INFRATEMPORAL FOSSA

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RESOURCES

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Introduction

- The infratemporal fossa is a complex area located at the base of the skull, deep to the masseter muscle and zygomatic arch.
- It is associated with both the temporal and pterygopalatine fossae.
- It acts as a pathway for neurovascular structures passing from and to the cranial cavity, pterygopalatine fossa and temporal fossa.
The infratemporal fossa contains some of the muscles of mastication.

The lateral pterygoid splits the fossa contents in half:

- The branches of the **mandibular nerve** is located deep to the muscle.
- The **maxillary artery** is located superficial to the muscle.
BORDERS

- **Lateral:** condylar process and ramus of the mandible bone.
- **Medial:** lateral pterygoid plate; tensor veli palatine, levator veli palatine and superior constrictor muscles.
- **Anterior:** posterior border of the maxillary sinus.
- **Posterior:** carotid sheath.
- **Roof:** greater wing of the sphenoid bone.
- **Floor:** medial pterygoid muscle.
MUSCLES

- The infratemporal fossa is linked to the muscles of mastication.
- The **medial** and **lateral pterygoids** are located within the fossa.
- The **masseter** and **temporalis muscles** insert and originate into the borders of the fossa.
NERVES

- **Mandibular Nerve**
  - It is a branch of the trigeminal nerve (CN V).
  - It enters the fossa via the foramen ovale, giving rise to motor and sensory branches.
  - The sensory branches continue inferiorly to provide innervation to some of the cutaneous structures of the face.

- **Auriculotemporal, Buccal, Lingual and Inferior Alveolar Nerves**
  - Sensory branches of the trigeminal nerve.

- **Chorda Tympani**
  - It is a branch of the facial nerve (CN VII).
  - It follows the anatomical course of the lingual nerve and provides taste innervation to the anterior 2/3 of the tongue.

- **Otic Ganglion**
  - It is a parasympathetic collection of neurone cell bodies.
  - Nerve fibres leaving this ganglion hitchhike along the auriculotemporal nerve to reach the parotid gland.
BLOOD SUPPLY

- **Maxillary artery**
  - The terminal branch of the external carotid artery. It travels through the infratemporal fossa.
  - Within the fossa, it gives rise to the middle meningeal artery, which passes through the superior border via the foramen spinosum.

- **Pterygoid venous plexus**
  - Drains the eye and is directly connected to the cavernous sinus.
  - It provides a potential route by which infections of the face can spread intracranially.

- **Maxillary vein**
- **Middle meningeal vein**
MANDIBULAR NERVE
INTRODUCTION

- The mandibular nerve is a terminal branch of the trigeminal nerve.
- It has a sensory role in the head, and is associated with parasympathetic fibres of other cranial nerves.
- Mandibular nerve is the only branch of trigeminal nerve that has a motor function.
MANDIBULAR NERVE AND DENTAL WORK

- The mandibular nerve plays a role just about every time you get dental work done, especially in the lower part of your mouth.
- Anytime you have dental work done, you'll face a small risk of permanent nerve damage.
- Wisdom tooth extraction is a common case in which patients face this risk.
- And in any dental surgery, you'll need local anaesthesia, so your mandibular nerve won't transmit pain messages during the surgery.
- Local anaesthetics block the part of the nerve that is affected.
- However, nerve damage also makes a rare complication for procedures like dental implants and other dental surgeries.
- That's why you should always work with an experienced, responsible dentist who can minimize your risk.
The mandibular nerve contains both sensory and motor axons.

It originates from three sensory nuclei (mesencephalic, primary sensory and spinal nuclei of trigeminal nerve) and one motor nucleus (motor nucleus of the trigeminal nerve) respectively.

The motor root runs along the floor or the trigeminal cave, beneath the ganglion, joining the sensory root before leaving the cranium through the foramen ovale.

Once the mandibular branch exits from the cranium, it courses through the infratemporal fossa, branching into four tributaries.
AURICULOTEMPORAL NERVE

- The auriculotemporal branch arises from the trigeminal nerve as two roots:
  - **Superior root** comprises sensory fibers.
  - **Inferior root** carries secretory-motor parasympathetic fibers, originating from CN IX, to the parotid gland.

