

The scalp contains a series of muscles that allow it to be moved in an upward or downward direction. Movement of the skin of the forehead in this manner functions to serve as shading for the eyes, such as in squinting or in elevating the skin during upward gaze. For these purposes the following muscles are located within the scalp: the frontal and occipital bellies of the occipitofrontal muscle and the corrugator supercilii (Fig. 18-1). The frontal belly fibers of the occipitofrontal muscle have a scanty origin from the bone and periosteum of the supraorbital rim. The fibers are directed vertically, thinning before inserting into an aponeurosis termed the *galea aponeurotica,* which they share with the occipital belly fibers. The occipital belly arises from bone and periosteum along the superior nuchal line before its fibers join into the aponeurosis. The two bellies of the occipitofrontal muscle serve an opposing function: the occipital belly elevates the skin of the forehead, whereas the frontal belly pulls the skin downward toward the eyebrow.

The other muscle of this region, the corrugator supercilii, arises from the orbital rim near the medial canthus and then directs its fibers superiorly and laterally to insert into the deep surface of the frontal belly of the occipitofrontal muscle (Fig. 18-2). Contraction of the corrugator supercilii draws the brow medially, producing the oblique frown lines over the glabellar region. During coronal forehead lifts, a section of this muscle is resected in an attempt to reduce or eliminate the glabellar frown lines. Likewise, the central portion of the frontal belly fibers of the occipital frontal muscle, located between the two supraorbital nerves, is frequently sectioned in a gridlike pattern to weaken this portion of the muscle for the purpose of reducing the horizontal creases of the forehead.

The other small muscles in the scalp relate to the ear, and because they are not important, they are not considered in this chapter. Another aspect of the scalp, however, that is germane to the otolaryngologist - head and neck surgeon is the layering of the scalp tissues. The letters of the word *scalp* are a familiar acronym to medical students for remembering the five individual layers of the scalp structure: skin, connective tissue, aponeurosis, loose connective tissue, and periosteum. The first three layers of the scalp - the skin, dense connective tissue, and aponeurosis - do not readily separate. The majority of blood vessels and cutaneous nerves are located in the dense connective tissue space superficial to the galea aponeurotica. An important exception to this rule is the origin of the supraorbital and supratrochlear neurovascular bundle at the rim of the orbit. As these vessels emerge from the orbit, they must traverse the loose connective space and galea aponeurotic before penetrating into the dense connective tissue plane. At this point they are vulnerable during brow- and forehead-lifting procedures. Similarly, lacerations of the brow at the supraorbital rim may result in anesthetized areas of the scalp when the supraorbital or supratrochlear nerves are severed. These nerves are cutaneous and have no role in the innervation of the scalp muscles, which are supplied by branches of the seventh cranial nerve (CN VII). These are discussed in the following section after the description of the facial muscles.

Separation of the scalp from the skull in avulsion injuries usually occurs at the plane of the loose connective tissue layer. The term *danger space* is applied to the loose connective tissue layer refers not to this particular traumatic event but to the fact that infection may spread readily in this space and be subsequently transmitted intracranially by emissary veins.

Orbital region and eyelid

The orbicular eye muscle, a series of concentric rings, originates either from the medial palpebral ligament or from bone on the medial orbital wall. Three parts of the muscle are usually described: the large orbital region, which covers the superior and inferior limits of the orbit; the palpebral part, which is adjacent to the upper or lower eyelids, and the lacrimal portion attached to the posterior lacrimal crest. Closure of the entire orbital region and lid is accomplished by coordinated contraction of the entire muscle group, whereas blinking is limited to the palpebral region of the muscle covering the lid. The palpebral portion of the muscle passes posterior to the medial palpebral ligament adjacent to the lacrimal sac (Fig. 18-2). When the eye is closed, these fibers can exert traction on the lacrimal sac, serving as a pump to aid in the drainage of the tears (Jones, 1957; Reeh et al, 1982). The orbital portion is attached to the skin where it broadens over the anterior temporal and malar region. These skin attachments give rise in the aging face to the radially oriented skin creases known as "crow's feet". The palpebral portion does not attach to the overlying skin or underlying orbital septum, but rather is separated from these structures by a layer of areolar connective tissue. This relationship accounts for the ease in developing a cutaneous or musculocutaneous flap during blepharoplasty.

