

530.301 – Head and Neck Lecture Notes

THE SKULL

• Cranium

The cranium is a closed chamber with rigid walls and acts to protect the brain. The roof, sides, front and back walls are smooth and of uniform thickness – this is the calvaria. The floor of the chamber is comparatively irregular, and is known as the cranial base.

8 bones contribute to the cranium:

- 2 paired: Parietal bone
Temporal bone
- 4 unpaired: Frontal bone
Ethmoid bone
Sphenoid bone
Occipital bone

The **frontal bone** is a broad, convex plate of bone that forms the front of the cranium and roof of the orbits. In foetal skulls, a *metopic suture* divides the two halves of the frontal bone.

1. Squama – underlies the scalp of the forehead
2. Supraorbital margins – upper border of the orbits
3. Zygomatic processes – found at the lateral ends of the supraorbital margins
4. Temporal line – extends up and back from the zygomatic processes
5. Glabella – central part between the supraciliary arches
6. Ethmoidal notch – central part between superciliary arches

It articulates with the two parietal bones at the *coronal suture*, the nasal bones at the *frontonasal suture*, and also the zygomatic, lacrimal, ethmoid and sphenoid bones.

Apertures to the *frontal air sinuses* can be found on either side of the ethmoidal notch. These are part of a complex set of cavities known as the paranasal sinuses – they are lined with mucous membrane and communicate with the nasal cavity.

The **parietal bones** are domed to form large parts of the walls of the calvaria. They articulate with each other in the median plane at the *sagittal suture*.

1. Parietal eminence – central, rounded, and protruding on the wall
2. Superior temporal line – attachment of *temporal fascia*
3. Inferior temporal line – attachment of the *temporalis muscle*
4. Vascular grooves – for the ant and post branches of the middle meningeal vessels
5. Groove for the transverse sinus

They articulate with the occipital bone at the *lambdoid suture*, the frontal bone, the temporal bones and the greater wings of sphenoid bone.

The **occipital bone** forms much of the base and posterior aspect of the skull – the back half encloses the cranium, the front half extends towards the sphenoid.

1. Squama – pentagonal part posterior to the foramen magnum
 - a. Superior/Inferior nuchal lines
 - b. 4 fossae – 2 superior (occipital poles) and 2 inferior (cerebellar hemispheres)
2. Condylar part – lateral to the foramen magnum
 - a. Jugular process – upper surface
 - b. Occipital condyle – anteriorly, articulate with C1 (atlas)
 - i. Hypoglossal canal – in the base of the occipital condyle
3. Basilar part – anterior to the foramen magnum

The **temporal bones** form parts of the sides and base of the skull. Each is comprised of 4 distinct parts that fuse during development.

1. Squama – external to the lateral surface of the temporal lobe
 - a. Mandibular fossa (for head of mandible) – inferior surface
2. Petromastoid – a block enclosing the internal ear and mastoid cells
 - a. Mastoid process (note the mastoid notch between this and styloid)

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- b. Internal auditory meatus
- c. Groove for the sigmoid sinus
- 3. Tympanic part
 - a. External auditory meatus
- 4. Styloid process – attachment to ligaments and muscles
 - a. Stylomastoid foramen – posterolateral to styloid
 - b. Jugular fossa – medial to styloid

They articulate at sutures with the parietal, occipital, sphenoid and zygomatic bones – note the zygomatic process, which articulates with the temporal process of the zygomatic bone to form the *zygomatic arch*.

The **sphenoid** is a wedge-shaped bone – it is a key bone in the cranium as it articulates with eight other bones (frontal, parietal, temporal, occipital, vomer, zygomatic, palatine and ethmoid).

- 1. Body
 - a. Sella turcica – roof of the paranasal sinuses
 - i. Anterior clinoid processes (prominent, part of lesser wing)
 - ii. Dorsum sellae (back of the saddle)
 - 1. Posterior clinoid processes
 - b. Left and right sphenoidal sinuses
- 2. Lesser wing – arises from the superolateral margin of the body
- 3. Greater wing – arises from the lower margin of the body
 - a. Foramen ovale and foramen spinosum (lateral)
 - b. Superior orbital fissure (between greater and lesser wings)
 - c. Foramen rotundum (below superior orbital fissure)
 - d. Pterygoid process
 - i. Medial pterygoid plate
 - 1. Pterygoid canal (below and medial to foramen rotundum)
 - ii. Lateral pterygoid plate

The **ethmoid bone** lies between the orbits and underlies the frontal bone. On each side is a rectangular block (ethmoidal labyrinths), and these are joined at their upper edges by the cribriform plate (transmits bundles of olfactory nerve). The crista galli rises up into the cranium.

• Facial Skeleton

9 bones contribute to the facial skeleton:

- 4 paired:
 - Nasal bone
 - Zygomatic bone
 - Maxilla
 - Palatine bone

- 1 unpaired: Mandible

Note that the maxillary and other paranasal sinuses are essentially not present in the newborn skull – these form large spaces in the adult facial skeleton, however.

The **maxillae** form the skeleton of the face between the mouth and eyes, surrounding the anterior nasal apertures, and articulating with each other at the *intermaxillary suture*.

- 1. Body – base forms the lateral wall of the nose
 - a. Maxillary sinus – anterior/posterior walls, roof (floor of orbit)
 - b. Nasal, orbital, infratemporal and anterior surfaces
 - c. Infraorbital foramen
 - d. Incisive fossa
- 2. Zygomatic process – articulates with zygomatic bone
- 3. Frontal process – articulates with the frontal, nasal and lacrimal bones
- 4. Palatine process
- 5. Alveolar processes – sockets for the maxillary teeth

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They also articulate with the vomer, sphenoid and palatine bones.

The **zygomatic bones** form the prominences of the cheeks, and the anterolateral and infraorbital parts of the orbits.

1. Orbital margin/surface (120°)
 - a. Zygomaticofacial foramen
 - b. Zygomatico-orbital foramina
2. Frontal process
 - a. Zygomaticotemporal foramen
3. Temporal process – unites with the zygomatic process of the temporal bone

They articulate medially with the greater wings of the sphenoid bone, as well as the frontal, maxilla and temporal bones.

The **mandible** is a U-shaped unpaired bone that forms the skeleton of the lower jaw. It is the largest and strongest facial bone.

1. Body (U-shaped bone, represented anteriorly as the chin)
 - a. Alveolar process
 - b. Mental foramen – below the premolar teeth
2. Ramus – a plate behind and lateral to the last molar tooth
 - a. Coronoid process – attachment for temporalis muscle (anterior)
 - b. Condylar process – carries the head of the mandible (posterior)
 - c. Mandibular notch – between the coronoid and condylar
 - d. Mandibular foramen – inner surface of the ramus
 - i. Mylohyoid groove/sulcus

The **palatine bone** makes up the posterior third of the palate – it consists of two plates (horizontal and perpendicular). The perpendicular plate overlies the posterior third of the medial wall of the body of maxilla, and articulates with the pterygoid process of the sphenoid.

The **nasal bone** is small and trapezoidal.

The **lacrimal bone** is a scale-like oval of bone.

The **vomer** forms the posterior part of the nasal septum

The **inferior concha** spans the lower part of the opening of the maxillary sinus, and articulates with the palatine bone, maxilla and uncinat process of the ethmoid. Note the superior and middle conchae are part of the ethmoidal labyrinth.

CERVICAL FASCIAE, POSTERIOR TRIANGLE, ROOT OF THE NECK

• Cervical Fasciae

The deep fascia of the neck is divided into three layers – investing, pretracheal and prevertebral. These form natural lines of cleavage through which tissues may be separated, and limit the spread of pus from infections in the neck.

The **investing layer** of deep cervical fascia forms a collar around the neck, located between the superficial fascia and the muscular layer. It is attached:

- Superiorly – superior nuchal line, external occipital protuberance, mastoid process, lower border of the mandible
- Inferiorly – spine of the scapula, acromion process, clavicle, manubrium
- Posteriorly – ligamentum nuchae, C7 spine
- Anteriorly – symphysis menti, body of hyoid

The investing layer splits to enclose:

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- 2 muscles – trapezius, sternocleidomastoid
- 2 salivary glands – parotid, submandibular
- 2 spaces – suprasternal, supraclavicular

Where it splits to enclose the parotid gland (between the angle of the mandible and mastoid process), the superficial parotid fascia extends to the zygomatic arch; while the deep lamina forms the stylomandibular ligament.

It prevents extension of abscess to the surface, which usually spreads laterally. Note that if it is in the anterior triangle, it may enter the suprasternal space or anterior mediastinum.

The **pretracheal layer** is attached:

- Superiorly – hyoid bone, oblique thyroid cartilage, cricoid cartilage
- Inferiorly – arch of the aorta (superior mediastinum)
- Laterally – fuses with the carotid sheath

Infections of the head and neck can spread posterior to the oesophagus to the posterior mediastinum, or anterior to the trachea to the anterior mediastinum. Similarly air from a ruptured trachea or oesophagus can spread to the neck, leading to *cervicofacial emphysema*.

The **prevertebral layer** forms part of a fascial sleeve for the prevertebral muscles. Note that the cervical plexus and proximal parts of the brachial plexus are deep to it. It is attached:

- Superiorly – base of the skull
- Inferiorly – body of T4 vertebrae

Pus from an abscess posterior to the prevertebral fascia may extend laterally, deep to this layer to form a swelling posterior to the sternocleidomastoid muscle.

The **carotid sheath** encloses the *common and internal carotid arteries, internal jugular vein* and *vagus nerve*. The *sympathetic chain* is located posterior to (and outside) the sheath.

