



Anatomical Considerations for Botulinum Toxin Injections

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A good mastery of anatomy is very important in minimally invasive procedures. Botulinum toxin injection is the most common procedure in the field of esthetic. To inject botulinum toxin properly, a mastery of the facial muscles is essential. In this chapter, we shall describe the location of facial muscles and important factors to consider during botulinum toxin injection. We shall also describe glands of the face where botulinum toxin is injected for volume reduction.

2.1 Muscles of the Face

Botulinum toxin injections are most frequently performed on weakening expression muscles and masticatory muscles. Thus, having a knowledge of facial muscle anatomy is essential for the injection. It is worth noting that there exist some anatomical variations between different individuals. Doctors should therefore remember the approximate location of each facial muscles including individual variations. Important muscles of the face include the following (Fig. 2.1):

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2.1.1 Frontalis Muscle

The frontalis muscle is located at the forehead and usually functions in lifting the eyebrows. Its antagonist muscles are the procerus, corrugator supercilii, depressor supercilii, and orbicularis oculi muscles. Its fibers run from the galea aponeurotica to the occipital muscle at the occipital area. It extends to the superficial temporal fascia laterally to form the superficial temporal septum (STS) between both structures. The lateral side of the frontalis muscle tends to extend over the STS. Therefore, a full injection should be administered at the lateral side (Fig. 2.2). Otherwise, only the lateral frontalis muscle will be able to contract resulting in a condition called “samurai eyebrow” (in oriental culture) or “Mephisto eyebrow” (in western culture) [1].

A few years ago, some reports suggested that the bifurcation of the frontalis muscle occurred nearly 3.5 cm above from the superior orbital rim. Reports suggested that there are no fibers of the frontalis muscle at the upper and medial portion, thus implying that botulinum toxin injection is useless in these regions. However, recent reports suggest that there are cases where the bifurcation is located higher above and that even though there is no muscle in the gross view, there are muscle fibers histologically. Consequently, it is recommended to also perform botulinum toxin injection in the upper medial portion (Fig. 2.2) [2].