The eyelid is best viewed structurally from a sagittal section, which illustrates the central tarsal region versus the peripheral septal region (Fig. 18-3). In the central part of the upper lid just above the margin of the eyelash, the layers of the eyelid are skin, orbicular eye muscle, tarsal plate, and conjunctival sac. More peripherally the layers are skin, orbicular eye muscle, orbital septum, preaponeurotic space, levator aponeurosis, postaponeurotic space, superior tarsal muscle, and conjunctival layer. Three muscles therefore are represented in the upper lid. The orbicular eye muscle is a striated muscle supplied by CN VII, which is responsible for lid closure. The levator palpebrae superior muscle, also striated, functions to elevate the upper lid and is supplied by the third cranial nerve (CN III). In contrast, the superior tarsal muscle is smooth muscle supplied by the sympathetic nervous system and has only a minor role in supporting the lid. Nevertheless, loss of function in either CN III or the sympathetic nervous system can result in ptosis of the upper lid.

The pathway of sympathetic fibers to the superior tarsal muscle begins in the lateral gray matter of the spinal cord at the level of T1. These preganglionic fibers pass through the first thoracic spinal nerve and its white ramus communicans. After entering the sympathetic trunk, the preganglionic fibers ascend in the cervical chain, where they synapse in the superior cervical sympathetic ganglion. Postganglionic fibers form a plexus on the surface of the internal carotid artery and in this way are distributed via branches of the internal carotid system (ophthalmic artery) ultimately to the superior tarsal muscle in the upper eyelid.

Interruption of these fibers along any point from the spinal cord to the point of innervation of the muscle will result in ptosis and myosis, which are part of Horner's syndrome. The additional clinical findings of Horner's syndrome, anhidrosis and vasodilatation, of the ipsilateral face occurs only if the fibers are disrupted in the neck at the level of the superior cervical sympathetic ganglion. Metastatic masses, whether derived from primary tumors in the head and neck or thorax (for example, Pancoast tumor of the lung), can erode the sympathetic trunk and cause Horner's syndrome. Likewise, trauma or surgery performed in the vicinity of the sympathetic cervical ganglion can produce a similar finding. In contrast, CN III palsy, while also producing ptosis, results in midriasis because of the loss of the constrictor pupillae muscle. The severity of ptosis is usually gravest with CN III palsy, whereas in Horner's syndrome it is more moderate. In fact, in some cases it is almost imperceptible.

The levator palpebrae superioris extends forward from the lesser wing of the sphenoid to form a broad aponeurosis that attaches to the entire anterior surface of the tarsal plate of the upper eyelid. At the junction of the levator's muscle belly with its aponeurosis, two "check ligaments" are formed by thickenings of the connective tissue sheath of the muscle. These ligaments assist in tensing the levator at the level of the supratarsal fold, thus creating the fold.

Clinically, the septum orbitale is a particularly important structure in that it represents a line of continuity between periosteum and periorbita, and technically separates the intraorbital contents from the extraorbital structures. Preseptal infections of the eyelid are known as *periorbital cellulitis,* and are more common and less serious than postseptal orbital cellulitis. However, preseptal infections may expand posteriorly through the septum to produce orbital cellulitis and abscess formation, resulting in rapid deterioration of vision and even complete, permanent blindness. The orbital septum also represents an important landmark for the cosmetic surgeon performing blepharoplasties in that the septum must be penetrated to remove orbital fat where required as part of the surgical procedure. In the case of upper lid blepharoplasty, the surgeon must take care in removing the fat located between the orbital septum and the levator aponeurosis so as not to injure the latter structure, causing iatrogenic ptosis.