• Posterior Triangle

The **posterior triangle** is bounded by:

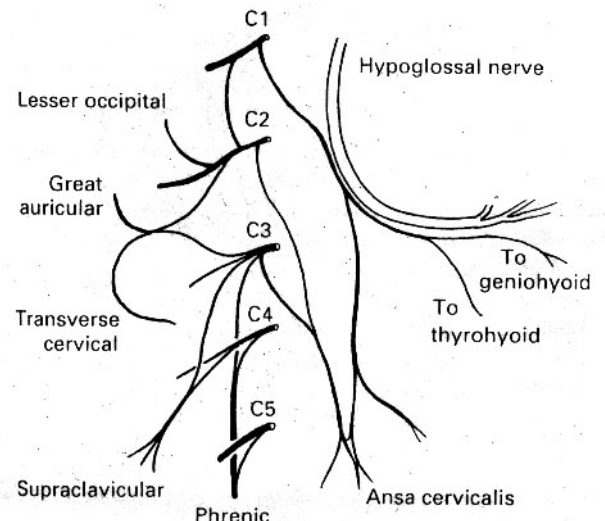
- Apex – superior nuchal line
- Base – middle 1/3 of clavicle
- Anterior border – posterior border of sternocleidomastoid
- Posterior border – anterior border of trapezius
- Roof – investing cervical fascia
- Floor – prevertebral fascia (over splenius capitis, levator scapulae, scalenus medius)

It contains:

- 3 nerves – *spinal accessory nerve, brachial plexus, cervical plexus*
- 4 arteries – *subclavian artery (3rd part), transverse cervical artery, suprascapular artery, occipital artery*
- 1 vein – *external jugular vein*
- Lymph nodes

Cervical plexus:

- C1 – nerve to geniohyoid, nerve to thyrohyoid
- C1-3 – ansa cervicalis (infrahyoid muscles)
- C2 – lesser occipital nerve
- C2-3 – great auricular nerve
- C2-3 – transverse cervical nerve
- C3-4 – supraclavicular nerve
- C3-5 – phrenic nerve



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- o External jugular vein is only visible when there is increased ventricular pressure (heart failure)
- o Lesions of the accessory nerve (trauma, tumour, fractures involving the jugular foramen, neck lacerations) result in unilateral paralysis of trapezius and an inability to shrug the shoulders and abduct the arm past horizontal.
- o The nerves of the cervical plexus receive rami communicantes (mainly from the sympathetic superior cervical ganglion) – interruption leads to Horner syndrome
- o Cervical block – inject along the posterior border of sternocleidomastoid
- o Brachial block – inject superior to the midpoint of the clavicle (avoid subclavian)

• Root of the Neck

The **root of the neck** is the junction between the neck and thorax – important structures are the superior thoracic aperture, cervical pleura and scalenus anterior muscle.

Boundaries of the thoracic inlet:

- Posterior – T1 vertebra
- Lateral – 1st rib and costal cartilage
- Anterior – manubrium

Contents of the root of the neck:

1. Nerves
 - a. *Vagus nerve and recurrent laryngeal nerve*
 - b. *Sympathetic chain*
 - c. *Phrenic nerve* (on scalenus anterior, deep to prevertebral fascia)
2. Arteries
 - a. *Right brachiocephalic trunk* (→ right subclavian, right common carotid posterior to sternoclavicular joint)
 - b. *Left subclavian artery*
 - c. *Left common carotid artery*
 - d. *Subclavian artery* (medial, posterior and lateral parts by scalenus anterior)
 - i. *Vertebral artery, internal thoracic artery, thyrocervical trunk*
 - ii. *Costocervical trunk* (from 1st part on the left)
 - iii. *Suprascapular and/or dorsal scapular arteries*
3. Veins (unite posterior to sternoclavicular joint)
 - a. *Subclavian vein*
 - b. *Internal jugular vein*
4. Lymphatics
 - a. Left side – thoracic duct
 - b. Right side – jugular, subclavian, bronchomediastinal lymph trunks (→ right lymphatic duct)
5. Viscera
 - a. Trachea
 - b. Oesophagus
 - c. Apex of the lung (and pleural cupula)
6. Muscles
 - a. Longus colli
 - b. Sternal ends of sternocleidomastoid, sternohyoid, sternothyroid
 - c. Scalene muscles (marginal)

Horner syndrome:

- Pupillary constriction (paralysis of dilator pupillae muscle)
- Ptosis (paralysis of smooth muscle in levator palpebrae superioris)
- Sinking in of the eye (paralysis of orbitalis muscle)
- Vasodilation and absence of sweating on the face and neck

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ANTERIOR TRIANGLE, THYROID GLAND

- C1 – Hard palate; transverse process palpable behind the mastoid process
- C2
- C3 – Hyoid bone
- C4 – Upper border of thyroid cartilage
- C5 – Lower border of thyroid cartilage; cricothyroid membrane
- C6 – Cricoid cartilage, pharyngeal-oesophageal junction, laryngeal-tracheal junction

• Anterior Triangle of the Neck

The **anterior triangle** is bounded by:

- Base – lower border of mandible; line from the angle of mandible to mastoid process
- Apex – Jugular notch
- Anterior border – midline
- Posterior border – anterior border of sternocleidomastoid
- Roof – skin, superficial fascia, investing layer of deep cervical fascia
- Floor – pharynx, larynx, prevertebral fascia

Contents of the anterior triangle:

1. Muscles
 - a. Hyoid muscles
 - i. Suprahyoid muscles – mylohyoid, geniohyoid, stylohyoid, digastric
 - ii. Infrahyoid muscles – omohyoid (superior belly), sternohyoid, sternothyroid, thyrohyoid
2. Nerves
 - a. Cranial nerves IX, X, XI and XII
 - b. Ansa cervicalis
 - c. Sympathetic trunk
3. Arteries - Common carotid, internal carotid, external carotid
4. Veins - Anterior jugular vein, internal jugular vein
5. Viscera
 - a. Pharynx → oesophagus
 - b. Larynx → trachea
6. Glands
 - a. Parotid, submandibular, thyroid, parathyroid

The **superior belly of omohyoid** and **digastric muscles** divide the anterior triangle into 4 further triangles:

1. Submental triangle – median triangle formed between the anterior bellies of digastric and the hyoid bone. The mylohyoid muscle forms its floor.

Cancer of the lip metastasises to submental (central lip) and submandibular (other parts) lymph nodes

2. Digastric triangle
 - a. Boundaries
 - i. Anterior – anterior belly of digastric
 - ii. Posterior – posterior belly of digastric
 - iii. Base – base of mandible; line from angle to mastoid process
 - iv. Roof – skin, superficial fascia, deep fascia
 - v. Floor – mylohyoid, hyoglossus, middle constrictor of pharynx
3. Carotid triangle
 - a. Boundaries
 - i. Anteroinferior – superior belly of omohyoid
 - ii. Posterior – anterior border of sternocleidomastoid
 - iii. Superior – posterior belly of digastric and stylohyoid
 - iv. Roof – skin, superficial fascia, deep fascia
 - v. Floor – thyrohyoid, hyoglossus, middle and inferior constrictors of pharynx

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- b. *Carotid sheath* – common and internal carotid arteries, internal jugular vein, vagus nerve
- c. *Carotid sinus* – baroreceptor at the bifurcation of the common carotid, innervated by the sinus branch of CN IX
- d. *Carotid body* – chemoreceptor posterior to the bifurcation of the common carotid → reflex change in respiration

- o Important surgical approach for carotid arteries, internal jugular vein, vagus nerve, hypoglossal nerve, cervical sympathetic trunk
- o Pressure on the carotid sinus → syncope, cessation of heart beat
- o Carotid pulse – absence indicates cardiac arrest

4. Muscular triangle

- a. Boundaries
 - i. Inferolateral – anterior border of sternocleidomastoid
 - ii. Superolateral – superior border of omohyoid
 - iii. Medial – midline
- b. Contains the infrahyoid muscles – these are all innervated by the *ansa cervicalis* except thyrohyoid, which is innervated by C1 nerve.

- o Surgical approach for thyroid, larynx, trachea and oesophagus (deep to this triangle)

Midline structures of the neck:

1. Body of the hyoid bone
 - a. Median thyrohyoid ligament
 - b. Laryngeal prominence
2. Cricoid cartilage
 - a. Cricothyroid ligament
 - b. Cricothyroid muscle
3. 1st tracheal ring
4. Isthmus and pyramidal lobe of the thyroid gland
5. Inferior thyroid veins
6. Jugular venous arch (joins the two anterior jugular veins)
7. Thyroid ima artery

• Thyroid Gland

The **thyroid gland** is the largest of the endocrine glands, and consists of two lateral lobes, an isthmus and a pyramidal lobe (sometimes). Features:

1. Levator glandulae thyroidea muscle between pyramidal lobe and hyoid bone (remnant of the thyroglossal duct)
2. Isthmus overlying the 2nd-4th tracheal rings
3. Lateral lobes (medial parts) overlying the larynx, trachea, oesophagus, inferior constrictor of pharynx, cricothyroid muscle
4. Extends onto the carotid sheath posteriorly, infrahyoid muscles cover the gland anteriorly
5. Parathyroid glands – posterior border, near the anastomosis of superior and inferior thyroid arteries

Arteries

1. *Superior thyroid artery*
2. *Inferior thyroid artery*
3. *Thyroid ima artery* (sometimes)

Veins

1. Venous plexus on the surface of the gland
 - a. *Superior thyroid vein* → internal jugular vein
 - b. *Middle thyroid vein* → internal jugular vein
 - c. *Inferior thyroid vein* → external jugular vein / left/right brachiocephalic

Coverings

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1. Capsule
2. Pretracheal fascia and infrahyoid muscles
3. Investing layer of deep cervical fascia
4. Superficial fascia and platysma
5. Skin

- o Relation of isthmus to tracheal rings – tracheotomy
- o Relation of external laryngeal nerve to superior thyroid artery – thyroidectomy
- o Relation of recurrent laryngeal nerve to inferior thyroid artery – thyroidectomy
- o Remnant of thyroglossal duct may present as a midline cyst
- o Relation of parathyroid to thyroid explains hypoparathyroidism after thyroidectomy

SCALP, FACE, PAROTID REGION

• Scalp

The scalp consists of five layers of soft issue that cover the calvaria, extending from the superior nuchal line to the supraorbital margins. Laterally, it extends into the temporal fossae to the level of the zygomatic arches.

