2019

Session 5 - Head and Neck Surface Anatomy

SKMC Surface Anatomy

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Surface Anatomy Program
Session 5 — Head and Neck Surface Anatomy
Wednesday, January 9th or Wednesday, January 16th

Learning Objectives
1. Identify where to palpate the temporal, facial, carotid and subclavian arteries
2. List the 4 paranasal sinuses and be able to identify where they are located
3. Identify the boundaries of the anterior and posterior neck triangles
4. Identify the triangles within the anterior triangle of the neck
5. Know how to test the function of CN V and CN VI

Disclaimer — This is not intended to serve as a primary study guide for Anatomy or Clinical Skills exams. Surface Anatomy is a peer-taught mentoring program overseen by Dr. Spudich; however, the review sessions are primarily designed by Program Coordinators. The goal of review sessions is to highlight clinically relevant anatomical landmarks in order to reinforce lecture material. All review topics have been discussed in lecture; no new testable material will be introduced in these sessions.

Program Coordinators
Christina Stuart, Rachel Calautti, Nick Jennelly, Arianna Heyer, Rachel Fogley, and Alisha Maity
Contact Us: jmcsurfaceanatomy@gmail.com

Surface Anatomy Projections of the Head

1. **Vertex**: Highest point on the head; demarcates cervical (posterior) and trigeminal (anterior) innervation
2. **Pinna/Auricle**: Visible part of the ear
3. **Philtrum**: Vertical groove in midline between external nose and upper lip
4. **External acoustic meatus**: Canal from the outer ear to the middle ear
5. **Mastoid process**: Bony prominence posteroinferior to the pinna

**DISCUSSION QUESTION 1** — The mastoid process serves as the attachment point for what four muscles?

6. **External occipital protuberance**: Bony prominence in the middle of the occipital bone
7. **Zygomatic bone**: Forms part of the floor/lateral wall of the orbit
   a. **Zygomatic Arch**: Part of the temporal bone; extends from TMJ area to zygomatic bone
8. **Mandible**: three divisions
   a. **Head**: Part of the condyle that forms the TMJ joint; open/close the mouth to palpate
   b. **Coronoid**: Insertion site for the temporalis muscle
   c. **Angle**: Demarcates the body of the mandible from the ramus; insertion site for the masseter and medial pterygoid

**DISCUSSION QUESTION 2** — What two cranial nerves can be injured with fracture of the mandible?

9. **Supraorbital notch**: Groove at the medial margin of the orbit in the frontal bone; conveys the supraorbital nerve
10. **Infraorbital foramen**: Located ½ cm below the inferior margin of the orbit; conveys the *infraorbital* nerve, artery and vein; use and *infraorbital nerve block* during repair injury of cheek, upper lip, or maxillary incisor teeth

**Sinuses**

1. **Frontal**: Located above the eyes in the frontal bones

2. **Maxillary**: Largest sinuses; located under the eyes in the maxillary bones

3. **Ethmoid**: Clusters of ethmoid air cells within the ethmoid bone between the eyes/nose

4. **Sphenoid**: Located within the sphenoid bone (sella turcica) under the pituitary gland

**DISCUSSION QUESTION 3** — Which sinus is most often infected and why?

**Trigeminal Nerve (CNV)** — *sensory* innervation to the face + *motor* innervation to muscles of mastication

1. **CNV1 (Ophthalmic division)**: Test by having patient close their eyes and lightly stroking both sides of the forehead

2. **CNV2 (Maxillary division)**: Stroke both cheeks

3. **CNV3 (Mandibular division)**: Stroke anterior body of the mandible (lower jaw) on both sides

**Facial Nerve (CNVII)** — *motor* to muscles of facial expression + *taste* from the anterior 2/3rds of the tongue

1. Test by asking patient to raise eyebrows and smile

2. The parotid gland holds the facial nerve “hostage”, take care to isolate the nerve during excision of the parotid gland during a parotidectomy procedure

3. The five branches of the facial nerve are...
   1. Temporal
   2. Zygomatic
   3. Buccal
   4. Marginal Mandibular
   5. Cervical

**DISCUSSION QUESTION 4** — How do you differentiate between a peripheral and central cranial nerve VII lesion?

**Head Clinical Correlations**

1. **Epidural Hematoma**: Located within the dura mater at the pterion; caused by rupture of the *middle meningeal* artery with lateral blows to the head
   a. Signs and Symptoms: headache, nausea, vomiting, LOC with lucid interval, lens shape on imaging