Nose

The muscles of the nose include the procerus muscle and the nasal muscle. The procerus muscle is a small muscle overlying the bridge of the nose and in part continuous with the frontal belly fibers of the occipitofrontal muscle. This muscle actually works with the frontal belly fibers in drawing the skin of the forehead downward during the act of squinting. Because of its vertically arranged muscle fibers, it forms transverse frown lines in the skin between the eyes. During rhinoplasty, avulsion of the procerus muscle is sometimes performed in attempts to deepen the nasofrontal angle.

The nasal muscle is frequently described as having two portions: a transverse portion and an alar portion. The transverse fibers, also termed the *compressor naris*, form an inverted U over the bridge of the nose. As the name implies, these fibers compress the naris by compressing or flexing the upper lateral nasal cartilage at its joint with the alar or lower lateral nasal cartilage. Dilatation of the naris is accomplished by the alar portion, which elevates the lower lateral or alar cartilage.

Mouth region (cheek and lips)

The buccinator muscle arises from the pterygomandibular raphe and the tuberosity of the maxilla. The fibers of the muscle cross anteriorly in the substance of the cheek and then blend at the corner of the mouth with the fibers of the orbicular mouth muscle. The essential function of the buccinator muscle is to maintain food between the teeth during the masticatory process. In this regard, it is more a muscle of mastication than a muscle of facial expression. Tension in this muscle also maintains the cheek against the teeth when one forcibly blows into a wind instrument, such as the trumpet, and thus prevents the cheeks from "ballooning out".

The buccal space is located immediately lateral to the buccal muscle, and includes the buccal fat pad and the parotid duct. The space is limited above by the attachment of the buccal muscle to the alveolar process of the maxilla, and below by the attachment to the mandible. In most adults, the molar apices are not beyond the muscle attachments, so that an apical abscess presents in the oral vestibule medial to the muscle. In contrast, younger individuals frequently have tooth roots that extend beyond the muscle attachment. Apical abscess formation in these individuals, as well as in adults with exceptionally long roots, often will result in extension of the infective process to the buccal space. Infections ascending along the parotid duct toward the gland from the mouth can also involve the buccal space. Patients with an abscess of the buccal space may present with marked swelling of the cheek without abnormalities visible intraorally.

The muscles of the lips include the orbicular mouth muscle, which is primarily a contractor or constrictor of the mouth region, and several muscles that open the mouth by elevating or depressing the lip. The orbicular mouth muscle is a series of concentric rings surrounding the mouth, which, when contracted, purse the lips. Many of the fibers interlace with the buccinator muscle, as well as with muscles that elevate or depress the lip. Elevation of the upper lip is accomplished by either the levator labii or the levator anguli oris muscle. The levator labii muscle elevates the lip itself, whereas the levator anguli oris muscle moves the angle of the lip. A complementary pair of muscles is found in the lower lip: the depressor labii and depressor anguli oris muscles.

The elevators of the lip arise from the infraorbital portion of the maxilla, whereas the depressors arise from the anterior aspect of the ramus of the mandible. The muscle fibers of the buccinator muscle, orbicular mouth muscle, and the elevators and depressors of the lip are substantially interlaced. The greater and lesser zygomatic muscles are located more superficially than the levators of the lip. Both the greater and lesser zygomatic muscles arise from the zygomatic bone lateral to the infraorbital foramen. The lesser zygomatic attaches into the orbicular mouth muscle near the ala of the nose, whereas the greater zygomatic attaches at the corner of the mouth. Both are elevators of the lip, although the lesser zygomatic muscle is important in producing the nasolabial fold.

Chin and neck

The mentalis (levator labii inferioris) is a flat band of fibers arising from the mandible near the roots of the incisors and inserting into the skin near the midline. The action of these fibers is to tense the skin of the chin as well as aid in protruding the lower lip.

Although the platysma may be thought of as a muscle of the neck region, it is in fact part of the facial musculature. The muscle arises from the inferior margin of the body of the mandible as a broad sheet from the mental symphysis anteriorly, to the area of the parotid gland at the angle of the mandible. The fibers descend over the neck, crossing the clavicle superficially and inserting into the skin over the upper portion of the breast area. The platysma is an important landmark for many surgical procedures performed in the region of the upper neck, such as facelift surgery and excision of the submandibular gland. In this region the mandibular branch of the facial nerve is located immediately deep to the muscle.