Layers of the scalp – note that the scalp proper refers to the first three (fused) layers

1. **Skin** – covered in hair with many blood vessels and lymphatics. Thin in the elderly.
 - o Scalp lacerations bleed profusely due to communicating arteries (that do not retract) – untreated, infection → osteomyelitis, extradural abscess or meningitis
2. **Connective tissue** – thick subcutaneous layer, richly vascularized and innervated.
 - a. Collagen and elastin criss-cross attaching the skin to aponeurosis epicranialis
 - b. Fat present as lobules between the connective fibres – decreases with age
3. **Aponeurosis epicranialis** – strong membranous sheet covering the superior calvaria – the membranous tendon of the epicranium muscles
 - a. Epicranium muscle consists of occipitofrontalis (CN VII) that covers the scalp and has 2 occipital and 2 frontal bellies connected by the aponeurosis.
 - b. Epicranium aponeurosis is continuous laterally with the fascia covering temporalis (attached to the zygomatic arch)
 - o The aponeurosis prevents superficial lacerations from gaping – however, deeper wounds gape widely due to the pull of epicranium (especially coronal plane)
4. **Loose areolar tissue** – many potential spaces, allows movement of the scalp proper over the pericranium
 - o Dangerous area of the scalp – pus or blood can spread easily
 - o Infection may pass to the cranial cavity via emissary veins (through apertures in cranial bones). It may also pass to the eyelids and root of the nose, as frontalis muscle inserts into the skin and dense subcutaneous tissue
 - o Infection will not pass into the neck – occipitalis is attached to the superior nuchal line and the mastoid parts of the temporal bone
 - o Infection will not pass laterally past the zygomatic arches, as the epicranium aponeurosis is continuous with the fascia of temporalis
5. **Pericranium** – dense layer of specialised connective tissue with poor osteogenic properties
 - a. Attached to the scalp by connective tissue fibres (Sharpey's fibres)
 - b. Continuous with the endocranium in the cranial sutures
 - o Bleeding between the pericranium and the calvaria at birth – cephalhematoma
 - o Bone of the calvaria does not regenerate in adults – surgical bone flaps, metal or plastic plates required to repair trauma

Components of the scalp:

1. **Muscle**
 - a. Occipitofrontalis

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2. Nerves (sensory)

- a. Trigeminal (CN V) supplies the scalp anterior to the vertex
 - i. Ophthalmic nerve (V_1) → supratrochlear, supraorbital
 - ii. Maxillary nerve (V_2) → zygomatico-temporal
 - iii. Mandibular nerve (V_3) → auriculotemporal nerves
- b. C2 → greater and lesser occipital nerves supply the superior and posterior scalp

3. Arteries

- a. Internal carotid artery → supraorbital, supratrochlear
- b. External carotid artery → superficial temporal, posterior auricular, occipital arteries

4. Veins

- a. Supratrochlear, supraorbital veins → facial vein
- b. Superficial temporal vein → maxillary vein → retromandibular vein
- c. Retromandibular, posterior auricular vein → external jugular vein
- d. Occipital vein → suboccipital venous plexus → vertebral veins (→ internal jugular)
- e. Emissary (valveless) veins pass to the intracranial venous sinuses

5. Lymph

- a. Above the parotid → parotid lymph nodes
- b. Above the auricle → retroauricular (mastoid) lymph nodes
- c. Back of scalp and auricle → occipital lymph nodes at the apex of the posterior triangle

- o Infection of the scalp may spread to the intracranial venous sinuses via the emissary veins → venous sinus thrombosis
- o Surgical pedicle flaps are made to preserve the blood supply and innervation to the scalp (that enter inferiorly)

• Face

The face covers the part of the head anterior to the external ears, and between the hairline and the tip of the chin.

Components of the face:

1. **Skin** – sweat and sebaceous glands, connected to bone by loose connective tissue
2. **Superficial fascia** – muscles of facial expression are embedded in this layer

- o There is no deep fascia – so lacerations gape widely

3. Nerves

- a. Sensory
 - i. Ophthalmic nerve (V_1) → lacrimal, supraorbital, supratrochlear, infratrochlear, external nasal nerves
 - ii. Maxillary nerve (V_2) → infraorbital, zygomaticofacial, zygomaticotemporal nerves
 - iii. Mandibular nerve (V_3) → mental, buccal, auriculotemporal, inferior alveolar, lingual nerves
 - iv. Great auricular (C2-3) → area over the parotid and angle of the mandible

- o An infraorbital nerve block is used for treating wounds of the upper lip, cheek or maxillary teeth – note proximity of companion infraorbital vessels
- o An inferior alveolar nerve block is used when performing surgery on the mandibular teeth
- o A lesion of the entire trigeminal nerve causes anaesthesia involving the anterior half of the scalp, the face (aside from an area near the angle of the mandible), the cornea and conjunctiva, and mucous membranes of the nose, mouth and tongue.

b. Motor

- i. Facial nerve → temporal, zygomatic, buccal, mandibular, cervical branches

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- o Bell's palsy – unilateral paralysis of the facial nerve for no obvious reason. Most commonly due to inflammation of the facial nerve near the stylomastoid foramen.

4. **Arteries**
 - a. External carotid artery → facial artery → submental, inferior labial, superior labial, lateral nasal arteries
 - b. External carotid artery → superficial temporal artery → transverse facial artery
 - c. Internal carotid artery → branches of supraorbital, supratrochlear arteries supply the skin of the forehead via the ophthalmic artery
5. **Veins**
 - a. Supraorbital, supratrochlear veins unite at the medial eye → facial vein
 - b. Note that the facial vein is connected to the cavernous sinus (via the supraorbital and superior ophthalmic veins) – dangerous area of the face
 - c. Veins (corresponding to branches of the facial artery) → common facial vein → internal jugular vein. Note that the deep facial vein also connect these with the pterygoid venous plexus.
6. **Lymphatics**
 - a. → submandibular, parotid, submental lymph nodes
7. **Muscles** – all supplied by the facial nerve (CN VII)
 - a. Eyelids – orbicularis oculi, levator palpebrae superioris (dilator), occipitofrontalis (dilator)
 - b. Nostrils – compressor naris, dilator naris
 - c. Lips – orbicularis oris, dilators radiating out from the lips
 - d. Cheek – buccinator muscle (compresses the cheek and lips on the teeth)

- **Parotid Gland and Region**

The parotid gland lies in the fossa posterior to the ramus of the mandible. It extends:

- Superior – external auditory meatus
- Inferior – upper part of the carotid triangle
- Medial – styloid process (gland wraps around the neck of the mandible)
- Posterior – overlaps sternocleidomastoid
- Anterior – extends over masseter

The facial nerve divides it into superficial and deep parts – the deep part may extend between the medial pterygoid muscle and the ramus of the mandible (pterygoid process). There may also be a detached accessory parotid gland in the facial region.

Components of the parotid gland:

1. **Coverings**
 - a. Inner connective tissue capsule
 - b. Outer dense fibrous capsule (from investing layer)
 - c. Stylomandibular ligament (from investing layer) separates parotid and submandibular glands
2. **Parotid duct** – 5cm long, passing 2 fingerbreadths inferior to the zygomatic arch
 - a. Turns medially at the anterior border of the masseter → pierces buccinator, enters the oral cavity adjacent to the upper second molar tooth
3. **Structures** within the gland – facial nerve, retromandibular vein, external carotid artery, lymph nodes
4. **Arterial supply** – branches of the external carotid artery
5. **Nerve supply**
 - a. Secretomotor parasympathetic – glossopharyngeal (CN IX) via otic ganglion
 - b. (Sympathetic postganglionic – plexus around the external carotid artery)
 - c. Sensory fibres – branches of the great auricular and auriculotemporal nerves

- o Facial nerve involvement in lesions of the parotid gland – generally only malignant lesions cause facial palsy
- o Retrograde bacterial infection of the parotid gland → acute inflammation
- o Acute infection via blood supply (mumps)

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- o Swelling is painful due to the fascial capsule limiting expansion – a swollen glenoid process is responsible for pain during mastication
- o Sialogram – radiopaque material injected into the parotid duct

FUNCTIONAL AND CLINICAL ANATOMY OF THE EYE

The eye (~2.5cm in diameter) is located within the orbit along with the lacrimal sac/gland, ocular muscles and tarsal plates making up the eyelids.

The eyeball itself has a number of **features**:

1. Anterior Compartment
 - a. Cornea (~0.5mm) – responsible for ~2/3 of focussing power
 - i. In vivo confocal microscope allows us to look at the various layers in the living cornea:
 1. Epithelium (multiple cell layers, nerves)
 2. Bowman's membrane (collagen)
 3. Stroma (cells and fibrils)
 4. Descemet's layer (collagen)
 5. Endothelium (single layer of hexagonal cells which do not replicate). It functions to keep water out of the stroma while allowing nutrients in.
 - ii. Corneal dystrophies
 1. Fuchs's endothelial dystrophy – destruction of the corneal endothelium
 2. Keratoconus– onset around puberty, develops progressively. Contact lenses may help, but the cornea can become so distorted that a corneal graft is required.
 - b. Lens – responsible for ~1/3 of focussing power
 - i. Encased in a capsule, anterior surface has an epithelium lining
 - ii. Fibres extend the length of the lens – forming sutures as they meet
 - iii. Banding pattern due to cell layers – the central unbanded area is known as the nucleus and is the first to form.
 - iv. Cataracts (nuclear and cortical) – lens becomes stiffer (more cell layers), and nuclear cells degenerate and are replaced by protein/crystals with age.
 - c. Ciliary body
 - i. The interaction of the circular ciliary muscle, the zonules (suspensory ligaments – constant tension) and the lens allows accommodation i.e. contraction of the ciliary muscle reduces tension → thicker lens
 - ii. Ciliary epithelium produces aqueous humour continuously – this is drained by the trabecular network to the canal of Schlemm (→ veins)
2. Posterior Compartment
 - a. Vitreous humour
 - i. Degeneration can pull away part of the retina → 'floaters'
 - b. Sclera – fibrous tissue, helps to maintain shape and has blood supply to the anterior compartment
 - c. Choroid (continuous with the ciliary body) – has blood supply to the retina
 - d. Retina
 - i. Ophthalmoscopic features
 1. Optic disc/cup with optic nerve – no rods or cones
 2. Macula with fovea – high presence of cones in this area
 3. Retinal arteries
 - ii. Note that light passes through a number of cell layers before reaching the rods and cones
3. Nerves and Muscles
 - a. Extraocular muscles – $SO_4(LR_6)_3$ for innervation
 - i. Superior, medial, lateral, inferior rectus muscles

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- ii. **Inferior (superomedial movement) and superior oblique (inferolateral movement) muscles [check this]**
- b. Orbicularis oculi muscle (CN VII)
- c. Levator palpebrae superioris
- 4. Glands and the tear film
 - a. Consists of three layers
 - i. Mucous – goblet cells
 - ii. Aqueous – lacrimal gland
 - iii. Oil – Meibomian glands
 - b. Helps to prevent reflection – problems with the tear film lead to visual distortion/blurriness and pain (nervous stimulation)

CRANIAL FOSSAE, MENINGES, CAVERNOUS SINUS

• Cranial Fossae

The **anterior cranial fossa** is the shallowest of the three fossae and contains the inferior and anterior parts of the frontal lobes.