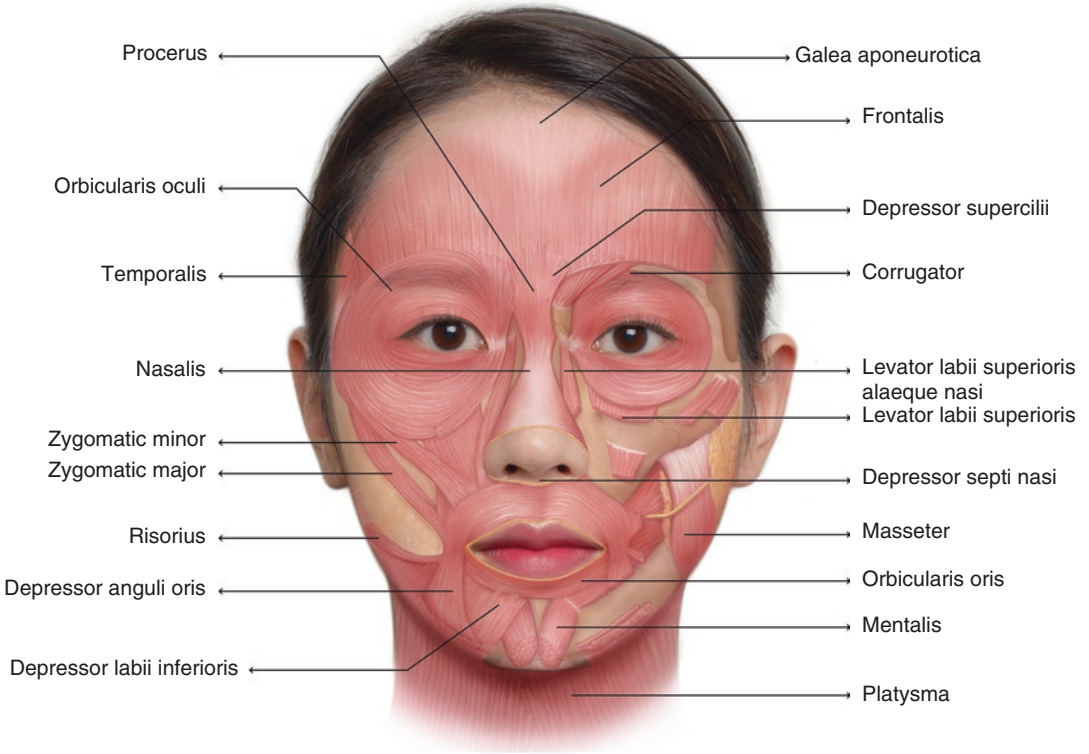


Fig. 2.1 Muscles of the face

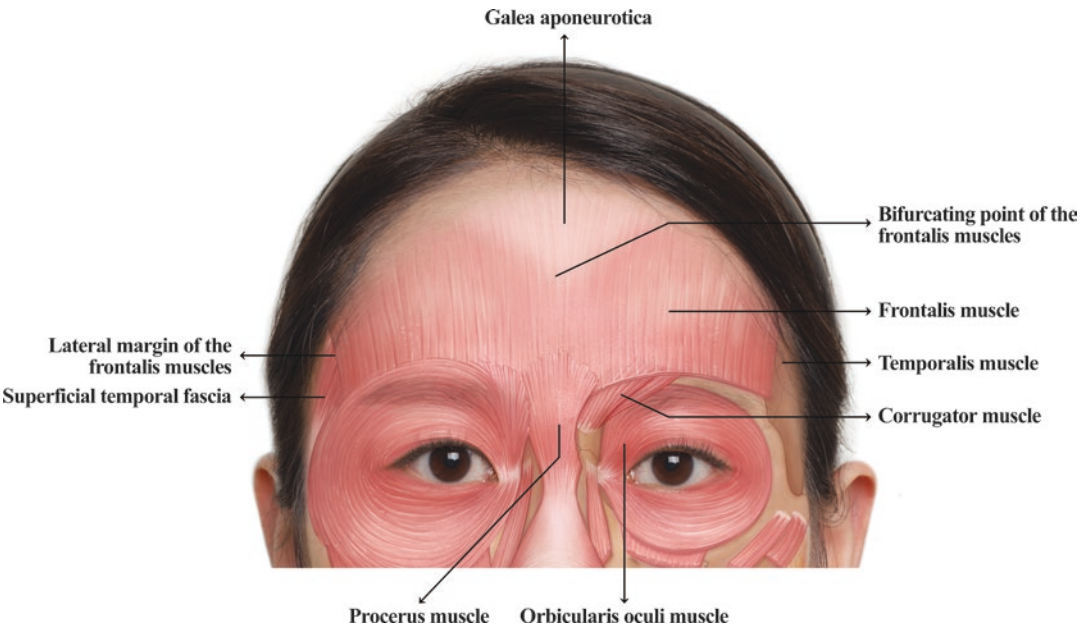


Fig. 2.2 Muscles of the forehead region

The depth of the injection should be determined. The frontalis muscle is usually located about 3–5 mm below the skin. Its width is variable, so it is better to tell the patient to wrinkle his forehead before administering the injection. The frontalis muscle is the only muscle that raises the eyebrows. Thus, a complete block might result in severe eyebrow ptosis. Recently, beginning with lower doses of botulinum toxin for the initial injection and providing additional doses subsequently based on the need has been recommended.

2.1.2 Corrugator Supercilii Muscle

The frowning vertical wrinkle look at the glabella is achieved by the deepest depressor muscle, which is the corrugator supercilii muscle. This muscle can be divided into a transverse and an oblique head, but what is most important is the pattern of the wrinkles on the skin surface. The wrinkles appear when frowning for the first time; then repetitive movement of the muscle can result in scars that resemble wrinkles. Once the wrinkle groove appears, it is not easy to solve the problem just by injecting botulinum toxin. It is therefore recommended to inject botulinum toxin in a dynamic wrinkle state (Fig. 2.3) [3].