**DISCUSSION QUESTION 5** — A blow to which part of the skull is mostly likely going to lead to an epidural hemorrhage and why?
2. **Subdural Hematoma**: Extravasated blood, typically venous in origin, splits open dural border cell layer (not a pre-existing space) at dura-arachnoid cell layer
   a. Signs and Symptoms: headache, nausea, vomiting, LOC, focal neurologic deficits, crescent shape on imaging

3. **Subarachnoid Hemorrhage**: Extravasation of blood into subarachnoid space (a true space); usually arterial origin; saccular aneurysm rupture is most common
   a. Signs and Symptoms: worst headache of life, LOC, AMS, nausea, vomiting, nuchal rigidity, CNIII palsy

**Arterial Pulses**
1. **Temporal**: Palpate the superficial temporal artery immediately anterior to ear and posterior superior to TMJ.

2. **Facial**: Palpate on the inferior border of the mandible, adjacent to anterior border of masseter muscle.

3. **Carotid**: Common/external carotid; palpate on the anterior triangle of the neck.

4. **Subclavian**: Palpate between the medial and middle third of the clavicle within the greater supraclavicular fossa

**Clinical Correlation**: If have severe bleeding of the upper limb, you can achieve immediate hemostasis by compressing the subclavian artery at its palpation point described above.

**DISCUSSION QUESTION 6** — When using the subclavian artery compression technique described above to achieve hemostasis, what structure are you compressing the artery against?

**Surface Anatomy Projections of the Neck**
1. **Thyroid notch**: In superior margin of thyroid cartilage

2. **Laryngeal prominence**: Inferior to thyroid notch
   a. Structure more prominent in men than women

3. **Cricoid cartilage**: At C6 vertebral level; inferior to soft depression that defines the cricothyroid ligament
   a. Cricothyroid ligament: Pierced during emergency cricothyrotomy

4. **Thyroid gland**: Usually more apparent if pathology is present (i.e. goiter)
   a. **Pyramidal lobe of thyroid gland**: If present can be found at midline (or crossing it) between skin and cricothyroid ligament
   b. **Isthmus of thyroid gland**: Inferior to cricoid cartilage; crosses trachea anteriorly; might be able to palpate upper part of trachea just superior to isthmus

**DISCUSSION QUESTION 7** — How do you properly palpate the thyroid on the physical exam?
5. **SCM**: Key muscular landmark of neck, dividing neck into anterior and lateral cervical regions (defines SCM region); superior attachment is mastoid process with two inferior attachments (heads) to the sternum and clavicle; visualize SCM by asking patient to rotate face toward contralateral side and lift the chin.

6. **EJV**: May be seen running vertically over SCM towards angle of the mandible.

7. **Greater supraclavicular fossa**: Depression overlying supraclavicular triangle; area to palpate subclavian artery.

**DISCUSSION QUESTION 8** — What can be palpated in the Greater Supraclavicular Fossa?

8. **Lesser supraclavicular fossa**: Between sternal and clavicular heads of SCM, covering inferior end of IJV; entry site for needle or catheter.

**DISCUSSION QUESTION 9** — Where is the importance of the Lesser Supraclavicular Fossa?

### Neck Triangles

1. **Anterior triangle boundaries**: the inverted triangle when looking at the neck in the coronal view
   a. **Apex** = Jugular notch in the manubrium (sternum)
   b. **Anterior** = Midline of the neck from the chin to manubrium
   c. **Base** = Inferior margin of the mandible to the angle of mandible
   d. **Posterior** = Anterior border of the SCM

**DISCUSSION QUESTION 10** — What four triangles can the Anterior Triangle of the Neck be divided into? What muscles separate these triangles?

**DISCUSSION QUESTION 11** — What is contained within the submental triangle? What are the contents of the muscular triangle?