- 1. Boundaries
 - a. Anterior – inner surface of the frontal bone
 - b. Posterior – lesser wing of the sphenoid bone
 - c. Floor – orbital plates of the frontal bone, cribriform plate and crista galli of the ethmoid, jugum and lesser wing of the sphenoid
- 2. Features – crista galli (attaches to the falx cerebri), anterior clinoid processes (attaches to the tentorium cerebelli)
- 3. Foramina
 - a. Foramina of the cribriform plate – axons of olfactory cells (→ CN I)
 - b. Nasal slit – anterior and posterior ethmoidal nerves and arteries
 - c. Foramen caecum – nasal emissary vein between nasal cavity and superior sagittal sinus (1% of people)

The **middle cranial fossa** contains the anterior and ½ of the inferior parts of the temporal lobes. It is separated from the posterior cranial fossa by the dorsum sellae.

- 1. Boundaries
 - a. Anterior – lesser wing of the sphenoid bone
 - b. Posterior – superior borders of petrous part of the temporal bone
 - c. Floor – body and greater wings of the sphenoid, squamous and petrous parts of the temporal bone
- 2. Features
 - a. Sella turcica – tuberculum sellae, hypophyseal fossa, dorsum sellae
 - b. Posterior clinoid processes
 - c. Sulcus chiasma, groove for internal carotid artery, groove for middle meningeal vessels, impression for the trigeminal ganglion
- 3. Foramina
 - a. Optic canal – optic nerve (CN II) and ophthalmic arteries
 - b. Crescent of foramina in the greater wing
 - i. Superior orbital fissure – ophthalmic veins, CN V¹ (ophthalmic), II, IV, VI and sympathetic fibres
 - ii. Foramen rotundum – CN V² (maxillary)
 - iii. Foramen ovale – CN V³ (mandibular), accessory meningeal artery
 - iv. Foramen spinosum – middle meningeal artery and vein, meningeal branch of CN V³
 - c. Foramen lacerum – internal carotid artery, sympathetic and venous plexuses
 - d. Hiatus of greater petrosal nerve – greater petrosal nerve, petrosal branch of middle meningeal artery
 - e. Hiatus of lesser petrosal nerve – usually too small to be seen (if present)

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The **posterior cranial fossa** is the largest and deepest fossa, and contains the cerebellum, pons and medulla. Note that the occipital lobes lie on the tentorium cerebelli, superior to the posterior cranial fossa.

1. Boundaries
 - a. Anterior – superior border of petrous part of the temporal bone
 - b. Posterior – internal surface of the occipital bone
 - c. Floor – occipital bone, mastoid bone
2. Features
 - a. Internal occipital crest → internal occipital protuberance – divides the fossa into two cerebellar fossae (superior and posterior)
 - b. Groove for transverse sinus → sigmoid groove
 - c. Clivus – anterior to the pons and medulla
3. Foramina
 - a. Foramen magnum – medulla and meninges, spinal roots of CN XI, vertebral arteries, anterior and posterior spinal arteries, dural veins
 - b. Jugular foramen – CN IX, X, XI, superior bulb of internal jugular vein, inferior petrosal and sigmoid sinuses, meningeal branches of ascending pharyngeal and occipital arteries
 - c. Hypoglossal canal – CN XII
 - d. Condylar canal – emissary vein between sigmoid sinus and vertebral veins
 - e. Mastoid foramen – mastoid emissary vein between sigmoid sinus and meningeal branch of occipital artery

• Meninges and Dural Venous Sinuses

The **dura mater** consists of collagenous connective tissue. While it consists of one layer, it is described as a two-layered membrane as it adheres so closely to the internal periosteum (endocranium) except for where there are dural venous sinuses.

1. Dural septa (reflections of the dura) divide the cranial cavity into one subtentorial and two supratentorial compartments
 - a. Falx cerebri – attached to the internal surface of the calvaria from crista galli to internal occipital protuberance (also the midline of tentorium cerebelli)
 - b. Tentorium cerebelli
 - i. Anterior – superior edges of petromastoid part of the temporal bones, anterior and posterior clinoid processes
 - ii. Posterior – occipital bone along the grooves for transverse sinuses
 - c. Falx cerebelli
 - d. Diaphragma sellae – roof for the hypophyseal fossa with a central aperture for hypophyseal veins and the hypophyseal stalk (infundibulum)
2. Nerve supply – mainly via the three divisions of CN V (particularly ophthalmic), although CNX and the superior three cervical nerves (accompanying CN XII) also contribute. More numerous adjacent to the superior sagittal sinus, tentorium cerebelli and arteries and veins.
3. Arterial supply – middle meningeal artery (foramen spinosum → greater wing of sphenoid bone → anterior/frontal and posterior/parietal branches)
4. Venous drainage – middle meningeal veins → foramen spinosum and ovale → pterygoid plexus

The **arachnoid mater** is composed of weblike tissue and is separated from the dura by a potential subdural space. It does not dip into the sulci and fissures of the brain, and is separated from the **pia mater** by the subarachnoid space. The pia mater consists of highly vascularized loose connective tissue and is adherent closely to the surface of the brain. Note that the perivascular spaces are continuous with the subarachnoid space.

- o Meningitis – inflammation of the pia and/or arachnoid mater
- o Tentorial herniation of the temporal lobe → laceration and damage to CN III
- o Expansion of a pituitary tumour → bulging of diaphragma sella (visual disturbances)
- o Extradural haemorrhage - fracture in the pterion region → middle meningeal vessel
- o Subdural haemorrhage – tearing of superior cerebral vein in the sagittal sinus

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- o Subarachnoid haemorrhage – rupture of a berry aneurysm

Dural venous sinuses (underline between dura layers, *italics* between layers of dural folds):

1. Superior sagittal sinus – upper attached margin of falx cerebri
2. Transverse sinuses – attached margin of the tentorium cerebelli
3. Sigmoid sinuses – groove in the occipital and mastoid parts of the temporal bone
4. Cavernous sinuses – either side of the body of the sphenoid bone
 - a. Superior and inferior petrosal sinuses – between sigmoid and cavernous
 - i. *Basilar plexus* – basilar part of occipital bone between inferior petrosal sinuses, communicates with internal vertebral venous plexus
 - b. Sphenoparietal sinuses – cavernous sinus → lesser wing of the sphenoid
 - c. *Intercavernous sinuses*
5. *Inferior sagittal sinus* – lower free margin of falx cerebri
 - a. *Straight sinus* – inferior sagittal sinus → confluence of sinuses
6. Occipital sinus – attached margin of falx cerebelli

Confluence of the sinuses – superior sagittal, straight, occipital and transverse sinuses

- o Basilar and occipital sinuses communicate with the internal vertebral plexuses (via foramen magnum) – these are valveless → bi-directional blood/tumour spread
- o Scalp infections can pass to the venous sinuses via emissary veins

• Cavernous Sinus

The **cavernous sinuses** are 1.5mL sinuses located on each side of the sella turcica and the body of the sphenoid bone. Each extends from the superior orbital fissure to the apex of the petrous part of the temporal bone.

1. Receives blood from:
 - a. Superior and inferior ophthalmic veins (orbit)
 - b. Central retinal vein (retina)
 - c. Superior middle cerebral vein (brain)
 - d. Sphenoparietal dural venous sinus (skull)
 - e. Intercavernous sinuses
2. Drains blood to:
 - a. Superior and inferior petrosal sinuses
 - b. Pterygoid venous plexus
3. Relations
 - a. Extended
 - i. Anterior – apex of the orbit
 - ii. Posterior – brainstem
 - iii. Medial – body of sphenoid and pituitary fossa
 - iv. Lateral – medial surface of temporal lobe
 - v. Superior – internal carotid artery and uncus of the temporal lobe
 - vi. Inferior – greater wing of the sphenoid
 - b. Immediate
 - i. Lateral wall – CN III, IV, V¹ and V² (NOT V³)
 - ii. Internal – internal carotid artery, CN VI

- o Fractures of the base of the skull → tearing of internal carotid artery → arteriovenous fistula → engorgement of veins (especially ophthalmic) → pulsing exophthalmos
- o Spread of infection via the ophthalmic veins to the cavernous sinus (dangerous area)

ORBIT AND ITS CONTENTS

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• Bones of the Orbit

Boundaries of the orbit:

1. Superior – frontal bone
2. Inferior – zygomatic and maxillary bones
3. Medial – frontal and maxillary bones
4. Lateral – zygomatic and frontal bones

Walls of the orbit:

1. Medial wall
 - a. Bones – maxilla, lacrimal, ethmoid, sphenoid (body)
 - b. Features – nasolacrimal canal, anterior and posterior ethmoid foramina
2. Lateral wall
 - a. Bones – greater wing of sphenoid (anterior surface), zygomatic (orbital part)
 - b. Features – zygomatic canal for *zygomatic nerve* (branch of maxillary)
3. Roof
 - a. Bones – frontal, lesser wing of sphenoid
 - b. Features – lacrimal fossa, optic foramen, trochlear fossa
4. Floor
 - a. Bones – maxilla, zygomatic, palatine
 - b. Features – infraorbital groove and canal

Superior orbital fissure – separates the lateral wall from the roof of the orbit; lies between the greater and lesser wings of the sphenoid. It connects the orbit with the middle cranial fossa and transmits CN III, IV, VI, branches of VI and ophthalmic veins.

Inferior orbital fissure – separates the floor of the orbit from the lateral wall; lies between the greater wing, maxilla and zygomatic. It connects the orbit with the pterygopalatine and infratemporal fossae, and transmits the maxillary and zygomatic nerves, and infraorbital vessels.