The medial part of the corrugator supercilii muscle originates about 2.9 mm lateral from mid-line and 9.8 mm above the nasion. It runs in the upward lateral direction to attach to the skin surface. There are interpersonal variations in the muscle’s insertion point, but the latter could be estimated by following the skin dimpling when the patient is asked to frown. The muscle’s location is approximately lateral to the skin dimpling. The portion of the muscle with the greatest thickness is about 2–3 mm thick and is located between the medial canthal line and the mid-pupillary line (Fig. 2.4).

When administering botulinum toxin injection in the corrugator muscle, the doctor should consider the “gliding plane” (the space between the muscle and periosteum). Botulinum toxin can

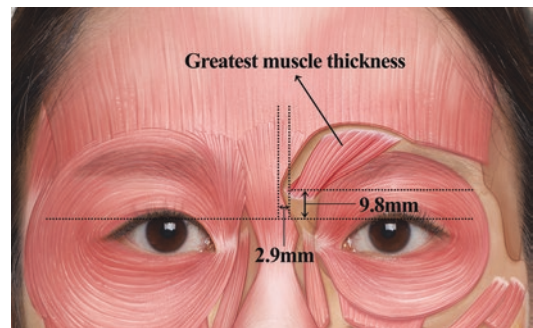


Fig. 2.4 Position and muscle thickness of corrugator supercilii muscle

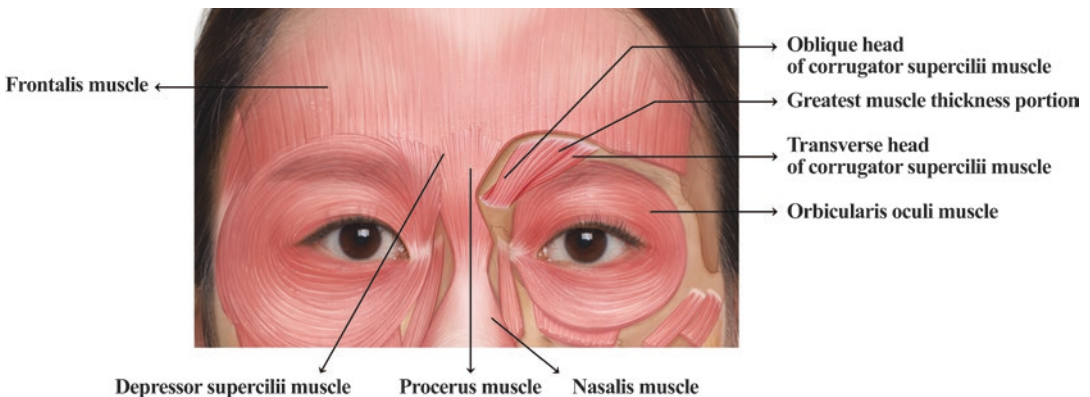


Fig. 2.3 Muscles of the glabellar region

diffuse into this space when it is administered deeper beneath the muscle. From this space, it could spread to the adjacent levator palpebrae superioris muscle and cause blepharoptosis. It is therefore recommended to avoid deep injections of botulinum toxin at the level of the corrugator supercilii muscle.

2.1.3 Procerus Muscle

A vertical wrinkle on the glabellar region is usually achieved by the corrugator; furthermore, a horizontal wrinkle is the action of the procerus muscle. The procerus muscle originates from the nasal superficial musculoaponeurotic system (SMAS) and inserts on the inter-eyebrow skin. It runs from the supraorbital rim level to the medial canthal line or nasion level (Fig. 2.3) [4]. A more specific mastery of the anatomy (location and thickness) of the corrugator and procerus muscles is important because both muscles are relatively smaller compared to the frontalis muscle.