2. **Carotid triangle**: Between posterior belly of digastric, superior belly of omohyoid, and SCM; Contains part of carotid sheath, carotid bifurcation, carotid sinus/body, initial branches of ECA.
3. **Posterior Triangle**: located in the lateral aspect of the neck, separated by the inferior belly of the omohyoid into the occipital and subclavian triangles
   a. **Apex** = SCM and trapezius meet at the superior nuchal line
   b. **Anterior** = Posterior border of the SCM
   c. **Base** = Middle third of the clavicle
   d. **Posterior** = Anterior border of the trapezius

Vertebral Levels
1. **C3**: Hyoid bone slightly superior
2. **C3-C4**: Bifurcation of the common carotid arteries into ECA and ICA
3. **C4**: Upper margin of thyroid cartilage
4. **C6**: Transition from the pharynx to the larynx/esophagus, level of inferior margin of cricoid cartilage

Neck Clinical Correlations
1. **Cricothyrotomy**: Emergency airway puncture; located in the midline between the thyroid notch (of the thyroid cartilage) and the cricoid cartilage
2. **Tracheostomy**: Transverse incision through skin of neck and ant wall of trachea between 1\(^{st}\)-2\(^{nd}\) or 2\(^{nd}\)-4\(^{th}\) rings of trachea to establish airway
3. **External Jugular Vein** – Barometer for venous pressure; more prominent with increased venous pressure
4. **Internal Jugular Vein Puncture** – Preferable to use right IJV (straighter). IV or central line placement directed lateral to the common carotid with the lesser supraclavicular fossa toward ipsilateral nipple.
5. **Subclavian Vein Puncture** – Entry point for central line placement
   a. Infraclavicular subclavian vein approach- place thumb of one hand on middle of clavicle and index finger on jugular notch of manubrium. Needle punctures skin inferior to thumb (middle of clavicle within infraclavicular fossa) and advance towards tip of index finger (manubrium) until tip enters right venous angle, post to sternoclavicular joint
6. **Thoracic Outlet Syndrome**: Neurovascular compression at the superior thoracic aperture, due to muscular or bony abnormalities; symptoms include pain, weakness and paresthesia of the arm and fingers (p85)
Case Based Learning

A 67-year-old man present to his physician with pain on swallowing and hoarseness. He has noted some swelling of the right side of his neck. The patient has smoked one pack of cigarettes per day since he was 15 years of age and drinks two beers nightly. Physical examination reveals a palpable neck mass and white plaques in his mouth.

What conditions should be considered in the differential diagnosis of a neck mass?

What is the most likely diagnosis?

What risk factors increase this patient’s likelihood of disease?

Which procedures can help confirm the diagnosis?

Where are the lesions of this condition commonly located?

What are the appropriate treatments for this condition?

Case 16 from Chapter 8: Hematology and Oncology of First Aid Cases for the USMLE Step 1, 3rd edition

General Practice Questions

1. The maxillary sinuses are
   a. Largest sinuses; located under the eyes in the maxillary bones
   b. Located above the eyes in the frontal bones
   c. Located within the sphenoid bone (sella turcica) under the pituitary gland.
   d. Clusters of ethmoid air cells within the ethmoid bone between the eyes/nose

2. The ______ is pierced during emergency cricothyrotomy
   a. Thyroid notch
   b. Laryngeal prominence
   c. Cricoid cartilage
   d. Cricothyroid ligament

3. The anterior triangle boundaries are comprised of
   a. Apex = SCM and trapezius meet at the superior nuchal line
      Anterior = Post. border of the SCM
      Base = Middle third of the clavicle
      Posterior = Ant. border of the trapezius
   b. Apex = Jugular notch in the manubrium (sternum)
      Anterior = Midline of the neck from the chin to manubrium,
      Base = Inf. margin of the mandible to the angle of the mandible,
      Posterior = Ant. border of the SCM.
   c. Between posterior belly of digastric, superior belly of omohyoid, and SCM

4. While performing a neuro exam on a patient, you note that she is able to sense touch on her forehead, unable to sense touch on her cheeks, and is able to sense touch on her jaw. Which cranial nerve might be damaged?
   a. CNVII - Zygomatic Division
   b. CNV2 - Maxillary Division
   c. CNVII - Buccal Division
   d. CNV3 - Mandibular Division
5. Inflammation of the ______ nerve as it exits the stylomastoid foramen may lead to ______
   a. Facial nerve / Bell’s Palsy
   b. Facial nerve / Horner’s Syndrome
   c. Trigeminal nerve / Bell’s Palsy
   d. Sympathetic Trunk / Horner’s Syndrome

6. Which of these vessels is ideal for a central line placement?
   a. External jugular vein
   b. Carotid artery
   c. Subclavian vein
   d. Aorta