- o Blow to the eye → blow-out fracture of the orbit due to increase in infraorbital pressure (and relative thinness of medial and inferior walls)
- o Prefrontal lobotomy was previously performed through the roof of the orbit
- o Foreign bodies - roof → frontal sinus, floor → maxillary sinus
- o Tumours in the sphenoidal or posterior ethmoidal sinuses may compress the optic nerve and orbit contents

• Contents of the Orbit

Muscle	Origin	Insertion	Innervation	Action
Levator palpebrae superioris	Lesser wing of sphenoid	Skin of eyelid	CN III	Elevates upper eyelid
Superior tarsal muscle	Continuation of LPS	Tarsal plate	Cervical symp. trunk, int. carotid plexus	Elevates upper eyelid
Superior rectus	Common tendinous ring	Posterior to sclero-corneal junction	CN III	Elevation, medial rotation
Inferior rectus	Common tendinous ring	Posterior to sclero-corneal junction	CN III	Depression, lateral rotation
Medial rectus	Common tendinous ring	Posterior to sclero-corneal junction	CN III	Adduction
Lateral rectus	Common tendinous ring	Posterior to sclero-corneal junction	CN VI	Abduction
Superior oblique	Body of sphenoid	Posterosuperior lateral orbit	CN IV	Medial rotation, depression
Inferior oblique	Maxilla (orbital floor)	Posteroinferior lateral orbit	CN III	Lateral rotation, elevation

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A **fascial sheath** surrounds the eyeball (except the cornea) and is attached to the sclera, close to the optic nerve and at the sclerocorneal junction. It is pierced by the tendons of the muscles that rotate the eyeball, and blends with their fasciae.

1. Potential space between sheath and eyeball allows for movement
2. Ligaments prevent excessive movement – medial and lateral expansions of the fascial sheaths of the medial and lateral rectus muscles
3. Suspensory ligament of the eye – thickening of inferior fascial sheath, attached to anterior medial and lateral walls of the orbit

Nerves of the orbit:

1. Inside the common tendinous ring
 - a. Optic nerve (CN II)
 - b. Oculomotor nerve (CN III)
 - c. Nasociliary nerve (branch of CN V₁)
 - i. → Ciliary ganglion (→ short ciliary nerves), long ciliary nerves, anterior ethmoid nerve, infratrochlear nerve
 - d. Abducens nerve (CN VI)
2. Outside the common tendinous ring
 - a. Trochlear nerve (CN IV)
 - b. Lacrimal nerve (branch of CN V₁)
 - c. Frontal nerve (branch of CN V₁)
 - i. → Supratrochlear nerve, supraorbital nerves

Blood vessels of the orbit:

1. Ophthalmic artery
 - a. Central artery of the retina
 - b. Ciliary arteries
 - c. Lacrimal artery – note that the recurrent meningeal branch anastomoses with the middle meningeal artery
 - d. Muscular branches → anterior ciliary arteries
 - e. Supraorbital, supratrochlear, dorsal nasal arteries exit the orbit
2. Veins
 - a. Superior and inferior ophthalmic veins communicate with the facial vein and cavernous sinus. They receive tributaries from the choroidal veins and communicate with the pterygoid plexus.

- o CN III palsy – levator palpebrae superioris affected → ptosis
- o CN VII damage – orbicularis oculi paralysis → inability to close the eye
- o Extraocular muscle paralysis → diplopia. Exam – superolaterally (SR), inferolaterally (IR), superomedially (IO), inferomedially (SO), medially (MR), laterally (LR)
- o Retinal artery is an end artery – obstruction → instant and total blindness
- o Thrombophlebitis of a facial vein → cavernous sinus → retinal vein thrombosis

NOSE AND NASAL CAVITY, PARANASAL SINUSES

• Nose

Functions of the nose:

1. Protection, especially to the eyes – ruptured orbits
2. Cosmetic – note that shape is largely defined by the shadows around the nose
3. Ventilation

The variations in shape of the **external nose** are mostly due to differences in cartilage.

1. Parts – root, apex, nares, dorsum nasi, ala nasi
 - a. Anterior nares (nostrils) are bounded laterally by the ala
 - b. Posterior nares open to the nasopharynx
 - c. Nasal septum – perpendicular plate of ethmoid, vomer and septal cartilage
2. Skeletal framework

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- a. Superior bony part (nasal bones, frontal processes of maxillae, nasal part of frontal bone)
- b. Cartilaginous part – 5 parts joined by periosteum and perichondrium
 - i. U-shaped alar cartilages are mobile and dilate/constrict nares

- o Fractures (transverse) are common as the perpendicular plate of the ethmoid and the vomer are thin bones – cribriform plate can become fractured with a direct blow
- o Deviation of the nasal septum may be due to trauma, birth injury, or congenital malformation – surgery is required if it comes into contact with the lateral walls

The **nasal cavity** consists of the lateral wall, septum, floor, roof, nasal apertures & vestibule

- 1. Floor – palatine processes of maxillae and horizontal plates of palatine bone
- 2. Roof – frontonasal, ethmoidal, sphenoidal parts
- 3. Medial wall (septum) – vomer, perpendicular plate of ethmoid, septal cartilage, fibrofatty tissue of the mobile septum
- 4. Lateral wall:
 - a. Skeletal framework – nasal bone, frontal process of maxilla, lacrimal, ethmoid labyrinth, perpendicular plate of palatine bone, medial pterygoid plate
 - b. Conchae – shelf-like bony projections covered in mucus membrane (superior, middle and inferior)
 - c. Meatuses – correspond to the conchae (superior, middle and inferior)
 - i. Sphenoethmoidal recess is superior to the superior meatus
 - ii. Bulla ethmoidalis – rounded elevation in the middle meatus due to the middle ethmoid air cell group
 - iii. Hiatus semilunaris – curved groove in the middle meatus between the bulla and uncinate process of ethmoid bone
 - d. Openings in the lateral wall:
 - i. Sphenoethmoidal recess – opening of the sphenoidal sinuses
 - ii. Superior meatus – opening of the posterior ethmoid cell group
 - iii. Middle meatus – frontal sinus, anterior ethmoid cell group, maxillary sinus
 - iv. Inferior meatus – nasolacrimal duct
- 5. Linings of the nasal cavity:
 - a. Vestibule – skin with vibrissae
 - b. Roof, adjoining septum and lateral wall – olfactory mucosa
 - c. Rest of the nasal cavity – respiratory mucosa (rich venous plexuses)
 - d. Note that the nasal mucosa is continuous with that in the paranasal sinuses

Nerves, arteries and lymphatics:

- 1. Nerves
 - a. CN I (olfactory nerve) → olfactory area
 - b. CN V¹ (ophthalmic nerve) → anterior ethmoidal nerve
 - c. CN V² (maxillary nerve) → nasopalatine and greater palatine nerves
- 2. Arterial supply
 - a. Ophthalmic artery → ethmoidal branches
 - b. Maxillary artery → sphenopalatine and greater palatine branches
 - c. Facial artery → superior labial, ascending palatine, lateral nasal branches
- 3. Lymphatics
 - a. Drainage → submandibular, retropharyngeal and upper deep cervical nodes

- o CSF rhinorrhea due to fracture of the cribriform plate and tearing of the meninges
- o Anosmia (loss of smell) may be due to conditions affecting the olfactory receptor cells, the secondary olfactory neurons in the olfactory bulb, or their connections
- o Infections may spread to the anterior cranial fossa (via the cribriform plate), the nasopharynx, middle ear (via the auditory tube), the paranasal sinuses or the lacrimal apparatus and conjunctiva
- o Epistaxis is generally due to trauma, but may be associated with hypertension or infection. Severe bleeding may be treated by clamping the external carotid arteries

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• Paranasal Air Sinuses

The **paranasal air sinuses** are air-filled cavities within the frontal, maxillary, ethmoid and sphenoid bones of the skull. They are lined with respiratory mucosa but that which is thin, less vascular and loosely attached to periosteum.

1. Relations to orbit
 - a. Superior – frontal sinus
 - b. Inferior – maxillary sinus
 - c. Medial – ethmoidal sinus
 - d. Posterior – sphenoidal sinus
2. Frontal sinus – in the frontal bones beneath the medial 1/3 of the superciliary arch
 - a. Between the inner and outer tables of the frontal bone
 - b. Opens to the middle meatus (frontonasal duct → infundibulum → hiatus semilunaris)
 - c. Innervated by branches of CN V¹ (supraorbital nerve)
3. Maxillary sinus – in the maxilla
 - a. Pyramidal shape (apex faces zygoma)
 - b. Relations – skin, pterygopalatine fossa, eye, teeth, nose
 - c. Opens to the infundibulum of the frontonasal duct near the roof of the sinus (hence the sinus must fill before it can drain)
 - d. Innervated by CN V² (alveolar nerve)
 - e. Blood supply from the maxillary artery
4. Ethmoidal air cells – in the labyrinthine part of the ethmoid bone
 - a. Numerous, divided into three groups
 - i. Anterior ethmoid air cell group → middle meatus
 - ii. Middle ethmoid air cell group (beneath the bulla ethmoidalis) → middle of the bulla in the middle meatus
 - iii. Posterior ethmoid air cell group → superior meatus
5. Sphenoidal sinus – in the body of sphenoid bone
 - a. Divided by a septum (not usually midline)
 - b. Opens into the sphenoethmoidal recess
 - c. Closely related to the cavernous sinus, internal carotid arteries, pituitary fossa, basilar artery, midbrain

Arteries, nerves and lymphatics:

1. Arteries – branches of ophthalmic, maxillary and facial arteries
2. Nerves – branches of the trigeminal nerve
3. Lymphatics
 - a. Frontal, anterior/middle ethmoidal, and maxillary → submandibular nodes
 - b. Posterior ethmoidal and sphenoidal sinuses → retropharyngeal nodes

- o Growth of the paranasal sinuses (particular frontal and sphenoidal) is important in determining the shape of the face, and adding resonance to the voice
- o Maxillary sinus is poorly drained
- o Shoddy removal of the modal teeth below the maxillary sinus may allow communication to the oral cavity → spread of infection
- o Infection of the ethmoidal sinus → infection/pus collection in the orbit
- o Sinusitis (pansinusitis) may result in blockage of one or more openings into the nasal cavity. This is associated with toothache as the superior alveolar nerves supply the maxillary teeth and the mucous membrane of the maxillary sinus
- o Blowing the nose after fractures of the frontal, ethmoidal, maxillary or nasal bone may introduce air into subcutaneous tissues or the cranium