Facial Nerve and Innervation of the Facial Muscles

All of the muscles discussed previously, from the occipitofrontal to the platysma, are supplied by CN VII, the facial nerve. The embryologic origin of these muscles is from mesodermal components in the second branchial arch. The position of this arch in the embryo is adjacent to the developing brainstem and the emerging nerve fibers, which will become CN VII. Axons growing from cell bodies in the motor nucleus of CN VII innervate the primitive muscle cells in the second branchial arch. Regardless of the migration of these future muscle cells, whether cranial or caudal to their original position in the branchial arch, the basic pattern of innervation by CN VII is thus established.

Because a sensory element accompanies CN VII, mostly taste fibers that are distributed to the tongue, neural crest cells become associated with the developing CN VII. These cells send central processes into the brainstem to synapse with neurons in the nucleus solitarius. Peripheral processes growing from these same neural crest cells join with the motor fibers to be distributed to taste buds in the oral cavity. In this manner, the neural crest cells form the geniculate ganglion of CN VII, a homologue of the sensory dorsal root ganglion of the spinal nerves.

The intracranial course of the facial nerve within the temporal bone is discussed in Chapter 139, and a discussion of the nervus intermedius appears in Chapter 55. Innervation of the lacrimal gland by the great petrosal branch of the geniculate ganglion is discussed in Chapter 35.

CN VII exits the skull via the stylomastoid foramen. The first branch to arise from CN VII after it emerges from the stylomastoid foramen is the posterior auricular nerve. This nerve courses inferior to the auricle, ascending superficially on the mastoid process to supply eventually the occipital belly of the occipitofrontal muscle. In relation to the auricle, some sensory fibers may supply the skin of the external auditory meatus. The evidence for this is the clinical presentation of vesicles in herpes zoster oticus (Ramsay Hunt syndrome). Also arising from the major trunk of CN VII in this region are direct motor branches to the posterior belly of the digastric muscle and to the stylohyoid muscle. The remaining trunk of CN VII forms two or three divisions with five major branches: temporal, zygomatic, buccal, mandibular, and cervical (Fig. 18-4).

The temporal branch of CN VII arises from the anterior aspect of the parotid gland and courses superficial to the zygomatic arch. It provides motor innervation to the frontal belly of the occipitofrontal muscle, as well as to the orbicular eye muscle and the corrugator supercilii muscle. The zygomatic branch ascends to the lateral canthus, where it also supplies the orbicular eye muscle and forms an anastomotic network with the temporal branch. The buccal branch crosses transversely on the face to supply the central muscles of the face, including the greater and lesser zygomatic muscles, the levator anguli oris and levator labii superioris muscles, and all the small muscles associated with the surface of the nose. The buccal branch overlaps with the zygomatic branch in its supply of muscles in the central part of the face. Principally, it supplies the buccinator muscle and the orbicular eye muscle. The mandibular branch (marginal mandibular) crosses inferior to the angle of the mandible into the submandibular triangle and then ascends, crossing the mandible a second time to supply the muscles over the surface of the chin. The cervical branch of CN VII emerges from the inferior tip of the parotid gland, following the deep surface of the platysma muscle, which it innervates.

In review, three areas of CN VII may be delineated on a general topographic basis: an intraparotid portion, an exposed area, and a submuscular portion. Clearly, the most vulnerable part of CN VII is the part between the parotid gland and the muscles it innervates. Dissection superficial to either the parotid fascia or superficial to any of the facial muscles is a safe plane with respect to the branches of CN VII.

As the individual branches leave the substance of the parotid gland and course distal to the muscles, they gain an increasingly superficial plane in relation to the skin. For instance, the area where the temporal branch crosses the zygomatic arch represents the most superficial location of any of the major divisions of the facial nerve, and is considered a "danger zone" for facelift surgery. Terminals of the zygomatic branch at the point where they innervate the orbicular eye muscle are essentially at the level of the dermis. Even shallow incisions for removal of moles, for example) may divide these nerves, producing paralysis of the orbicular eye muscle and an inability to close the eye. Another particularly vulnerable site is the region of the submandibular triangle. Although the mandibular branch of CN VII is under the cover of the platysma, the site is a common surgical approach to the submandibular gland.