2.1.4 Orbicularis Oculi Muscle

The orbicularis oculi muscle can be divided into the orbital, preseptal, and pretarsal portions. Clinically, it functions in closing the eye and plays an important role in controlling facial expressions around eyes. Crow's feet develops when the orbicularis oculi muscle contracts. When an individual smiles, the pretarsal portion crumbles and assumes full thickness. Botulinum toxin can be administered to treat crow's feet or wide pretarsal fullness (Fig. 2.5) [5].

Anatomical and histologic studies have shown that the functioning of the orbicularis oculi is not affected by the aging process. Eyelid movement is like an involuntary movement, and it occurs more than a thousand times in a single day. As the aging process develops, the orbicularis oculi muscle still contracts, unlike its antagonist muscles whose function decreases, causing the lateral eyebrow to descend.

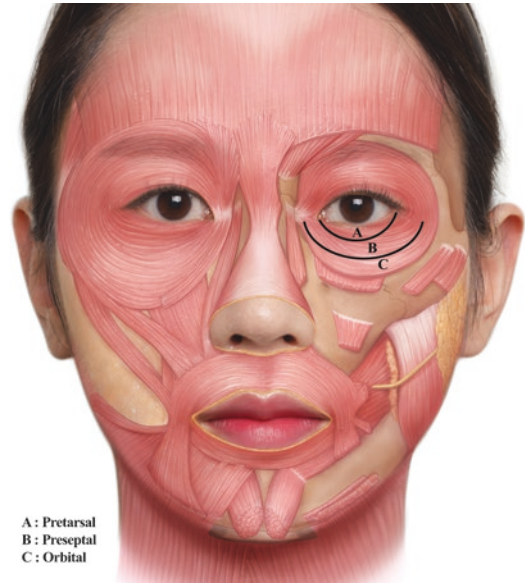


Fig. 2.5 Three divisions of the orbicularis oculi muscle

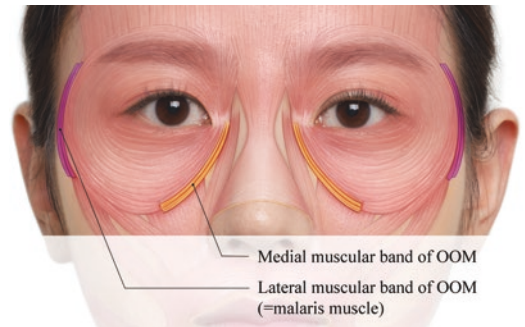


Fig. 2.6 Medial and lateral muscular bands of orbicularis oculi muscle

The medial muscular band of the orbicularis oculi muscle can be seen when it is hyperactive and the skin is thin. When this muscle is hyperactive, filler injection at the tear trough area cannot solve the problem because of muscle lumpiness. In this case, botulinum toxin can be helpful [6].

There is also a lateral muscular band, also called the “malaris muscle.” Sometimes, this muscle extends laterally to the zygomaticus major muscle. However, this lateral band usually runs more superficially and can therefore be distinguished from the zygomaticus major muscle (Fig. 2.6) [7].