MOUTH, TONGUE, PALATE, SUBMANDIBULAR REGION

• Mouth

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The **mouth** is comprised of three parts – the oral cavity, lips and cheeks:

1. Oral cavity – divided into vestibule (between teeth and lips) and the mouth proper
 - a. The palate (hard and soft) forms the roof, while the palatoglossal arches/folds are lateral
 - b. Communicates posteriorly → pharynx via oropharyngeal isthmus (of fauces)
 2. Lips
 - a. Covered externally by skin, internally by submucous coat and mucous membrane, and contains part of the orbicularis oris muscle
 - b. Attached to the gums by the frenulum; meet at the angles (labial commissures) of the mouth
 - c. Moistened by mucous labial salivary glands in the vestibule
 - d. Features:
 - i. Zones – cutaneous, vermilion border, transitional and mucosal zones
 - ii. Nerves – infraorbital (V^2), mental (V^3)
 - iii. Arteries – labial arteries (branches of the facial artery)
 - iv. Lymph → submandibular nodes
 1. Exception – central lower lip → submental lymph nodes
- o Pustules/infection of the lip → superior labial vein → angular vein → supraorbital vein → cavernous sinus
 - o Cleft lip – may be limited to the vermilion border, or extend to the palate
 - o Carcinoma of the lip – more common in the lower lip and in males
3. Cheeks – continuous with the lips (same general structure)
 - a. Buccinator forms the muscle layer, deep to the buccal fat pad
 - b. Parotid duct opens on a small papilla opposite the crown of 2nd upper molar
 - c. Features:
 - i. Nerves – branches of CN V^2 and V^3

• Tongue

The **tongue** is a mobile muscular organ that consists of three parts – a root, body and tip. At rest it fills most of the mouth proper and functions to squeeze food into the pharynx, and forming words during speaking.

1. Subdivisions – separated by the sulcus terminalis
 - a. Oral part (body) – anterior 2/3
 - b. Pharyngeal part – posterior 1/3
 - c. Subdivision has an embryological basis – foramen caecum at the apex of the sulcus terminalis is the remnant of the thyroglossal duct
 2. Surfaces
 - a. Dorsum (upper)
 - i. Vallate, fungiform and filiform papillae
 - ii. Lingual tonsil in posterior 1/3
 - b. Ventrum (lower)
 - i. Frenulum linguae – note the deep lingual vein and openings of the submandibular glands on either side
 - c. Related features of the oropharynx:
 - i. Between the posterior 1/3 of the tongue and the epiglottis:
 1. Median glossoepiglottic fold
 2. Lateral glossoepiglottic folds
 3. Valleculae of the epiglottis
 - ii. Between the palatoglossal fold and palatopharyngeal fold:
 1. Palatine tonsil
 - d. The median groove is the line of fusion of the embryonic tongue buds
- o Ankyloglossia (tongue-tie) – frenulum linguae extends to the tip of the tongue
3. Musculature
 - a. Extrinsic muscles – genioglossus, hyoglossus, styloglossus, palatoglossus
 - b. Intrinsic muscles – superior/inferior longitudinal, transverse, vertical muscles
4. Other features:
 - a. Nerves

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- i. Sensory
 - 1. General – anterior 2/3 by lingual nerve, posterior 1/3 by glossopharyngeal nerve
 - 2. Special (taste) – anterior 2/3 by chorda tympani (branch of facial), posterior 1/3 by glossopharyngeal
- ii. Motor
 - 1. Hypoglossal nerve – all muscles except palatoglossus
 - 2. Palatoglossus is supplied by vagus via pharyngeal plexus
- b. Arteries
 - i. Lingual artery – major artery
 - ii. Facial artery → tonsillar and ascending palatine branches
 - iii. Ascending pharyngeal artery
- c. Veins – lingual vein on each side → internal jugular or facial veins
- d. Lymphatics
 - i. Tip → submental lymph nodes
 - ii. Anterior 2/3 → submandibular lymph nodes, central → both sides
 - iii. Posterior 1/3 → deep cervical lymph nodes

- o Glossitis usually accompanies stomatitis – marked oedema due to lymphatics and loose areolar tissue in the tongue
- o Atrophy of filiform papillae in some forms of anaemia and vitamin deficiencies
- o Lesion of CN XII → paralysis/atrophy (tongue deviates towards affected side)
- o Posterior part of the tongue can obstruct the larynx in unconscious patients
- o Carcinoma of the posterior part of the tongue has poor prognosis (bilateral spread)
- o Floor of the mouth allows access to deep lingual veins → drug administration

• Palate

Hard palate

- 1. Skeleton – palatine processes of maxilla, horizontal plates of palatine bones
- 2. Alveolar margin – teeth and gum
- 3. Posterior margin – soft palate
- 4. Oral surfaces – stratified squamous keratinised epithelium, transverse palatine folds, prominent mucosal glands

Soft palate

- 1. Boundaries
 - a. Anterior (base) – hard palate
 - b. Posterior – free border, uvula in the midline
 - i. Palatoglossal and palatopharyngeal folds arise from the undersurface
 - c. Lateral – continuous with the walls of the pharynx
 - d. Oral and pharyngeal surfaces
- 2. Structure
 - a. Oral surface (and adjoining pharyngeal surface) – oral mucosa
 - b. Rest of pharyngeal surface – respiratory mucosa
 - c. Core contains palatine aponeurosis
 - i. Upper surface – levator palati muscle
 - ii. Lower surface – palatopharyngeus and palatoglossus
- 3. Muscles – tensor & levator palati, musculus uvulae, palatoglossus, palatopharyngeus
- 4. Other features:
 - a. Nerves
 - i. Sensory – greater palatine, lesser palatine, nasopalatine nerves
 - ii. Motor – CN XI fibres → pharyngeal plexus (via vagus and pharyngeal branches)
 - 1. Tensor palati is supplied by mandibular nerve
 - b. Arteries – greater and lesser palatine arteries (branches of maxillary)
 - c. Veins → pterygoid plexus
 - d. Lymphatics → submandibular, retropharyngeal, deep cervical lymph nodes

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• Submandibular Region

The **submandibular region** lies between the body of the mandible and the hyoid bone. Its superficial part includes the submental and digastric triangles, while the deep part includes the root of the tongue and floor of the mouth.

1. Important structures

- a. Digastric muscle – two bellies connected by an intermediate tendon
 - i. Anterior belly – nerve to mylohyoid
 - ii. Posterior belly – facial nerve
- b. Stylohyoid muscle – closely related to the posterior belly of digastric
 - i. Innervated by facial nerve
- c. Mylohyoid muscle – forms the muscular floor of the mouth between the mylohyoid line of the mandible to the hyoid bone
 - i. $\frac{3}{4}$ interdigitates with the opposite side to form the median raphe
- d. Hyoglossus – thin quadrangular muscle between the hyoid bone and the side/inferior aspect of the tongue

2. Other structures:

- a. Lingual nerve
- b. Hypoglossal nerve
- c. Lingual artery

The **submandibular gland** is a mixed serous and mucous acinous gland (mucous predominates).

1. The U-shaped gland has superficial and deep parts, separated by mylohyoid
 - a. Superficial part – in the digastric triangle, reaching up under the body of the mandible. Separated from the parotid gland by the stylomandibular ligament.
 - b. Deep part – extends forwards between mylohyoid and hyoglossus and gives rise to the duct.
 - i. Posterior end is continuous with the superficial part of the gland; anterior extends to the sublingual gland.
2. Coverings – inner connective tissue capsule, outer fibrous capsule (derived from investing layer of deep cervical fascia)
3. Submandibular duct – runs between mylohyoid and hyoglossus
 - a. Opens on a small sublingual papilla on the floor of the mouth adjacent to the lingual frenulum
 - b. Note that the duct is crossed by the lingual nerve
4. Other features:
 - a. Nerves – derived from the submandibular ganglion
 - i. Parasympathetic fibres from chorda tympani (branch of facial)
 - ii. Lingual branch of mandibular nerve
 - iii. Sympathetic trunk
 - b. Arteries – branches of facial and lingual arteries
 - c. Veins – follow the arteries

- o Common site for calculus formation – seen as a tense swelling below the body of the mandible, largest before and during a meal.
- o In mumps swelling of the submandibular gland is an ovoid enlargement that extends anteroinferiorly from the angle of the mandible. Pain due to tight fibrous coverings.

INFRATEMPORAL REGION, TEMPOROMANDIBULAR JOINT

• Infratemporal Region

The **infratemporal region** lies beneath the base of the skull, between the pharynx and ramus of the mandible.

1. Boundaries

- a. Anterior – maxilla

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- b. Posterior – styloid process
- c. Superior – infratemporal surface of the greater wing of sphenoid
- d. Inferior – continuous with submandibular region
- e. Lateral – ramus of mandible
- f. Medial – lateral pterygoid plate
- 2. Contents:
 - a. 3 muscles – lateral pterygoid, medial pterygoid, lower part of temporalis
 - b. 3 nerves – mandibular nerve and branches, otic ganglion, chorda tympani
 - c. 3 vessels – maxillary artery, pterygoid venous plexus, maxillary vein
- 3. Nerves
 - a. Mandibular nerve - branches:
 - i. Main trunk
 - 1. Motor: medial pterygoid, tensor tympani, tensor palati nerves
 - 2. Sensory – meningeal branch
 - ii. Anterior division
 - 1. Motor – masseteric nerve, deep temporal nerves to temporalis, nerve to lateral pterygoid
 - 2. Sensory – buccal nerve
 - iii. Posterior division
 - 1. Motor – nerve to mylohyoid
 - 2. Sensory – auriculotemporal, lingual, inferior alveolar nerves
 - a. Middle meningeal artery between two roots of AT
 - b. Otic ganglion (parasympathetic) – immediately below the foramen ovale, deep to the main trunk of the mandibular nerve
 - c. Chorda tympani (branch of facial nerve)
 - i. Arises in the temporal bone and enters the temporal fossa via the petrotympanic fissure to join the lingual nerve
 - ii. Carries preganglionic parasympathetic fibres to the submandibular ganglion, and taste fibres from the anterior 2/3 of the tongue
- 4. Vessels
 - a. Maxillary artery – terminal branch of the internal carotid artery
 - i. Arises posterior and deep to the neck of the mandible, runs forward in the infratemporal fossa between the neck of the mandible and pterygopalatine fossa
 - ii. Divided into 3 parts by the pterygoid muscle:
 - 1. Runs forward between the neck of the mandible and the lower border of the lateral pterygoid
 - 2. Runs obliquely forward and upwards, superficial or deep to the lower head of the lateral pterygoid
 - 3. Runs between the heads of the lateral pterygoid (through the pterygomaxillary fossa) to the pterygopalatine fossa
 - iii. Main branches:
 - 1. Inferior alveolar artery
 - 2. Middle meningeal artery
 - 3. Palatine artery
 - 4. Infraorbital artery
 - 5. Sphenopalatine artery
 - b. Pterygoid venous plexus – between the two pterygoid muscles
 - i. → Facial vein through the deep facial vein
 - ii. → Cavernous sinus by veins through foramen ovale and lacerum
 - c. Maxillary vein – short vein, accompanies the first part of maxillary artery
 - i. Formed by the confluence of the veins of the pterygoid plexus
 - ii. Joins the superficial temporal vein → retromandibular vein