Interruption of the mandibular branch of CN VII results in an inability to depress the lower lip. In these patients the angle of the lip on the affected side is slightly elevated, whereas the lower portion of the lip on the affected side is pulled to the opposite side by tonic activity of the nonparalyzed muscles.

There are certain anatomic relationships between branches of CN VII and adjacent structures that are important to the surgeon performing parotidectomy, repairing cheek lacerations that have injured branches of the nerve, or performing other types of facial surgery. The zygomatic branch lies approximately 1 cm below the zygomatic arch in the region of the parotid gland, a fact that can be used as a guide in identifying this branch. The buccal branch crosses the parotid duct on its superficial surface, running from superior to inferior before turning anteriorly to be distributed to the facial musculature. By virtue of this relationship, injuries usually involve both structures concomitantly. The mandibular branch usually lies below the point at which the facial artery and vein emerge from the submandibular gland. In such instances, the commonly used maneuver in which the vascular structures are identified, divided, and elevated along with the overlying platysma and skin, does not represent a safe method of protecting the mandibular nerve. The nerve does, however, lie external to the fascial capsule of the submandibular gland and rarely extends below its inferior margin. Incising the capsular fascia at the inferior margin of the gland and elevating it along with the overlying tissues will provide protection for the nerve. The cervical branch of CN VII has an important relationship to the posterior division of the retromandibular vein, which, together with the posterior auricular vein, forms the external jugular vein. The nerve lies immediately on the lateral aspect of the posterior division of the retromandibular vein. Knowledge of this relationship can be used in performing retrograde dissection to the main trunk of CN VII. This is accomplished by identifying the external jugular vein, which is an easily located surgical landmark in the neck, and dissecting the vein upward to the posterior division of the retromandibular vein, at which point the cervical branch is encountered. The branch can be dissected retrograde to the inferior division of CN VII.

CN VII lesions

It is important to realize the differences between CN VII lesions that affect the upper motor neurons and those that involve the lower motor neurons. A lower motor neuron lesion is a deficit of the motor neuron in the CN VII nucleus or at any point distal to the nucleus. Thus, all motor branches, whether from the intracranial or facial parts of CN VII, would be affected. If the lesion is complete, a total hemiparesis of the face will result. Bell's palsy is an example of such a lesion, although in this case the site of injury is the bony facial canal in the temporal bone. In contrast, should a lesion affect the upper motor neuron at any point from the motor cortex or along the length of the axon before it synapses with the facial nucleus, a different set of physical findings will result. Paralysis as a result of this type of lesion spares the muscles of the upper portion of the face (that is, the orbicular eye and occipitofrontal muscles). However, the muscles of the central and lower portions of the face are paralyzed. This sparing occurs because the muscles of the upper part of the face receive motor supply from both cerebral cortices. Thus in a patient with a stroke lesion in the cerebral cortex or internal capsule, the orbicular eye and occipitofrontal muscles will be spared on the contralateral side because they receive secondary innervation from the ipsilateral cerebral cortex. Thus, the usual finding in stroke patients is paralysis of the muscles of the nose and mouth on the contralateral side of the cortical lesion.

Cutaneous Facial Innervation

A line projected from the tip of the chin to the vertex of the skull will define a plane in which the trigeminal nerve supplies all skin lying anterior to this plane. In contrast, the cervical plexus innervates all skin lying posterior to this plane (Fig. 18-5). The distribution of cervical fibers to the skin of the posterior aspect of the face and neck is discussed in Chapter 82. Distribution of trigeminal nerve fibers is topographically arranged according to the three divisions of the trigeminal. The ophthalmic division of the trigeminal supplies the forehead and bridge of the nose, the maxillary division supplies the area of the cheek, and the mandibular division supplies the area of skin covering the mandible and the temporal region.