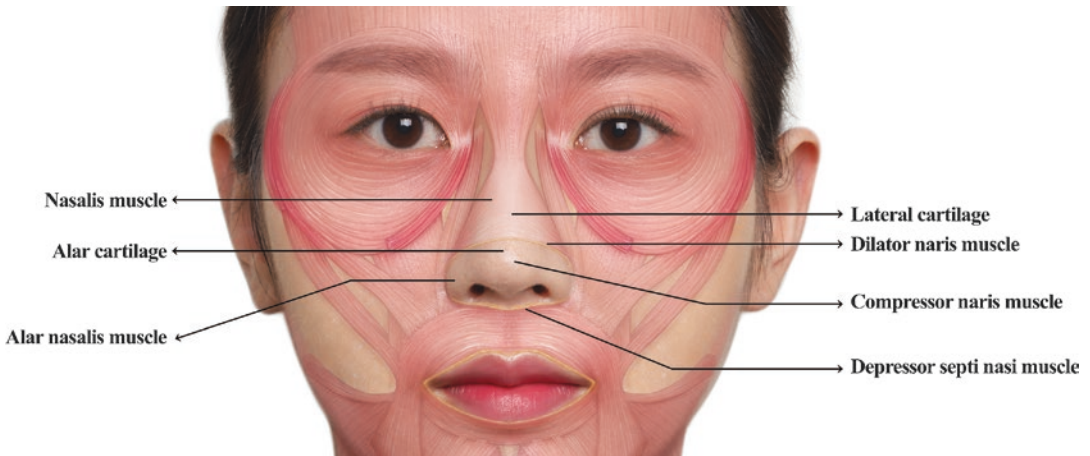


Fig. 2.7 Muscles of the nasal region

2.1.5 Nasalis Muscle

The nasalis muscle causes oblique wrinkles on the nose. It can be divided to alar and transverse parts. The transverse parts extend upward to connect to the procerus muscle (Fig. 2.7) [8].

2.1.6 Depressor Septi Nasi Muscle

It originates from the incisive fossa of the maxilla and inserts on the nasal septum at the base of the nose. Gummy smile is related to this muscle, and botulinum toxin injection can improve this condition (Fig. 2.8) [9].

2.1.7 Levator Labii Superioris (LLS) Muscle

The LLS originates from the lower portion of the arcus marginalis and inserts on the mid-upper lip portion. It is more deeply located than the orbicularis oculi muscle. The levator labii superioris alaeque nasi (LLSAN) is located medial to the LLS muscle; however, the zygomaticus minor and zygomaticus major muscle are located laterally. Clinically, the LLS muscle elevates the medial part of the upper lip. Therefore, botulinum toxin can be injected into this muscle to decrease gummy smile (Fig. 2.8) [10].

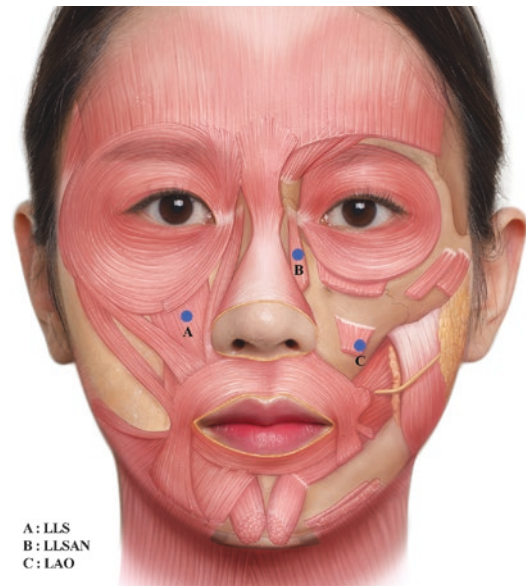


Fig. 2.8 Lip elevator muscles (medial parts)

2.1.8 Levator Labii Superioris Alaeque Nasi Muscle

The LLSAN muscle is located superficially to the LLS muscle and lines the lateral border of the nose. It originates from the lateral portion of the intercanthal area and inserts on the medial part of the upper lip (Fig. 2.9) [10].



Fig. 2.9 Lip elevator muscles (lateral parts)

2.1.9 Levator Anguli Oris (LAO) Muscle

The LAO muscle originates from the canine fossa and inserts on the lateral part of the upper lip. Unlike the LLS muscle, which originates from the lateral portion and inserts on the medial upper lip, the LAO muscle originates from the medial portion and inserts on the lateral upper lip. The LAO muscle is more deeply located compared to the LLS, zygomaticus major, and zygomaticus minor muscles (Fig. 2.8) [10].

2.1.10 Zygomaticus Major and Minor Muscles

Both muscles act to pull up and laterally the corners of the mouth. The zygomaticus minor muscle is located on the virtual line running from the lateral canthal area to the mouth corner; however, the zygomaticus major muscle is located on the crossline of vertical lines from the lateral canthal area and horizontal lines from nasal base (Fig. 2.9).