- o Mandibular nerve block – needle → the mandibular notch to the infratemporal fossa (extraoral approach). Blocks sensory nerves of the anterior and posterior divisions.
- o Inferior alveolar block – needle → mouth of the mandibular canal (mandibular foramen → pterygoid venous plexus). Blocks alveolar teeth, skin/mucous membrane of the lower lip, labial alveolar mucosa/gingivae and the skin of the chin.

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• Temporomandibular Joint

The **temporomandibular joint** is a synovial condylar (modified hinge) joint.

1. Articular surfaces are covered with fibrocartilage
 - a. Superior – articular tubercle and anterior part of the mandibular fossa of the temporal bone
 - b. Inferior – condyle of the mandible
 - c. Intra-articular disc divides the joint into upper and lower cavities
2. Fibrous capsule (lined by a synovial membrane)
 - a. Superior attachment – margins of the articular area of the temporal bone
 - b. Inferior attachment – neck of the mandible
3. Ligaments
 - a. Lateral temporomandibular ligament – strengthens capsule laterally
 - b. Sphenomandibular ligament – medial to the joint, extends between the spine of sphenoid to the lingula of the mandibular foramen
 - c. Stylomandibular ligament – apex of styloid process to angle of the mandible
4. Articular disc – oval plate comprised of fibrous tissue with upper and lower surfaces
 - a. Attached at the circumference to the fibrous capsule, and anteriorly to the tendon of the lateral pterygoid muscle
 - b. Posteriorly – divides into upper (→ posterior margin of mandibular fossa) and lower (→ back of the mandibular condyle) lamellae
5. Nerves – mandibular (CN V³) – auriculotemporal and masseteric branches
6. Arteries – superficial temporal and maxillary arteries

Movements – depression, elevation, protrusion, retraction, rotation

1. Resting – teeth are slightly separated
2. Closure – teeth come into apposition
3. Opening of mouth
 - a. Passive or active
 - b. Mandibular head and disc glide forward on the upper surface of the disc
 - c. Head of the mandible rotates on the lower surface of the disc
4. Closing of mouth – opposite to opening
5. Protrusion – lower teeth drawn forwards over the upper teeth
6. Retraction – mandible drawn backwards to a resting position
7. Rotatory movements (grinding) – both joints involved → bicondylar arrangement
8. Muscles involved:
 - a. Depression – digastric, mylohyoid, geniohyoid, infrahyoid muscles, gravity
 - b. Elevation – temporalis, masseter, medial pterygoid muscles
 - c. Protrusion – lateral and medial pterygoid muscles
 - d. Retraction – posterior fibres of temporalis muscle
 - e. Side-to-side – medial and lateral pterygoids of each side, acting alternately

Muscle	Origin	Insertion	Innervation
Temporalis	Temporal fossa Temporal fascia	Coronoid process Anterior border of ramus	Mandibular n. (CN V ³)
Masseter	Zygomatic arch	Lateral surface of ramus	Mandibular n. (CN V ³)
Lateral pterygoid	Infratemporal crest Lateral surface of lateral pterygoid plate	Neck of mandible Articular disc	Mandibular n. (CN V ³)
Medial pterygoid	Maxillary tuberosity Medial surface of lateral pterygoid plate	Medial surface of ramus	Mandibular n. (CN V ³)

- o Mandible can be dislocated anteriorly, especially when the mouth is open as the condyles are on the articular tubercles. Displaces → infratemporal fossa
- o Reduction is by placing both thumbs on the last molar teeth, depressing the jaw and pushing it backwards

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LARYNX AND PHARYNX

• Larynx

The larynx consists of a number of cartilages connected by membranes and ligaments, moved by muscles and lined internally by a mucous membrane.

External parts of the larynx

1. Cartilages

- a. Thyroid cartilage – largest of the laryngeal cartilages
 - i. 2 laminae fused inferoanteriorly → laryngeal prominence, thyroid notch
 - ii. Superior and inferior cornua
 1. Inferior articulates with cricoid cartilage (allows it to tilt or slide anteroposteriorly)
 - iii. Oblique line on the lateral surface of each lamina is the attachment for inferior constrictor, sternothyroid and thyrohyoid muscles
 - iv. Thyrohyoid ligament → hyoid bone
- b. Cricoid cartilage – signet ring shaped, thicker and stronger than thyroid
 - i. Band (arch) faces anteriorly, signet (lamina) faces posteriorly
 - ii. Forms the inferior aperture of the larynx
 - iii. Articulates with arytenoid cartilages
 - iv. Cricothyroid ligaments → inferior margin of thyroid cartilage
 - v. Cricotracheal ligament → first tracheal ring
- c. Arytenoid cartilages – 3 sided pyramids (apex superior)
 - i. Vocal process (anterior) → vocal ligament
 - ii. Muscular process (lateral) → posterior and lateral cricoarytenoid muscles
 - iii. Apex → aryepiglottic fold
- d. Corniculate cartilages – small nodules, posterior part of aryepiglottic fold
- e. Cuneiform cartilages – elongated, rod-shaped
 - i. Anterosuperior to corniculate cartilages in aryepiglottic fold
 - ii. Approximated to the tubercle of the epiglottis when the laryngeal inlet is closed during swallowing
- f. Epiglottic cartilages – leaf-shaped, thin
 - i. Posterior to root of the tongue and the hyoid bone
 - ii. Forms the superior part of the anterior wall and superior margin of the inlet of the larynx
 - iii. Thyroepiglottic ligament → thyroid cartilage at the thyroid notch
 - iv. Hyoepiglottic ligament → anterior attachment
 - v. Epiglottic tubercle projects posteriorly

2. Membranes and ligaments

- a. Extrinsic
 - i. Thyrohyoid ligament
 - ii. Cricotracheal ligament
- b. Intrinsic
 - i. Quadrangular membrane
 1. Extends between the epiglottis and arytenoid cartilage
 2. Lower margin forms the vestibular ligaments
 - ii. Cricothyroid ligament
 1. Anterior part (thick) – connects cricoid and thyroid cartilages
 2. Lateral part (thin) – lower border attached to upper border of cricoid cartilage, upper margin ascends deep to thyroid cartilage to form the vocal ligament
 3. Vocal ligament → deep surface of thyroid cartilage anteriorly, vocal process of arytenoid cartilage posteriorly

3. Inlet – inclination, boundaries, elevations – produced by corniculate and cuneiform cartilages in the free margin of the aryepiglottic fold

Internal parts of the larynx

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1. Cavity of the larynx – extends from the inlet of the larynx to the lower border of the cricoid cartilage. Divided into three parts:
 - a. Vestibule – inlet to vestibular folds
 - i. Features – walls, rima vestibuli, vestibular ligament
 - b. Middle part of larynx – between vestibular and vocal folds
 - i. Features – vocal folds, vocal ligament, rima glottidis, sinus of the larynx, saccule of the larynx
 - c. Lower part of larynx – vocal folds to inferior border of cricoid cartilage
 - i. Walls formed by inner surface of cricoid thyroid ligament and cricoid cartilage
2. Mucous membrane – numerous mucous glands in the saccules
3. Muscles
 - a. Extrinsic
 - i. Elevators – digastric, stylohyoid, mylohyoid, geniohyoid
 - ii. Depressors – sternohyoid, sternothyroid, omohyoid
 - b. Intrinsic – alter the length and tension of vocal folds
 - i. Controlling laryngeal inlet – oblique arytenoid
 - ii. Controlling movement of the vocal cords:
 1. Tensor – cricothyroid
 2. Relaxer – thyroarytenoid
 3. Adductors – lateral cricoarytenoid, transverse arytenoid
 4. Abductor – posterior cricoarytenoid
 - c. Sphincteric function of the larynx
 - i. At the inlet – oblique arytenoid and aryepiglottic muscles bring aryepiglottic folds together (approximates arytenoid cartilages to epiglottis during swallowing)
 - ii. Rima glottidis – serves as a sphincter when vocal cords are adducted (coughing, sneezing, abdominal straining)
 - d. Movement of vocal cords with respiration
 - i. Quiet respiration – rima glottidis remains open
 - ii. Forced inspiration – vocal folds are abducted
 - iii. Phonation – rima glottidis is partially closed
 - iv. Swallowing – rima glottidis is completely closed
4. Nerves – branches of the vagus
 - a. Sensory (to mucosa)
 - i. Internal laryngeal nerve above the vocal fold
 - ii. Recurrent laryngeal nerve below the vocal fold
 - b. Motor (to intrinsic muscles)
 - i. Recurrent laryngeal nerve for all except cricothyroid, which is innervated by the external laryngeal nerve
5. Arteries – superior laryngeal branch of superior thyroid artery, inferior laryngeal branch of inferior thyroid artery

- o Laryngeal fractures → submucous haemorrhage and oedema, respiratory obstruction, hoarseness, aphonia occasionally
- o If a foreign body enters the larynx, the laryngeal muscles spasm (closing the rima glottidis) → needle via median cricothyroid ligament, cricothyrotomy, tracheotomy
- o Damage to the internal laryngeal nerve → anaesthesia of the laryngeal mucous membrane as far posteriorly as the vocal folds
- o Damage to the recurrent laryngeal nerve → paralysis of the muscles in the aryepiglottic folds → dysphagia

• Pharynx

The **pharynx** is a funnel-shaped fibromuscular tube that conducts food to the oesophagus and air to the larynx and lungs. It extends 15cm from the base of the skull to the inferior border of the cricoid cartilage (and inferior border of C6 vertebrae).

