Anatomy of the Neck

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Editor Commentary: Garrett Wirth was the first resident to rotate with me in the new plastic surgery training program at the Aesthetic and Plastic Surgery Institute at the University of California, Irvine. I asked him to write about neck anatomy because I knew that he would take a dry subject and bring it to life. His important contribution sets the stage for safely treating the aging neck by understanding what structures lie beneath the skin. The danger zones can be avoided after reading and digesting this important subject.

THE NECK AND ITS DIVISIONS

The neck is the region of the body between the clavicle and the mandible. It contains several vital structures (described later) and serves to separate the head from the torso. This discussion begins by describing the divisions of the neck and their contents. Subsequently, the layers of the neck are discussed and, finally, relevance with regards to surgery. Naturally, risks of complications are increased with secondary and tertiary surgeries.

Generally, the neck is clinically divided into an anterior triangle and posterior triangle. The anterior triangle is further divided into 4 smaller triangles as follows:

Anteriorly: the midline of the neck from the sternal notch to the chin
Posteriorly: the anterior margin of the sternocleidomastoid muscle
Superiorly: the mandible’s inferior border

The anterior triangle is further divided into 4 smaller triangles as follows:

Submental triangle (also known as suprathyroid triangle) is bordered by the hyoid bone inferiorly, anterior belly of the diagastric posterior/anteriorly, and the midline of the neck anteromedially. Its floor is formed by the mylohyoid muscle. This triangle contains submental lymph nodes and veins that subsequently join to form the anterior jugular veins. These veins are only at risk with very deep dissection; thus, injury is unlikely.

Submandibular triangle (also known as the digastric or submaxillary triangle) is bordered by the anterior and posterior bellies of the diagastric muscle inferoanteriorly and inferoposteriorly, respectively. The superior aspect is bordered by the lower border of the mandible. This triangle contains the submandibular gland, facial vein and artery branches, and marginal mandibular branch of the facial nerve. The location of these structures deep to the platysma is significant during any neck operation. The location of the gland is relevant to any rejuvenation procedure involving the face/neck. The facial vein and artery must be protected for obvious reasons and damage to the marginal mandibular nerve has obvious deficits.

Carotid triangle (also known as the superior carotid triangle) is bordered by the anterior

KEYWORDS
- Neck anatomy • Plastic surgery • Neck lift

KEY POINTS
- Surgery of the neck is commonly performed by Plastic Surgeons.
- Neck anatomy and the location of important structures should be well known prior any neck surgery.
- Risks of complications are increased with secondary and tertiary surgeries.
border of the sternocleidomastoid posteriorly, superiorly by the posterior belly of the digastric and the stylohyoid muscle, and anteriorly by the omohyoid muscle. Its floor is formed by the middle and inferior pharyngeal constrictors, the hyoglossus, and the thyrohyoid. This triangle contains several important nerves, arteries, and veins. The nerves include branches of the facial nerve, cutaneous nerves, hypoglossal nerve, vagus nerve, sympathetic trunk, accessory nerve, and internal branch of the superior laryngeal nerve. The arteries include the superior aspect of the common carotid artery and its bifurcation into the external and internal carotids. The external carotid branches in this triangle include the superior thyroid artery, lingual artery, facial artery, occipital artery, and ascending pharyngeal artery. The veins contained in this space are the internal jugular vein (lateral to the common and internal carotid arteries) and corresponding veins to the external carotid artery—which drain into the internal jugular artery. This area is thus high risk, and great care has to be taken in this region with certain maneuvers.

Muscular triangle (also known as the inferior carotid triangle): this is bordered by the midline of the neck, the anterior aspect of the sternocleidomastoid posteriorly, and the superior belly of the omohyoid superoposteriorly. It contains supraclavicular nerve branches and the sternohyoid and sternothyroid muscles—which lie over the common carotid artery, the internal jugular vein, vagus nerve, branches of the ansa cervicalis, inferior thyroid artery, recurrent laryngeal nerve, sympathetic trunk and the esophagus, thyroid gland, and trachea medially.

**Posterior**

The posterior triangle of the neck is bordered by the following: anteriorly—posterior border of the sternocleidomastoid; posteriorly—anterior border of the trapezius; inferiorly—middle third of the clavicle; and apex—nuchal line of the occipital bone.