It is reported that 30% of the human population have a variation (a bifurcation) of the zygomaticus major muscle [11]. The zygomaticus major and minor muscles are very important muscle involved in the smiling process; thus botulinum toxin injection is not recommended. However, when there is an asymmetry caused by an ipsilateral hyperactivity, injection is usually considered.

2.1.11 Risorius Muscle

The risorius muscle pulls the mouth corner laterally. Its location varies between individuals of different races. When the muscle inserts on the upper lip part, the smiling appearance is more visible (Fig. 2.9) [12]. It originates from the fascia of the parotid gland and inserts on the corner of the mouth. Consequently, when botulinum toxin is injected too superficially for masseter reduction, the risorius muscle can be affected [9].

2.1.12 Depressor Anguli Oris (DAO) Muscle

The DAO muscle originates from the mandible and inserts on the mouth corner. This muscle pulls down the mouth corner. The superficial (skin) location of the insertion point of the DAO muscle is important as it is at the labiomandibular fold, together with the insertion points of the zygomaticus major and platysma muscles. The exact location of DAO is still controversial, but it is recommended to inject botulinum toxin in the point located 1 cm lateral to and 1 cm below the mouth corner (Fig. 2.10) [13].

2.1.13 Mentalis Muscle

The mentalis muscle originates from the mandible mentum and inserts on the skin of the chin. It consists of two fibers separated by the midline of the face. When the muscle contracts, the chin skin moves upward and assumes a “cobblestone appearance” (Fig. 2.10) [14].