7. A 24 year old man who was recently in a minor car accident presents to the ER with sharp, stabbing pain in his neck, shoulders, arms, and hands. One of his hands is noticeably cooler than the other. He denies chest pain. He claims to have experienced whiplash.
   a. Vasospasm or embolism
   b. Polymyalgia rheumatica
   c. Raynaud’s Syndrome
   d. Thoracic Outlet Syndrome

8. You’re examining a patient who’s neck veins are noticeably distended. This physical finding is significant for:
   a. Left sided heart dysfunction
   b. Portal hypertension
   c. Right sided heart dysfunction
   d. Cerebral edema

Step Style Practice Questions

1. A 33 year old woman presents to the emergency department complaining of pain behind her right ear since that morning. Neurological examination is notable for paralysis of the right side of her face, decreased taste sensation on the right side of her tongue and increased sensitivity to loud sounds in her right ear. The rest of her neurological examination is normal. In addition to the symptoms described above, this patient may also develop?
   A. Decreased sensation over her left upper cheek
   B. Decreased sensation over her right upper cheek
   C. Deviation of the uvula and soft palate to the left when the patient is asked to say “Ahh”
   D. Deviation of the uvula and soft palate to the right when the patient is asked to say “Ahh”
   E. Dryness in her left eye
   F. Dryness in her right eye

2. During an outbreak of meningitis at a local college, a 20-year old student presents to a hospital ED complaining of headache, fever, chills, and stiff neck. On examination, it appears that he may have meningitis and needs a lumbar puncture or a spinal tap. Cerebrospinal fluid (CSF) is normally withdrawn from which of the following spaces?
   A. Epidural space
   B. Subdural space
   C. Space between the spinal cord and the pia mater
   D. Subarachnoid space
   E. Space between the arachnoid and dura mater
3. A 42-year-old woman with metastatic breast cancer is known to have tumors in the intervertebral foramina between the fourth and fifth cervical vertebrae and between the fourth and fifth thoracic vertebrae. Which of the following spinal nerves may be damaged?
   A. Fourth cervical and fourth thoracic nerves
   B. Fifth cervical and fifth thoracic nerves
   C. Fourth cervical and fifth thoracic nerves
   D. Fifth cervical and fourth thoracic nerves
   E. Third cervical and fourth thoracic nerves

Discussion Question Answer Key

DISCUSSION QUESTION 1 — The mastoid process serves as the attachment point for what four muscles?
   1. sternocleidomastoid
   2. posterior belly of the digastric
   3. splenius capitis
   4. longissimus capitis

DISCUSSION QUESTION 2 — What two cranial nerves can be injured with fracture of the mandible?
   Hypoglossal and marginal mandibular nerve (branch of facial nerve)

DISCUSSION QUESTION 3 — Which sinus is most often infected and why?
   The maxillary sinus is the most commonly infected sinus. This is due the structure of the maxillary sinus. It has small ostia leading to the nasal cavity that are positioned high on the superior medial walls, leading to ineffective drainage.

DISCUSSION QUESTION 4 — How do you differentiate between a peripheral and central cranial nerve VII lesion?
   A patient with peripheral injury to cranial nerve VII will have ipsilateral paralysis of their upper and lower facial muscles. They will be unable to move their eyebrows. A patient with a central injury to cranial nerve VII will have contralateral paralysis of only the lower facial muscles. They will be able to move their eyebrows.

   A peripheral facial nerve palsy results from a lesion anywhere from the CN VII nucleus in the pons to the terminal branches in the face. This leads to a ipsilateral deficit. A central facial nerve palsy results from a lesion involving the supranuclear pathways prior to them synapsing at the cranial nerve VII nucleus in the pons. This leads to a contralateral nerve lesion. Additionally, the UMN have bilateral innervation to the upper facial muscles and unilateral innervation the lower facial muscles.

DISCUSSION QUESTION 5 — A blow to which part of the skull is mostly likely going to lead to an epidural hemorrhage and why?
   A blow to the Pterion, which is located 2 fingers breadth superrior to the zygomatic arch and one thumb’s breadth posterior to the frontal process of the zygomatic bone will lead to an epidural hemorrhage. The Pterion is formed by the congruence of the frontal, parietal and sphenoid bones. Due to the union of these bone it is a site of structural weakness and will fracture. The middle meningeal artery passes beneath it and can be damaged leading to hemorrhage.
DISCUSSION QUESTION 6 — When using the subclavian artery compression technique described above to achieve hemostasis, what structure are you compressing the artery against?