The posterior triangle of the neck is further divided into the following two triangles by the inferior belly of the omohyoid muscle: occipital triangle and subclavian triangle (or supraclavicular triangle). The posterior triangle of the neck contains several important nerves, muscles, vessels, and lymph nodes. These include

- Spinal accessory nerve
- Branches of the cervical plexus
- Roots and trunks of the brachial plexus
- Phrenic nerve
- Subclavian artery
- Transverse cervical artery
- External jugular vein
- Inferior belly of the omohyoid
- Scalene muscles
- Splenius muscle
- Levator scapulae muscle
- Occipital and supraclavicular lymph nodes

Dissection above this level is safe and dissection below should be carried out on the deep aspect of the muscle.

The neck, enclosed by skin and underlying fascia, has its fascia divided into superficial and deep cervical fascia.

**THE MUSCLES OF THE NECK**

**The Platysma**

The platysma is a thin sheet-like muscle that originates from the fascia over the pectoralis and deltoid below the clavicle. Superiorly, it inserts at the base of the mandible, orbicularis, and angle of the mouth. The blood supply consists of a dominant pedicle (a branch off of the submental artery) and a minor pedicle (branching off of the suprascapular artery). The platysma is innervated by the cervical branch of the facial nerve. It functions to draw inferiorly the corners of the mouth and lower the lower lip as well. The activity of the platysma can be deceptive as the mouth can move—thus, injuries to the marginal mandibular nerve should still be considered. When the teeth are clenched it pulls the skin of the neck superiorly.

The anatomy of the platysma varies. There are 3 main categories of the anatomic platysma variation involving its decussation. Type I is the most common, occurring in 75% of patients—this involves decussation extending up to 2 cm below
the mandibular symphysis. Type II occurs in 15% of cases and the decussation is from the mandibular symphysis to the thyroid cartilage. Type III is having no decussations occurring—this occurs in approximately 10% of patients. The platysma is a significant contributor to the appearance of the aging neck; thus, reshaping of the platysma results in dramatic cosmetic changes. Multiple surgical techniques have been utilized to make cosmetic changes to the platysma. Many of these techniques will be discussed throughout this edition of Clinics in Plastic Surgery.

The Sternocleidomastoid

The sternocleidomastoid muscle originates from the sternal manubrium and medial aspect of the clavicle and attaches to the mastoid process of the temporal bone and superior nuchal line. It is supplied by the occipital artery and superior thyroid artery. It functions to flex the neck (when both sides are activated), extends the head, and rotates the head. It is also an accessory muscle of inspiration. The motor component of the muscle is from the accessory nerve and the sensory innervation is from the cervical plexus. The variation in this muscle is the extent of its origination off of the clavicle, an attachment that may be as much as 7.5 cm. Dissections over this muscle posteriorly must be carried out with care to avoid the great auricular and spinal accessory nerves.

The Trapezius

The trapezius is a large muscle that originates in the occipital protuberance and medial superior nuchal line and attaches at the lateral third of the clavicle, acromion process, and spinous processes of C7-T12. It functions to shrug the shoulders (elevation of the scapulae) as well as to rotate, depress, and retract the scapulae. It is a significant component of maintaining posture and works with different muscle groups to allow throwing (with the deltoid) and various scapular movements (ie, with the serratus and rhomboids). The main motor component is supplied by the spinal accessory nerve (cranial nerve XI), and minor motor and sensory components are supplied by cervical spinal nerves C3 and C4. The main artery supplying the trapezius is the superficial branch of the transverse cervical artery, or the superficial cervical artery, and in 20% the subclavian artery. This is rarely of importance for correction of the neck, but the nerves are still at risk.
The Suprahyoid Muscles (Which Function to Elevate the Hyoid)

Digastric
The digastric muscle is made up of an anterior belly, which originates from the digastric fossa in the inner surface of the mandible and attaches to the hyoid bone, and a posterior belly, which originates from the mastoid process of the temporal bone and attaches to the hyoid bone. The blood supply of the anterior belly is from the submental branch of the facial nerve and the blood supply of the posterior belly is from the occipital artery. The nerve supply of the anterior belly is a branch of the mandibular division of the trigeminal nerve (the mylohyoid nerve) and the posterior belly is supplied by the facial nerve. The anterior belly of the digastric muscle has been of significant interest to many plastic surgeons. Various dissection and surgical techniques are discussed throughout this edition of Clinics in Plastic Surgery.

Mylohyoid
The mylohyoid originates from the mylohyoid line of the mandible and attaches at the hyoid bone and median raphe. The nerve supply is a branch of the mandibular division of the trigeminal nerve (the mylohyoid nerve) and the posterior belly is supplied by the facial nerve. The anterior belly of the digastric muscle has been of significant interest to many plastic surgeons. Various dissection and surgical techniques are discussed throughout this edition of Clinics in Plastic Surgery.