- The secretory-motor fibers run to synapse in the otic ganglion, while the sensory fibers pass through the ganglion without synapsing to eventually innervate:
  - Anterior part of the auricle
  - Lateral part of the temple
  - Anterior external meatus
  - Anterior tympanic membrane
The buccal branch of the mandibular nerve contains sensory fibres.

As it emerges from the mandibular nerve, it passes between the two heads of the lateral pterygoid muscle before heading to its target sites.

The nerve provides general sensory innervation to the buccal membranes of the mouth.

It also branches to supply the second and third molar teeth, which is important when performing dental work on those structures.
INFERIOR ALVEOLAR NERVE

- The inferior alveolar nerve carries both sensory and motor axons to and from the respective trigeminal nuclei.
- It gives rise to the mylohyoid nerve, a motor nerve to the mylohyoid and anterior digastric muscles.
- The remaining sensory axons enter the mandibular canal, a narrow tunnel running through the mandible bone.
- Within this canal the nerve provides branches to the mandibular teeth.
- The nerve emerges through the mental foramen as the mental nerve.
- This provides sensory innervation to the lower lip and chin.
LINGUAL NERVE

- The lingual nerve carries general sensory axons.
- It also acts as a canal for special sensory and autonomic fibers belonging to the chorda tympani, a branch of the facial nerve (CN VII).
- General sensory fibers innervate the anterior 1/3 of the tongue, as well as the mucus membrane lining its undersides.
- The special sensory fibers carry on with the lingual nerve to provide taste to the anterior 1/3 of the tongue.
- The autonomic fibers branch to synapse in the submandibular ganglion, eventually innervating the submandibular and sublingual glands.
SENSORY FUNCTIONS

- The sensory fibres associated with the mandibular branch of trigeminal nerve provide innervation to:
  - The facial skin in the lower third of the face, including the chin and lower lip.
  - Inferior row of teeth and gingiva.
  - The anterior two thirds of the tongue.
- These functions are distributed between the four branches of the nerve, as described previous slide.
MOTOR FUNCTIONS

▪ The mandibular nerve is the only branch of trigeminal to conduct motor axons to the muscles of the head and neck.

▪ The motor root of the trigeminal nerve joins the sensory component distal to the trigeminal ganglion and distributes its axons to the muscles of mastication:
  • Masseter
  • Medial and lateral pterygoids
  • Temporalis

▪ In addition to enabling mastication, the mandibular nerve also innervates muscles involved in several other processes:
  • Tensor tympani: dampens sounds, such as those created by chewing, by stabilizing the malleus bone in the middle ear
  • Tensor veli palatini: helps elevate the soft palate to prevent regurgitation of food and liquid into the nasopharynx.
  • Anterior belly of digastric: a suprathyroid muscle involved in elevation of the hyoid bone during swallowing
  • Mylohyoid: a suprathyroid muscle involved in elevation of the hyoid bone during swallowing
The trigeminal nerve does not have an autonomic nucleus and, as such, does not give rise to any autonomic axons directly.

However, all three branches of trigeminal nerve take on autonomic fibers of other cranial nerves to provide a passage to their respective targets.

The mandibular nerve is associated with parasympathetic secretory-motor fibers from two other cranial nerves.

**Facial Nerve**
- The chorda tympani nerve branches from the facial nerve in the region of the middle ear.
- It carries pre-synaptic parasympathetic fibers which join the lingual branch of the mandibular nerve, before branching to synapse in the submandibular ganglion.
- These fibers go on and innervate the submandibular and sublingual salivary glands.