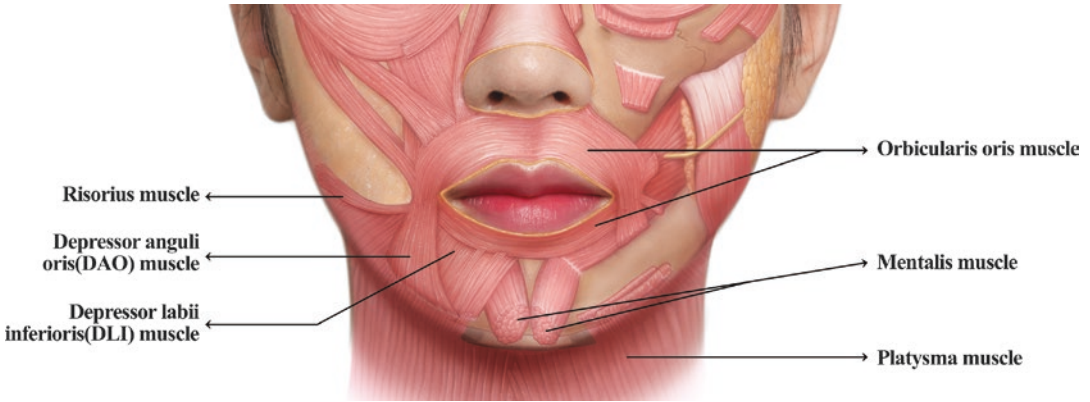


Fig. 2.10 Muscles of the perioral region

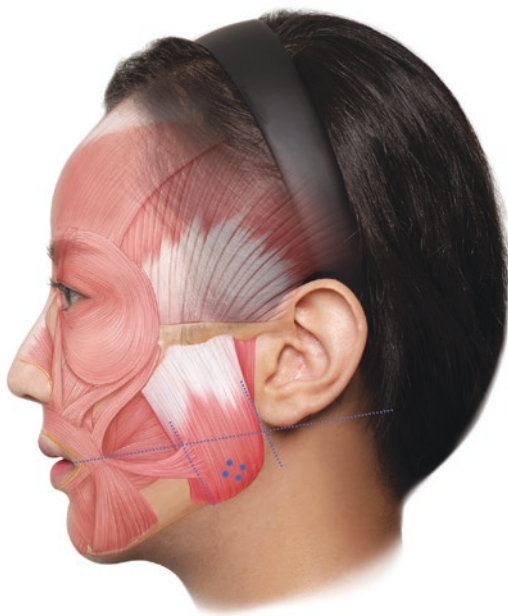


Fig. 2.11 The two layers of the masseter muscle and toxin injection points

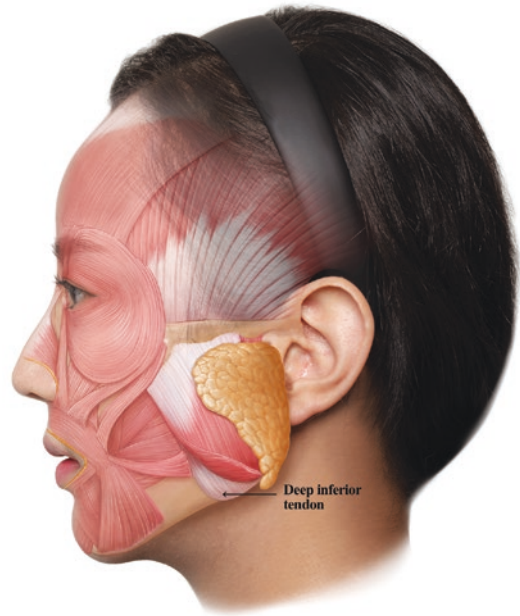


Fig. 2.12 Deep inferior tendon between the layers of the masseter muscle

2.1.14 Masseter Muscle

Masseter muscle botulinum toxin injection is one of the most common procedures in Korea. The masseter muscle is often divided into three parts: a superficial layer, an inferior layer, and a deep inferior tendon (DIT) (located in between the two previous layers) (Fig. 2.11) [15].

The DIT is an important structure that causes paradoxical masseter muscle bulging. When botulinum toxin is injected only in the deep layer of the

muscle, paradoxical bulging of the superficial layer can occur. In such a case, an additional injection is needed in the superficial layer (Fig. 2.12) [16].

2.2 Parotid and Submandibular Glands of the Face

Recently, with the increased use of botulinum toxin injections, a good knowledge of the anatomy of the parotid glands became of paramount impor-

tance. The parotid gland is known to be bordered superiorly by the zygomatic arch, posteriorly by the earlobe, and inferiorly by the mandibular border. However, in cases of parotid gland hypertrophy, the gland tends to be located more posteriorly to the mandibular ramus. The masseter muscle does not usually cross the mandibular border and is therefore distinguishable (Fig. 2.13) [17].

The parotid gland is divided into a superficial and a deep lobe, with the facial nerve running between the two lobes. There could also exist an accessory parotid gland near Stensen's duct area. The parotid gland is a deeply located structure, which is covered by the deep fascia of the SMAS. The gland's capsule wraps its parenchyma. Therefore, when injecting botulinum toxin into the parotid gland, the parotid capsule might offer some resistance. This sometimes occurs during masseter muscle injection as there are situations where the parotid gland surrounds the masseter muscle [18].

The submandibular gland is usually located on the posterior 2/3 of the mandible border (Fig. 2.13).