Geniohyoid
The geniohyoid muscle originates from inferior mental spine of the mandible and inserts at the hyoid bone. The nerve supply is C1 traveling with the hypoglossal nerve (cranial nerve XII).

The Infrahyoid Muscles (Which Function to Depress the Hyoid)

Sternohyoid
The sternohyoid is a paired muscle originating at the sternum and attaching at the hyoid. It is innervated by the ansa cervicalis (C1-C3) and the blood supply is from the superior thyroid artery.

Sternothyroid
The sternothyroid, wider and shorter in length than the sternohyoid, originates at the sternal manubrium and attaches at the thyroid cartilage. It is innervated by the ansa cervicalis (C1-C3) and the blood supply is from the superior thyroid artery.

Thyrohyoid
The thyrohyoid originates at the thyroid cartilage and attaches at the hyoid bone. It is innervated by C1 via the hypoglossal nerve and its blood supply is from the superior thyroid artery.

Omohyoid
The omohyoid originates from the scapula and attaches at the hyoid bone. It has 2 muscle bellies separated by a tendon. After arising from the scapula, it passes behind the sternocleidomastoid. Its tendon is surrounded and held in place by the deep cervical fascia. It is innervated by the ansa cervicalis (C1-C3).

THE LYMPH NODES

There are an estimated 300 lymph nodes in the neck. Several classification systems exist for cervical lymph nodes. The nodes are often classified by levels and/or regions as follows:

Classification by levels
- Level Ia: submental triangle
- Level Ib: submandibular triangle
- Level II: upper jugular nodes
- Level III: middle jugular nodes
- Level IV: lower jugular nodes
- Level V: posterior triangle nodes
- Level VI: anterior triangle nodes
- Level VII: upper mediastinal nodes
Classification of nodes by region
Deep lymph nodes: submental and submandibular nodes
Anterior deep cervical nodes: prelaryngeal, thyroid, pretracheal, and paratracheal nodes
Deep cervical lymph nodes: lateral jugular, anterior jugular, and jugulodigastric nodes
Inferior deep cervical lymph nodes: jugulomyoid and supraclavicular nodes

When operating on the neck, superficial lymph nodes are encountered (deep nodes are usually not encountered in aesthetic surgery). In general, they should not affect an operative plan, unless they seem abnormal. In the cases in which a lymph node seems abnormal, excisional biopsies should be performed and location of the node clearly documented. These lymph nodes are mostly encountered in the retroauricular and submental areas.

THE SUBMANDIBULAR GLAND

The submandibular glands are under each side of the mandible and above the digastric muscles—located in the submandibular triangle. They receive blood supply from branches of the facial artery. The mylohyoid muscle divides the submandibular gland into a superficial and deep portion. Medial to the submandibular gland are the mylohyoid and hyoglossus muscles as well as the lingual and hypoglossal nerves. Lateral to the gland are the platysma, mandible, and cervical branches of the facial nerve, which supplies the platysma and gives branches to the cervical cutaneous nerve. It is important to understand these relationships and possible variations before undergoing any resection. Superficial partial excisions are part of some aesthetic neck surgeries.

BLOOD SUPPLY OF THE NECK
Arteries

The neck and face are well-vascularized areas (see Figs. 2 and 3). The blood supply of the neck is based mainly on the external carotid artery and its branches. The external carotid artery, beginning at the upper border of the thyroid cartilage, gives off the superior thyroid artery, ascending pharyngeal artery, lingual artery, facial artery, and occipital artery (from inferior to superior) in the carotid triangle (described previously). Subsequently, it gives off the posterior auricular artery before forming its terminal branches, the maxillary artery, and superficial temporal artery. These are at risk with aggressive dissection but generally easy to identify.

The facial artery takes off superior to the lingual artery above the hyoid bone. It courses posterior to the submandibular gland along the medial aspect of the ramus of the mandible. It gives off the submental artery prior to running along the lower aspect of the mandible anterior to the masseter. It is important to note its location just underneath the platysma because it is here that it is intersected by the marginal mandibular nerve. It then curves toward the oral commissure. The facial artery subsequently becomes a major contributor to the facial soft tissues.

The submental artery (branching off of the facial artery) runs along the mylohyoid muscle below the body of the mandible. It then courses toward the chin and forms a network of arteries with the inferior labial and mental arteries.

The posterior auricular artery takes off just above the digastric muscle and courses between the ear and mastoid process. It divides into an auricular branch and occipital branch, which subsequently anastomoses with branches of the occipital artery branches. These are at risk during surgery but at low risk for complication.