**Glossopharyngeal Nerve**
- Autonomic innervation of the parotid gland originates from CN IX, however the auriculotemporal nerve transmits the post-synaptic axons from the otic ganglion to the gland.
- They pass through the inferior of the two founding roots of the branch.
INFERIOR ALVEOLAR NERVE BLOCK

- The inferior alveolar nerve (branch of V3) travels through the mandibular foramen and mandibular canal.
- Within the mandibular canal, the inferior alveolar nerve forms the inferior dental plexus, which innervates the lower teeth.
- A major branch of this plexus, the mental nerve, supplies the skin and mucous membranes of the lower lip, skin of the chin, and the gingiva of the lower teeth.
- In some dental procedures which require a local anaesthesia, the inferior alveolar nerve is blocked before it gives rise to the plexus.
- The anaesthetic solution is administered at the mandibular foramen, causing numbness of area supplied by the inferior alveolar nerve.
- The anaesthetic fluid also spreads to the lingual nerve which originates near the inferior alveolar nerve, causing numbness of the anterior 2/3 of the tongue.
TEMPOMANDIBULAR JOINT
INTRODUCTION

- The temporomandibular joint (TMJ) is formed by the articulation of the mandible and the temporal bone of the cranium.
- It is located anteriorly to the tragus of the ear, on the lateral aspect of the face.
The temporomandibular joint consists of articulations between three surfaces; the mandibular fossa, articular tubercle (from the squamous part of the temporal bone), and the head of mandible.

This joint has a unique mechanism; the articular surfaces of the bones never come into contact with each other cause they are separated by an articular disk.

The presence of such a disk splits the joint into two synovial joint cavities, each lined by a synovial membrane.

The articular surface of the bones are covered by fibrocartilage, not hyaline cartilage.
LIGAMENTS

- There are three extracapsular ligaments.
- They act to stabilize the temporomandibular joint.
- **Temporomandibular ligament**
  - The major ligament, and it runs from the beginning of the articular tubule to the mandibular neck.
  - It is a thickening of the joint capsule, and acts to prevent posterior dislocation of the joint.
- **Sphenomandibular ligament**
  - Originates from the sphenoid spine, and attaches to the mandible.
- **Stylomandibular ligament**
  - A thickening of the fascia of the parotid gland.
  - Along with the facial muscles, it supports the weight of the jaw.
MOVEMENTS

- Movements at this joint are produced by the muscles of mastication, and the hyoid muscles.
- The two divisions of the temporomandibular joint have different functions.

**Protrusion and Retraction**

- The upper part of the joint allows protrusion and retraction of the mandible, which is the anterior and posterior movements of the jaw.
- The lateral pterygoid muscle is responsible for protrusion (assisted by the medial pterygoid), and the posterior fibres of the temporalis perform retraction.
- A lateral movement (i.e. for chewing and grinding) is achieved by alternately protruding and retracting the mandible on each side.

**Elevation and Depression**

- The lower part of the joint permits elevation and depression of the mandible; opening and closing the mouth.
- Depression is mostly caused by gravity.
- However, if there is resistance, the digastric, geniohyoid, and mylohyoid muscles assist.
- Elevation is very strong movement, caused by the contraction of the temporalis, masseter, and medial pterygoid muscles.
The arterial supply to the TMJ is provided by the branches of the external carotid, mainly the superficial temporal branch.

Other contributing branches include the deep auricular, ascending pharyngeal and maxillary arteries.

The TMJ is innervated by the auriculotemporal and masseteric branches of the mandibular nerve (CN V3).
The dislocation of the temporomandibular joint can occur via a blow to the side of the face, yawning, or taking a large bite. The head of the mandible slips out of the mandibular fossa, and is pulled anteriorly. The patient becomes unable to close their mouth. The facial and auriculotemporal nerves run close to the joint, and can be damaged if the injury is high-energy. Posterior dislocations of the TMJ are possible, but very rare, requiring a large amount of force to overcome the postglenoid tubercle and strong intrinsic lateral ligament.
MASTICATION
MUSCLES
INTRODUCTION

- The muscles of mastication are associated with movements of the jaw (temporomandibular joint).
- They are one of the major muscle groups in the head.
- There are four muscles:
  - Masseter
  - Temporalis
  - Medial pterygoid
  - Lateral pterygoid
- The muscles of mastication develop from the 1st pharyngeal arch.
- They are innervated by the mandibular nerve, which is a branch of the trigeminal nerve.
MASSETER MUSCLE

- It is the most powerful muscle of mastication.
- It is quadrangular in shape and has two parts: deep and superficial.
- The entire of the muscle lies superficially to the pterygoids and temporalis, covering them.