1. Relations of the pharynx:
 - a. Superior – posterior part of the body of the sphenoid

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- b. Inferior – continuous with oesophagus
- c. Posterior – separated from prevertebral fascia by retropharyngeal space
- d. Anterior – opens into nasal cavities, mouth and larynx
- e. Lateral – great vessels of the head and neck
- 2. The pharyngeal wall is composed of five layers – from internal to external:
 - a. Mucous membrane
 - b. Submucosa
 - c. Fibrous layer – pharyngobasilar fascia (attached to the skull)
 - d. Muscular layer:
 - i. 3 constrictors – superior, middle and inferior
 - ii. Internal - salpingopharyngeus, palatopharyngeus, stylopharyngeus
 - e. Connective tissue – buccopharyngeal fascia (continuous with the epimysium of the buccinator and pharyngeal muscles, contains pharyngeal plexus)
- 3. The pharynx can be divided into three parts:
 - a. Nasopharynx – posterior to the nose, superior to the soft palate, continuous with the oropharynx via the pharyngeal isthmus. Relations:
 - i. Superior – body of sphenoid, basilar part of occipital bone
 - ii. Posterior – continuous with the roof of the mouth, adenoid (pharyngeal tonsils) at the junction of roof and posterior wall
 - iii. Lateral – pharyngeal opening of the auditory tube, tubal elevation and tonsil, salpingopharyngeus muscle and fold, pharyngeal recess
 - b. Oropharynx – posterior to the mouth, between the soft palate and the upper border of the epiglottis
 - i. Opens anteriorly through the oropharyngeal isthmus to the mouth
 - ii. Lateral wall bounded by palatoglossal and palatopharyngeal arches
 - iii. Contains the palatine tonsil
 - c. Laryngopharynx – posterior to the larynx, between the upper border of the epiglottis and lower border of cricoid cartilage
 - i. Anterior wall – inlet of larynx (with piriform fossae), mucous membrane over posterior parts of arytenoid and cricoid cartilages
 - ii. Posterior wall – C3-C6 vertebrae
 - iii. Lateral walls – thyroid cartilage and thyrohyoid membrane
- 4. Nerves – glossopharyngeal, vagus and sympathetic trunk → pharyngeal plexus
 - a. Motor
 - b. Sensory:
 - i. Nasopharynx – maxillary nerve (CN V²) via pterygopalatine ganglion
 - ii. Oropharynx – glossopharyngeal nerve (CN IX)
 - iii. Laryngopharynx – vagus nerve (CN X) via internal laryngeal nerve
- 5. Arteries – branches of ascending pharyngeal, facial, maxillary and lingual arteries
- 6. Veins – begin in the pharyngeal plexus, communicate with the pterygoid plexus, drain into the internal jugular vein

- o Hypertrophy of the pharyngeal tonsils obstructs nasal respiration → mouth breathing, adenoid facies (open mouth, protruding tongue, dull expression. Infection may spread to the tubal tonsils (impairment of hearing) or to the middle ear (otitis media).
- o Bleeding following tonsillectomy commonly arises from the external palatine vein. Other structures that can be damaged includes the glossopharyngeal nerve, lingual nerve, and internal carotid artery (if adjacent tissues are damaged)
- o Branchial fistula – remnant of the second pharyngeal pouch and branchial groove
- o Foreign bodies may lodge in the piriform recess → injury of internal laryngeal nerve

EXTERNAL EAR, MIDDLE EAR

• External Ear

The **auricle** is the shell-like oval part of the external ear, and acts to funnel and modify sound into the external auditory meatus.

1. Composition – hairy glandular skin covering a single sheet of elastic cartilage

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- a. Vestigial auricular muscles are innervated by the facial nerve – join the auricle to the fascia of the skull
2. Lobule (lobe) has fibrous tissue, fat and blood vessels (no cartilage) – easily pierced
3. Arteries – posterior auricular artery, superficial temporal artery
4. Nerves – great auricular nerve, auriculotemporal nerve (superior to external auditory meatus)

The **external auditory meatus** is an s-shaped canal that extends from the concha of the auricle to the tympanic membrane (~2.5cm).

1. Composition – outer 1/3 elastic cartilage, inner 2/3 bone
 - a. Lined by skin – outer 1/3 has hair, sebaceous and ceruminous glands, inner 1/3 is thin and continuous with the tympanic membrane
 - b. Narrowings at the medial end of the cartilaginous part and 4mm before the tympanic membrane (at the isthmus)
2. Arteries – posterior auricular artery, deep auricular artery (branch of the maxillary)
3. Sensory innervation – auriculotemporal nerve (CN V³), facial nerve (CN V³), auricular branch of vagus nerve (CN X)

The **tympanic membrane** is a thin, translucent oval membrane separating the external and middle ear. It is a fibrous membrane with thin skin and mucous membrane (all three embryonic tissues represented).

1. Umbo – central depression formed by the handle of the malleus. A bright cone-shaped area of light radiates anteroinferiorly from this.
2. Pars tensa (most of it), pars flaccida (the attic), annulus (thick peripheral part)
3. Nerves – auriculotemporal nerve (CN V³), auricular branches of vagus nerve (CN X)

- o A hard blow to the chin may drive the head of the mandible into the external auditory meatus and damage it
- o Perforation of the tympanic membrane can lead to middle ear deafness
- o Haemorrhage or CSF otorrhoea may follow a blow to the head
- o Incisions in the tympanic membrane are made posteroinferiorly to avoid vessels, the chorda tympani nerve and ossicles

• Middle Ear

The **middle ear** is a narrow cavity in the petrous part of the temporal bone containing air, three auditory ossicles, a nerve, and two small muscles.

1. Walls:
 - a. Roof – tegmen tympani (separates middle ear from the temporal lobe dura)
 - b. Floor – thin plate of bone (separates the superior bulb of the jugular vein)
 - i. Tympanic nerve (CN IX) comes up via the floor → tympanic plexus
 - ii. Internal jugular may pass through the floor
 - c. Anterior wall
 - i. Inferiorly – thin plate of bone (separates the internal carotid artery)
 - ii. Superiorly – 2 openings: auditory tube (lower, larger) and the canal for tensor tympani muscle
 - d. Posterior wall
 - i. Superiorly – aditus to mastoid antrum (→ mastoid air cells)
 - ii. Inferiorly – pyramid (apex is origin of stapedius muscle). Lateral to this is the aperture for chorda tympani nerve (CN VII)
 - e. Lateral wall – formed by tympanic membrane inferiorly and squamous part of the temporal bone superiorly.
 - i. Tympanic cavity proper behind the tympanic membrane, epitympanic recess behind the temporal bone
 - f. Medial (labyrinthine) wall features:
 - i. Promontory – large first turn of the cochlea
 - ii. Tympanic plexus on the promontory – facial and glossopharyngeal
 - iii. Fenestra vestibuli (oval window) – contains the base of the stapes
 - iv. Fenestra cochleae (round window)

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2. Auditory ossicles

- a. Malleus:
 - i. Head – in the epitympanic recess, articulates with incus (saddle joint)
 - ii. Neck – lies against the flaccid part of the tympanic membrane, medial surface crossed by chorda tympani
 - iii. Handle – lies in the centre of the tympanic membrane, insertion of tensor tympani
- b. Incus:
 - i. Body – lies in epitympanic recess, articulates with head of malleus
 - ii. Long (lenticular) process – articulates with the stapes (ball/socket)
 - iii. Short process – connected to the posterior wall by a ligament
- c. Stapes:
 - i. Base – fits into the fenestra vestibuli on the medial wall
 - ii. Head – articulates with the lenticular process of the incus

3. Muscles of the ossicles:

- a. Tensor tympani – tenses tympanic membrane, reduces amplitude of oscillations. Prevents damage from excessively loud sounds.
 - i. Origin – superior surface of auditory tube, greater wing of sphenoid, petrous part of temporal bone
 - ii. Insertion – handle of malleus
 - iii. Nerves – mandibular nerve (CN V³) via the otic ganglion
- b. Stapedius – reduces oscillatory range of stapes, prevents movement
 - i. Origin – pyramidal eminence on posterior wall
 - ii. Insertion – neck of stapes
 - iii. Nerves – nerve to stapedius from the facial nerve (CN VII)

4. Auditory tube – funnel-shape tube (~4cm long) lined with mucous membrane that connects the nasopharynx (via the inferior meatus) to the tympanic cavity.

- a. Posterior 1/3 is bony, anterior 2/3 is cartilaginous
- b. Tubal tonsil – lymphoid tissue near the pharyngeal orifice
- c. Equalises pressure of the middle ear with atmospheric pressure, allows free movement of the tympanic membrane

5. Mastoid antrum and air cells

- a. Spherical sinus lined with mucous membrane in the petromastoid part of the temporal bone, posterior to the epitympanic recess.
- b. Connected to the tympanic cavity by the aditus to the mastoid antrum
- c. Separated from the middle cranial fossa by the tegmen tympani
- d. Related anteroinferiorly to the canal for the facial nerve
- e. Joins the mastoid air cells via a number of apertures

- o Otosclerosis (10% of population, 1% of population symptomatic) – spongy bone growth at the base of stapes and fenestra vestibuli
- o Otitis media can spread to the brain or meninges via tegmen tympani
- o Earache may be due to otitis externa (CN V³), referred pain from mouth or pharynx/larynx (CN X), or temporomandibular joint pain
- o Auditory tube allows spread of infection from the nasopharynx to the middle ear – note that it is easily blocked in infection, leading to hearing loss
- o Paralysis of stapedius → hyperacusia as movement is uninhibited

Final exam format:

Q1/Q2 – Essay questions, either/or. 60 marks, 60 minutes

Q3 – 3 out of 6 brief notes/short essay or label diagrams – 36 marks, 36 minutes

Q4 – Short answer questions or label diagrams (one or a few words) – 24 marks, 24 minutes

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