Veins

The venous drainage system of the head and neck is made of an intricate network of vessels, knowledge of which is relevant to all facial and neck surgeries. This knowledge is required to avoid potential intraoperative and postoperative bleeding and edema and to avoid associated nerves and other structures. The veins of the neck are generally divided into a superficial and deep system.

Facial vein

The facial vein, after coursing through the face, crosses over the mandible and superficial to the submandibular gland and digastric muscle—coming to join the internal jugular vein posteriorly approximately at the level of the base of the mandible. The facial vein, along with all of the deep veins of the neck, drain into the internal jugular vein. These are generally not problematic during aesthetic surgery of the neck but more at risk with gland and digastric work.

Superficial veins

The superficial veins of the neck ultimately drain into the external jugular vein—which receives blood from the face and scalp. The external jugular vein is formed by the posterior facial vein and posterior auricular vein. It receives blood from several veins, including the posterior external jugular vein, transverse cervical vein, transverse scapular vein, anterior jugular vein, internal jugular vein, and,
occasionally, the occipital vein. It begins in line
with the angle of the mandible in the parotid gland
and runs along the posterior aspect of the sternocleidomastoid until the clavicle, where it drains into
the subclavian vein. The platysma lies on top of the
external jugular vein—and the superior portion of
the external jugular vein runs parallel with the great
auricular nerve. Knowledge of this anatomy is
imperative when dissecting deep to the platysma.

**Anterior jugular veins**
The anterior jugular veins are in the submandibular
area and are formed by several smaller veins in the
submaxillary region. These course along the
medial aspect of the strap muscles superiorly to-
ward the sternal notch until they drain into the
external jugular vein or subclavian vein. Again,
knowledge of this anatomy is imperative when dis-
secting deep to the platysma because there is a
propensity toward bleeding.

**SIGNIFICANT NERVES IN THE NECK**

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**Great Auricular Nerve**
The great auricular nerve provides sensory innerva-
tion to the skin over the parotid gland and mastoid
process and parts of the ear (see Figs. 2 and 3).
Made up of the second and third cervical nerves,
the great auricular nerve comes around from the
posterior aspect of the sternocleidomastoid and
ascends up toward the parotid gland. Subse-
quently, it divides into anterior and posterior
branches. Inferior to the ear it courses intimately
with the external jugular vein. The great auricular
nerve is the most likely nerve to be damaged during
a facelift—this is at approximately 6.5 cm inferior to
the tragus, where it courses over the sternocleido-
mastoid. Damage to this nerve may result in numb-
ness to the aforementioned areas and potential
neuroma development.

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**Cutaneous Cervical Nerve**
The cutaneous cervical nerve (transverse cervical
nerve or superficial cervical nerve) provides sen-
sory innervation to the anterior and lateral aspects
of the neck. Like the great auricular nerve, it too is
made up of the second and third cervical nerves. It
also comes around the posterior aspect of the ster-
nocleidomastoid (approximately in the middle part
of the muscle) and courses over the muscle under
the external jugular vein until it perforates the deep
cervical fascia and divides into two branches, the
ascending and descending branches—subse-
quently innervating the anterior and lateral aspects
of the neck. This division into ascending and de-
scending branches is deep to the platysma. The
sternocleidomastoid muscle is the reference point
for this nerve intraoperatively.

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**Greater Occipital Nerve**
The posterior scalp is innervated by the greater
occipital nerve—a branch of dorsal ramus of C2.
This nerve comes through the suboccipital trian-
gle, pierces the trapezius, and ascends to supply
the scalp. The lesser occipital nerve arises from
C2-3 (ventral ramus), courses along the posterior
aspect of the sternocleidomastoid muscle, and as-
ccends to supply the lateral aspects of the scalp
posterior to the ear. These nerves are not usually
problematic during aesthetic neck surgery.

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**Marginal Mandibular Nerve**
The marginal mandibular nerve is a branch of
cranial nerve VII (the facial nerve) and innervates
muscles of the lower lip and chin. The muscles
innervated by the marginal mandibular nerve
include the depressor labii inferioris, the depressor
anguli oris, and the mentalis. These muscles serve
to depress the bottom lip, depress and move the
corner of the mouth laterally, and protrude the
lower lip, respectively. Knowledge of the course
of the marginal mandibular nerve is important for
surgeons. It follows the mandibular border as it
courses laterally and anteriorly. It runs as low as
2 cm below the inferior border of the mandible
prior to crossing the facial vessels. Thus, if dis-
secting deep to the platysma, it is imperative to
remain at least 2 cm inferior to the mandible in
this area to avoid damaging the marginal mandib-
ular nerve.