**Attachments:**
- The superficial part originates from maxillary process of the zygomatic bone.
- The deep part originates from the zygomatic arch of the temporal bone.
- Both parts attach to the ramus of the mandible.

**Actions:** Elevates the mandible, closing the mouth.

**Innervation:** Mandibular nerve.
TEMPORALIS MUSCLE

- The temporalis muscle originates from the temporal fossa – a shallow depression on the lateral aspect of the skull.
- The muscle is covered by tough fascia which can be harvested surgically and used to repair a perforated tympanic membrane.

**Attachments:**
- Originates from the temporal fossa.
- It condenses into a tendon, which inserts onto the coronoid process of the mandible.

**Actions:** Elevates the mandible, closing the mouth. Also, it retracts the mandible, pulling the jaw posteriorly.

**Innervation:** Mandibular nerve.
The medial pterygoid muscle has a quadrangular shape with two heads:

- Superficial and deep.

It is located inferiorly to the lateral pterygoid.

Attachments:

- The superficial head originates from the maxillary tuberosity and the pyramidal process of palatine bone.
- The deep head originates from the medial aspect of the lateral pterygoid plate of the sphenoid bone.
- Both heads attach to the ramus of the mandible near the angle of mandible.

Actions: Elevates the mandible, closing the mouth.

Innervation: Mandibular nerve.
LATERAL PTERYGOID MUSCLE

- The lateral pterygoid muscle has a triangular shape with two heads:
  - Superior and inferior.
- It has horizontally orientated muscle fibres, and thus is the major protractor of the mandible.
- **Attachments:**
  - The superior head originates from the greater wing of the sphenoid.
  - The inferior head originates from the lateral pterygoid plate of the sphenoid.
  - The two heads converge into a tendon which attaches to the neck of the mandible.
- **Actions:**
  - Bilaterally, the lateral pterygoids protract the mandible, pushing the jaw forwards.
  - Unilateral action produces the side to side movement of the jaw.
- **Innervation:** Mandibular nerve.
MAXILLARY NERVE
INTRODUCTION

- The maxillary nerve is the second branch of the trigeminal nerve, which originates embryologically from the 1st pharyngeal arch.
- The main trunk of the maxillary nerve leaves the pterygopalatine fossa via the infraorbital fissure.
- The primary function is sensory supply to the mid-third of the face.
NERVE COURSE

- After projecting from the trigeminal ganglion, the maxillary nerve passes through the lateral wall of the cavernous sinus, before leaving the skull through the **foramen rotundum**.

- It gives rise to numerous sensory branches:
  - Superior alveolar nerve (anterior, posterior and middle)
  - Middle meningeal nerve
  - Infraorbital nerve
  - Zygomatic nerve
  - Inferior palpebral nerve
  - Superior labial nerve
  - Pharyngeal nerve
  - Greater and lesser palatine nerves
  - Nasopalatine nerve
SENSORY FUNCTIONS

- The maxillary nerve terminal branches innervate the skin, mucous membranes and sinuses of derivatives of the maxillary prominence of the 1st pharyngeal arch:
  - Lower eyelid and its conjunctiva
  - Inferior posterior portion of the nasal cavity (superior anterior is CNV1)
  - Cheeks and maxillary sinus
  - Lateral nose
  - Upper lip, teeth and gingiva
  - Superior palate
PARASYMPATHETIC FUNCTION

- Post ganglionic fibres from the pterygopalatine ganglion (derived from the facial nerve) travel with the maxillary nerve to:
  - Lacrimal gland
  - Mucous glands of the nasal mucosa
TRIGEMINAL NEURALGIA

- Compression, degeneration or inflammation of the 5th cranial nerve may result in a condition called trigeminal neuralgia or tic douloureux (spasmodic contraction of the muscles in the face).
- This condition is characterized by recurring episodes (recurrent attacks) of intense stabbing pain radiating from the angle of the jaw along a branch of the trigeminal nerve.
- Usually involves maxillary & mandibular branches, rarely in the ophthalmic division.
- Usually, the problem comes from the contact between a normal blood vessel and the trigeminal nerve at the base of the brain. This contact puts pressure on the nerve and causes it to malfunction.
- Trigeminal neuralgia can occur as a result of aging, or it can be related to multiple sclerosis or a similar disorder that damages the myelin sheath protecting certain nerves.
- Trigeminal neuralgia can also be caused by a tumour compressing the trigeminal nerve.
PTERYGOPALATINE FOSSA
INTRODUCTION