The ophthalmic division of the trigeminal begins at the semilunar ganglion of the fifth cranial nerve (CN V) in the middle cranial fossa. After traversing the cavernous sinus, it enters the orbital cavity via the supraorbital fissure. At this point it divides into several branches, some of which eventually reach the skin of the nose and periorbital region. The three subdivisions of the ophthalmic branch within the orbit are the lacrimal, the nasociliary, and the frontal. The lacrimal nerve follows along the lateral and superior wall of the orbit and supplies a small area of skin near the upper lateral portion of the eyelid. The nasociliary nerve supplies two areas of skin: one via the infratrochlear nerve to the skin near the medial canthus of the upper lid and the other via the external nasal branch to the skin over the bridge of the nose. The external nasal nerve is not a direct branch of the nasociliary nerve; rather, it is the terminal branch of the anterior ethmoidal nerve after it supplies the ethmoid sinuses. The previously named nerves (that is, the lacrimal, infratrochlear, and external nasal nerves) supply only small areas of skin on the face. The major area of skin in the periorbital and frontal regions is supplied via branches of the frontal nerve from the ophthalmic division. The frontal nerve is given off soon after the ophthalmic division enters the orbit. Traversing the superior part of the orbital wall, the frontal division divides into the supraorbital and supratrochlear nerves, which emerge from the orbit through the supraorbital notch. In some individuals the notch is closed to form a bony foramen. From this point the nerve pierces the loose connective tissue and aponeurotic layers of the scalp to travel upward in the dense connective tissue layer of the scalp.

The maxillary division of the trigeminal nerve begins at the semilunar ganglion and enters the orbital region via the round foramen. As it enters the floor of the orbit, a zygomatic branch is given off that abruptly subdivides into two branches: the zygomaticotemporal and the zygomaticofacial. These nerves supply skin over the temporal and malar regions, respectively. After the zygomatic branch is given off, the maxillary nerve enters the infraorbital groove and traverses the infraorbital canal, emerging on the face via the infraorbital foramen. At this point three named branches of the infraorbital nerve appear (Fig. 18-5): the palpebral branch, which supplies the lower lid; the external nasal branch, which supplies the lateral and alar portions of the nasal skin; and the labial branch, which supplies the upper lid and cheek skin. In orbital blow-out fractures that disrupt the orbital floor, the zygomatic branch of the maxillary nerve is usually spared, because the injury is distal to its origin. However, the infraorbital branch of the maxillary nerve can be completely involved, leaving the patient with an anesthetized area over the lower lid, side of the nose, and upper lip and cheek. Furthermore, because the anterosuperior alveolar nerves arise from the infraorbital nerve, the anterior teeth (incisors and canines) are also numb. These nerves descend from the infraorbital nerve through small bony canals located in the anterior wall of the maxillary sinus. Caldwell-Luc and other surgical procedures that remove part or all of the anterior wall of the maxillary sinus will result in some numbness of these teeth as well.

After leaving the semilunar ganglion, the mandibular nerve exists the middle cranial fossa via the oval foramen. Here the nerve enters the infratemporal fossa and divides into several named branches, three of which are important to the innervation of the face. One is the auriculotemporal nerve, which courses laterally around the neck of the mandible and ascends the side of the skull in the skin of the scalp anterior to the ear. In addition to being a sensory nerve, the auriculotemporal nerve carries both parasympathetic postganglionic fibers from the otic ganglion to the parotid gland, and sympathetic fibers distributed via the carotid artery to innervate sweat glands of the skin in the area of the nerve distribution. Parotidectomy results in division of some of the branches of the auriculotemporal nerve, and may give rise to faulty reinnervation of sweat gland secretomotor receptors by parotid gland secretomotor fibers, resulting in the auriculotemporal (Frey) syndrome of gustatory sweating.