1st rib to reduce blood flow. You are compressing the third part of the subclavian artery.

DISCUSSION QUESTION 7 — How do you properly palpate the thyroid on the physical exam?

You can examine the patient sitting or standing. You will first want to examine the patient from the front and then additionally examine them from behind. Using two to three fingers begin midline at the base of the patient's chin. As you move downward palpate the thyroid cartilage. Once you have palpated the thyroid cartilage, move inferior to feel the cricoid cartilage. The cricoid cartilage sits immediately superior to the isthmus of the thyroid. The isthmus of the thyroid unites over the 2nd and 3rd tracheal rings. Move laterally from that point to feel the lobes of the thyroid. They are medial to the SCM. Instruct the patient to swallow, so that you can feel for the upward movement of the thyroid.

DISCUSSION QUESTION 8 — What can be palpated in the Greater Supraclavicular Fossa?

The subclavian artery which supplies blood to the upper limb. In this fossa the third part and most superficial part of the subclavian vein courses posterior to the clavicle and across the first rib. The arterial pulsation of the subclavian artery can be felt in the greater supraclavicular fossa. To feel the pulsation of the subclavian artery press inferoposterior immediately posterior to the junction of middle and medial thirds of the clavicle.

DISCUSSION QUESTION 9 — What is the importance of the Lesser Supraclavicular Fossa?

The lesser supraclavicular fossa is formed by the triangle between the sternal and clavicular heads of the SCM. This area is the entry site for a needle or catheter into the internal jugular vein. The right IJV is preferred because it is larger and straighter than the left. To puncture the IJV, palpate the common carotid artery and insert a needle into the IJV just lateral to it at a 30 degree angle with the needle directed inferolaterally towards the ipsilateral nipple. This can be used for right heart catheterization. The IJV is punctured and a catheter is introduced through the right brachiocephalic vein into the SVC.

DISCUSSION QUESTION 10 — What four triangles can the Anterior Triangle of the Neck be divided into? What muscles separate these triangles?

The boundaries of the anterior triangle are the SCM laterally, the Jugular notch to the middle of the mandible medially, the body of the mandible superiorly and the superficial fascia of the platysma forms its roof.

The digastric and the superior belly of the omohyoid divide the anterior triangle into the submental, submandibular, muscular and carotid triangles.

DISCUSSION QUESTION 11 — What is contained within the submental triangle? What are the contents of the muscular triangle?

Submental triangle: contains the small veins that unite to form the anterior jugular vein
Muscular triangle: contains the infrahyoid muscles, the thyroid gland and the parathyroid glands.

**Case Based Learning Answer Key**

What conditions should be considered in the differential diagnosis of a neck mass?

Congenital causes of a neck mass include torticollis, thyroglossal duct cyst, branchial cleft cyst, cystic hygroma, dermoid cyst, and carotid body tumor.
Acquired causes of neck mass include lymphoma, mononucleosis (Epstein-Barr virus), other causes of lymphadenopathy, and cervical lymphadenitis. Thyroid causes include goiter (midline). Malignant causes include thyroid cancer (ex, papillary, medullary, follicular, or anaplastic types), lymphoma, and head or neck malignancy (eg, squamous cell or adenocarcinoma).

**What is the most likely diagnosis?**
Squamous cell tumor of the head and neck

**What risk factors increase this patient’s likelihood of disease?**
Tobacco and alcohol use are risk factors for both squamous cell tumors and adenocarcinoma of the head and neck. Human papillomavirus (HPV) infection is now becoming a more common risk factor in head and neck cancers, particularly in association with nonsmokers.

Which procedures can help confirm the diagnosis? Diagnostic procedures include biopsy via fine-needle aspiration of the mass, and CT and/or MRI to determine the stage and possible vascular involvement and resectability. If lymphoma is suspected, excisional biopsy should be performed (Figure 8-11).

![Diagram of neck mass evaluation](image.png)

**Where are the lesions of this condition commonly located?**
Head and neck cancers are typically found in the oral cavity, nasopharynx, larynx, oropharynx, and salivary glands.

**What are the appropriate treatments for this condition?**
Localized lesions are removed surgically or by radiotherapy. Palliative radiation is used for larger, more complex lesions. Combined chemotherapy and radiotherapy is the standard of care for advanced lesions.

**General Practice Question Answer Key**

**Step Style Question Answer Key**
1. F  2. D  3. D