- The pterygopalatine fossa is a bilateral, cone-shaped depression extending deep from the infratemporal fossa all the way to the nasal cavity via the sphenopalatine foramen.
- It is located between the maxilla, sphenoid and palatine bones, and communicates with other regions of the skull and facial skeleton via several canals and foramina.
- Its small volume combined with the numerous structures that pass through makes this a complex region for anatomy students.
BORDERS

- The borders of the pterygopalatine fossa are formed by the palatine, maxilla and sphenoid bones:
  - **Anterior**: Posterior wall of the maxillary sinus.
  - **Posterior**: Pterygoid process of the sphenoid bone.
  - **Inferior**: Palatine bone and palatine canals.
  - **Superior**: Inferior orbital fissure of the eye.
  - **Medial**: Perpendicular plate of the palatine bone.
  - **Lateral**: Pterygomaxillary fissure.
Maxillary Nerve

- The maxillary nerve is the second branch of the trigeminal nerve.
- It passes from the middle cranial fossa into the pterygopalatine fossa through the foramen rotundum.

Maxillary Artery

- The maxillary artery is a terminal branch of the external carotid artery, and it lies within the pterygopalatine fossa.
- It separates into several branches which travel through other openings within the fossa to reach the regions they supply.
- These branches include:
  - Sphenopalatine artery (to the nasal cavity).
  - Descending palatine artery – branches into greater and lesser palatine arteries (hard and soft palates).
  - Infraorbital artery (lacrimal gland, and some muscles of the eye).
  - Posterior superior alveolar artery (to the teeth and gingiva).
Pterygopalatine Ganglion

- The pterygopalatine ganglion sits deep within the pterygopalatine fossa near the sphenopalatine foramen.
- It is the largest parasympathetic ganglion related to branches of the maxillary nerve and is predominantly innervated by the greater petrosal branch of the facial nerve.
- Postsynaptic parasympathetic fibres leave the ganglion and distribute with branches of the maxillary nerve.
- These fibres provide parasympathetic innervation to the lacrimal gland, and mucosal glands of the oral cavity, nose and pharynx.
FORAMINA

- There are seven foramina that connect the pterygopalatine fossa with the orbit, nasal and oral cavities, middle cranial fossa and infratemporal fossa.
- The openings transmit blood vessels and nerves between these regions.
- Pterygomaxillary Fissure: transmits two neurovascular structures:
  - Posterior superior alveolar nerve and terminal part of the maxillary artery.
- Foramen Rotundum: conducts a single structure, the maxillary nerve.
- Pterygoid canal: carries the nerve, artery and vein of the pterygoid canal.
- Pharyngeal canal: carries the pharyngeal branches of the maxillary nerve and artery.
- Inferior Orbital Fissure: the zygomatic branch of the maxillary nerve and the infraorbital artery and vein pass through the inferior orbital fissure.
- Greater Palatine Canal: transmits the descending palatine artery and vein, the greater palatine nerve and the lesser palatine nerve.
- Sphenopalatine Foramen: transmits the sphenopalatine artery and vein, as well as the nasopalatine nerve (a large branch of the pterygopalatine ganglion – CNV2).
MAXILLARY NERVE BLOCK

- Extensive dental surgery may require total nerve block of the maxillary branch of the trigeminal nerve.
- The maxillary nerve in the pterygopalatine fossa is most often approached intraorally via the greater palatine canal.
CHRONIC EPISTAXIS

- The sphenopalatine artery is often referred to as the **artery of epistaxis** (nosebleed).
- In cases of chronic epistaxis, the pterygopalatine fossa can be surgically approached via the maxillary sinus, and the artery ligated to control bleeding.
QUESTIONS?
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