The second important sensory branch of the mandibular nerve is the buccal branch, which traverses the infratemporal fossa and supplies part of the buccal mucosa, as well as the skin over the cheek region. The third branch is the inferior alveolar nerve, which, after entering the mandibular canal and supplying all of the mandibular teeth, emerges as the mental nerve, supplying skin over the point of the chin. While all of these nerves may be affected by lesions involving the proximal trunk of the mandibular division, each of these nerves individually may be injured by operative procedures or trauma. In the case of the auriculotemporal nerve, it may be injured by fractures of the neck of the mandible or during face-lifting procedures when the skin anterior to the ear is being elevated over the path of the nerve. Mandibular fractures through the mandibular canal almost always produce paralysis of the mental nerve, as well as numbness of the teeth. Injury to the mental nerve can also occur during the elevation of skin or mucosal flaps in the region of the mental foramen. Another consideration with respect to the anatomy of the trigeminal nerve is in regard to herpes zoster. The distribution of vesicles on the skin usually follows the pattern of one of the trigeminal divisions. Herpetic involvement of the ophthalmic division often causes more discomfort to patients because of the distribution of the nasociliary branch to the cornea and conjunctiva, resulting in excessive tearing, burning sensations, and shooting pains over the eye.

Facial Blood Supply

Both the internal and external carotid branches supply the face. The internal carotid gives off an ophthalmic branch at the level of the circle of Willis. This vessel traverses the optic canal, where it enters the orbit and is concerned principally with supplying the eye and intraorbital tissues. From this plexus of intraorbital arteries, two branches emerge: the supraorbital and the supratrochlear emerge at the orbital rim to parallel the course of the supraorbital and supratrochlear nerves (Fig. 18-6). These form a neurovascular bundle in the dense connective layer of the scalp. In summary, the internal carotid supplies the periorbital and scalp tissues of the forehead.

Two branches of the external carotid contribute to the blood supply of the face along with the internal carotid. These are the superficial temporal artery and the facial artery itself (Fig. 18-6). The superficial temporal artery is the terminal branch of the external carotid. It begins in the substance of the parotid, exiting at the superior pole of the gland, where it joins the auriculotemporal nerve to lie just under the skin anterior to the tragus of the ear. It is also vulnerable during the elevation of skin flaps for face-lifting procedures. After entering the upper portion of the scalp, the superficial temporal artery anastomoses in the region of the forehead with the supraorbital and supratrochlear branches of the ophthalmic artery. There is also an anastomotic pattern over the occipital area with posterior auricular branches of the external carotid.

The facial artery, a branch of the external carotid artery, supplies the major portion of the face. After its origin from the external carotid, the facial artery ascends deep to the posterior belly of the digastric muscle and crosses the mandible at the anterior margin of the masseter muscle. Here, the artery lies deep to the plane of the facial muscles and is protected by them until it reaches the angle of the mouth, where the artery divides into inferior and superior labial arteries. The main trunk continues into the nasolabial angle and, after coursing deep to the lesser zygomatic muscle, is no longer covered by a muscle sheath. The artery terminates by sending small branches to the lateral aspect of the nose and finally anastomosing in small networks with the plexus of vessels about the orbital region. This effectively provides an anastomotic link between the facial and ophthalmic arteries (external and internal carotid systems, respectively). In some individuals the facial artery may end effectively at the angle of the mouth. In this case the transverse facial artery originates from the superficial temporal artery within the parotid gland. This vessel exits the parotid, following a course similar to the zygomatic branch of the facial nerve. When this vessel is large, it replaces the angular portion of the facial artery.

In summary, three major trunks supply blood to the face. The first is the ophthalmic artery through its orbital branches. The second is the superficial temporal artery, which supplies most of the forehead and lateral scalp tissues. The third is the facial artery, which supplies the central and lower portions of the face. All these vessels have anastomotic connections, not only on the side of their origins, but also across the midline with their corresponding vessel. Furthermore, superficial vessels anastomose with vessels in the deep portion of the face, such as the infraorbital artery. The infraorbital artery, the terminal branch of the maxillary, is another example of an anastomosis between the internal carotid branches about the orbit with the external carotid system.

In the region of the orbit, the normal flow of blood is from ophthalmic arterial branches into the periorbital arterial plexus. In patients with occlusive disease of the internal carotid, the direction of this flow may be reversed because of the pressure differential between the internal carotid system (low) and the external carotid system (high). Anatomic and Doppler flow studies by Berthelot and Hureau (1982) have shown that, depending on the dominant pattern of anastomosis, blood can enter the ophthalmic vessels via either the superficial temporal, the infraorbital, or the angular branch of the facial artery in patients in whom the internal carotid is occluded.