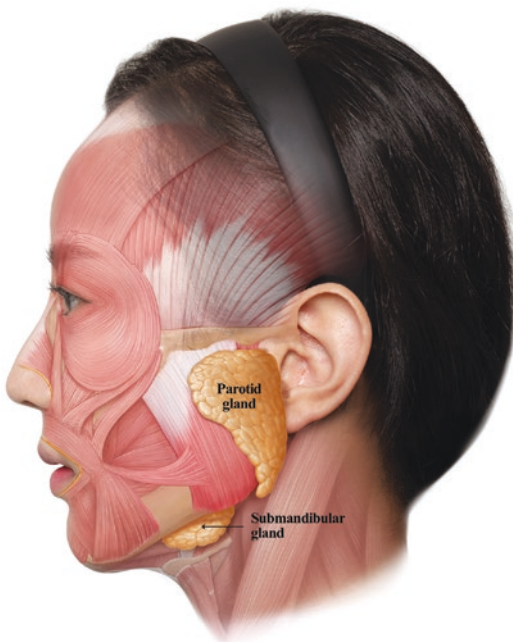


Fig. 2.13 Position of parotid and submandibular glands

Submandibular gland hypertrophy can be detected on the surface of the face. It is also deeply located and surrounded by deep fascia. The mylohyoid muscle passes through the submandibular gland. Therefore, care should be taken to avoid swallowing disturbances, when injecting botulinum toxin [19].

2.3 Vessels of the Face

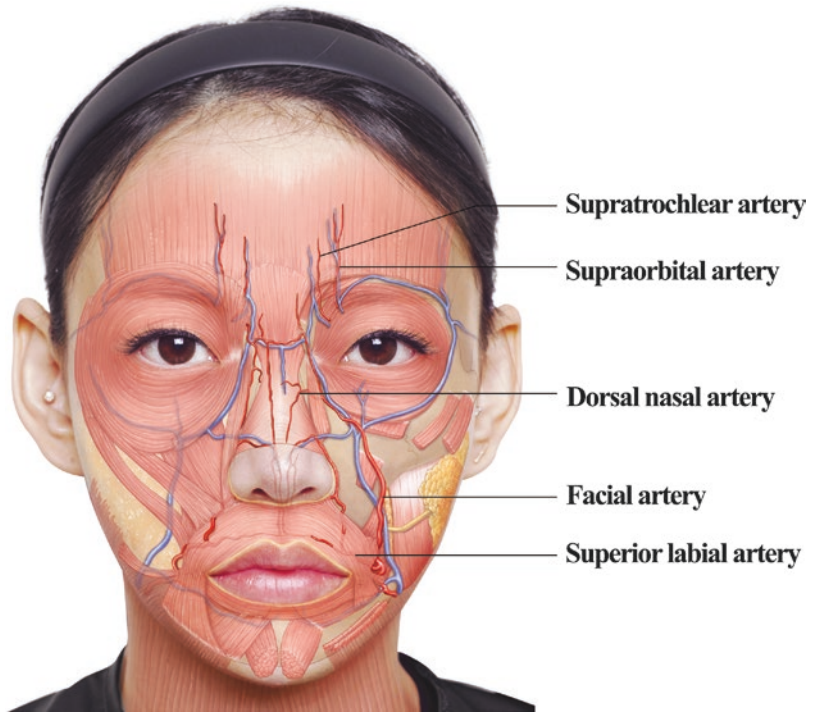
Botulinum toxin injection hardly causes vascular problems. Filler injection can cause arterial embolism and serious complications such as skin necrosis and ocular complications. However, even when botulinum toxin gets into vessels, it does not cause systemic problems. Hence, bruising might be the only vascular complication of botulinum toxin injection. Botulinum toxin is usually administered by needle injection, and even though the doctor may know the anatomy of vessels, it is impossible to detour all variations. Nonetheless, the main facial vessels are easily identifiable.

The facial artery passes between the middle of the inferior border of the mandible and the antegonial notch and runs to the upper medial portion of the face (Fig. 2.14).

Where the artery runs near the mandible area, it is deeply located and therefore safe [20]. For example, when injecting botulinum into the DAO muscle, vascular injury hardly occurs since the muscle is superficially located. Near the nasolabial fold area, the facial artery gives multiple branches to the nose and lips [21]. These branches tend to run superficially, so care should be taken when injecting the LLSAN muscle [22].

Bruising usually is a consequence of venous rather than arterial injury. During crow's feet correction procedures, bruising occurs quite often. The intercanthal vein can be ruptured when administering botulinum toxin injection. Veins are easily detectable in the supine rather than upright position, so careful inspection is needed [23].

Fig. 2.14 Facial artery pathway



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