Facial Venous Drainage

The principal venous drainage of the face occurs via the facial and retromandibular veins. The facial vein begins as the angular vein near the medial canthus of the eye, coursing inferiorly in the nasolabial angle (Fig. 18-7). The vessel receives branches from the nose and region of the lip. Paralleling the course of the facial artery, it descends on the face, crossing the angle of the mandible, where it joins the common facial vein, which empties into the internal jugular vein. The common facial vein also receives the retromandibular vein, which begins in the scalp as the superficial temporal vein. When the superficial temporal vein enters the superior portion of the parotid gland, it is joined by the maxillary vein from the infratemporal fossa. The union of these two vessels forms the retromandibular vein before it exits the parotid at its inferior pole to join the common facial vein at the angle of the mandible. In addition to joining the common facial vein, the retromandibular vein also anastomoses with the external jugular vein. In this manner the anterior and more lateral aspects of the face drain to both the internal and external jugular veins. The veins of the orbital region and lower portion of the forehead-scalp are tributaries of the ophthalmic veins within the orbital cavity. Usually there are superior and inferior branches of the orbital vein, which collect blood from the orbital region. These veins usually drain posteriorly through the apex of the orbit, becoming tributaries of the cavernous sinus.

The clinical significance of the venous drainage of the face is primarily the anastomosis of the superficial veins with vessels in the deep parts of the face and skull. Clearly, the anastomosis of vessels about the orbit with the cavernous sinus poses the potential for bacterial infection of the cavernous sinus and its disastrous sequelae: cavernous sinus thrombosis. Scalp vessels may also anastomose via emissary veins with other veins within the diploic space or with meningeal veins. Hence the possibility of osteomyelitis or meningitis exists from infections tracking along these particular vessels. In the central region of the face, the superficial veins also anastomose with vessels that are tributaries of the pterygoid venous plexus. While much of the blood flow in this plexus ultimately reaches the internal jugular veins, some of it may enter the base of the skull via emissary veins and, when bacteria are present, produce encephalitis or meningitis. While surface infections of the skin of the face or scalp may be the focus of such events, another common mechanism is sinusitis. The complications of meningitis following frontal sinusitis, or of orbital cellulitis following ethmoid sinusitis, are all well documented in the clinical literature.

Facial Lymphatics

The lymphatic drainage of the face occurs via several routes. The lower lip and skin of the chin drain inferiorly to submental and submandibular nodes that drain to second echelon nodes located in the superior aspect of the internal jugular chain. Lymphatic channels from the medial central face, such as the upper lip, nasal vestibule, external nose, medial cheek, canthus, and the skin of the glabella, drain to submandibular lymph nodes and then to second echelon nodes in the internal jugular chain. The most prominent lymphatic channel draining the medial central face is the facial chain, which parallels the facial artery. This chain contains the perifacial lymph nodes located on either side of the facial artery located along the inner aspect of the body of the mandible. These nodes may become involved with metastases from midfacial skin cancer, and their enlargement may be missed on clinical examination if bimanual palpation of the floor of the mouth is not done. The forehead, the frontal and temporal scalp, the skin of the temple, the eyelids, and the lateral cheek drain into periparotid lymph nodes and then to second echelon nodes in the internal jugular vein. The parotid nodes are located both superficial and deep to the parotid fascia, and a few are in intraglandular locations. Reactive and neoplastic enlargement of the parotid nodes may occur and thus must be considered in the differential diagnosis of a parotid mass.

The lymphatics of the parietal and occipital scalp and postauricular skin drain to postauricular and suboccipital lymph nodes with secondary drainage to the upper spinal accessory chain. The auricle represents a "watershed" area, draining anteriorly to the parotid nodes and posteriorly to the postauricular nodes. Thus, melanomas or other cutaneous malignancies of the external ear may drain to either or both of the nodal groups.