BY. DR. MATTHEW A. OKEKE.

SUBMANDIBULAR REGION:

DEFINITION(S) AND INTRODUCTION:

It is a region between the mandible and the Hyoid bones. It is formed by the Submental and Submandibular triangles. It contains the Submandibular gland. Skeletal support is provided by the mandible and the Hyoid bone.

The Mandible is the site of attachment of some of the Suprahyoid muscles and all muscles of mastication [Masseter, Medial and Lateral pterygoid, and Temporalis].

In adults, the mandible, which normally contains sixteen (16) permanent teeth, articulates with the temporal bone of the skull through the TEMPOROMANDIBULAR JOINT [TMJ].

The Hyoid bone is at the level of 3rd Vertebra Cervical [C III] does not articulate with other bones, and is suspended by ligament and the Suprahyoid and Infrahyoid muscles. It is linked to the thyroid cartilage through the Thyrohyoid membrane.

The Hyoid muscles therefore, move the larynx both superiorly and inferiorly during swallowing and speech.

CONTENTS:

(A) MUSCLES:

(1) DIGASTRIC MUSCLE:

This is the most superficial of muscles of Submandibular region, which has two bellies [Anterior and Posterior] connected by an intermediate tendon attached by the Hyoid bone via a "fascial pulley".

(a) STYLOHYOID MUSCLE

It extends from the Styloid process of the Temporal bone to the Hyoid bone. It is perforated by the tendon of the Digastric muscle at the Hyoid bone to create the 'Fascial pulley'

P.T.O.

(3) MYLOHYOID MUSCLE:
It is deep to the Anterior belly and superior to the Posterior belly of the digastric muscle and forms the floor of the mouth. It is a sheet-like muscle that extends through the Mylohyoid Line of the Mandible to the Hyoid bone.

Note: Lymph nodes and neurovascular structures of the Submandibular region are Superficial to the Mylohyoid muscle.

(4) GENIOHYOID MUSCLE
It emerges from the internal surface of the Mandible and attaches to the Hyoid bone, from the Mentine and deep to the Mylohyoid muscle.

5) HYPOGLOSSUS MUSCLE:
It emerges lateral and posterior to Geniohyoid muscle, attaches the Hyoid bone to the base of the tongue.

(B) SUBMANDIBULAR GLANDS.
The main function of the Submandibular glands is to contribute to the production of Saliva, which helps to lubricate the oral cavity and aids in the chemical digestion of food. The saliva also coats the food bolus, which makes it easier to swallow.

(C) SUBMANDIBULAR TRIANGLE:
It is an important anatomic landmark located underneath the body of the Mandible. The majority of the anatomic space bounded by the Submandibular Triangle consists of the Submandibular gland.

2 parts of SUBMANDIBULAR GLAND.

(i) Superficial lobe
(ii) Deep lobe.

Lying Superiorly to the Digastric muscles, each Submandibular gland is divided into the Superficial and deep lobes, which are separated by the Mylohyoid muscle.

(a) the Superficial lobe: Comprises most of the gland, with the Mylohyoid muscle runs under it.
(b) the Deep lobe: Is the smaller part.

NOTE THE DIFFERENCE BETWEEN THE SUBMANDIBULAR AND SUBLINGUAL GLANDS:

(1) SUBLINGUAL GLANDS:
Are below either side of your tongue, under the floor of your mouth.

(2) SUBMANDIBULAR GLANDS:
Are below your jaw and consists of two parts:-
(a) Superficial lobe (major).
(b) Deep lob (minor).

(3) NERVES:
Several Cranial nerves and their branches are associated with the Submandibular region.
(1) MANDIBULAR NERVE [V3] DIVISION OF TRIGEMINAL NERVE [V]
It is a mixed nerve motor and Seasory.
It gives off two nerves to the area:-
(a) FIRST BRANCH – The nerve to Mylohyoid (from the Inferior Alveolar nerve) – passes along the Mylohyoid groove on the

Medial surface of the Mandible and innervates the Mylohyoid muscle and the Anterior belly of the Digastric muscle.

(b) The Second branch:- The **LINGUAL NERVE** — It passes anteriorly and inferiorly from its origin in the Infratemporal fossa toward the tongue, carries **General Sensation** from the Anterior two-thirds [2/3rd] of the tongue, the mucosa of the floor of the mouth, and the Mandibular lingual gingiva and also contains taste and preganglionic parasympathetic nerve fibres from the FACIAL NERVE [VII] via CHORDA TYMPANI NERVE.

EXTRA NOTE

SUPRAHYOID MUSCLES	INFRAHYOID MUSCLES
Note: 4 on each side. They are: (1) Digastric (2) Stylohyoid (3) Mylohyoid (4) Geniohyoid	They are: (1) Sternohyoid (2) Omohyoid (3) Thyrohyoid (4) Sternothyroid
The Mylohyoids muscles of each side unite to form THE FLOOR OF THE MOUTH.	Note: Generally they are all depressors of the LARYNX.
	(1) STERNOTHYOID It acts directly on the Hyoid Cartilage, while others act indirectly via the Hyoid bone.

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SUPRAHYOID MUSCLES

INFRAHYOID MUSCLES [CONTINUED]

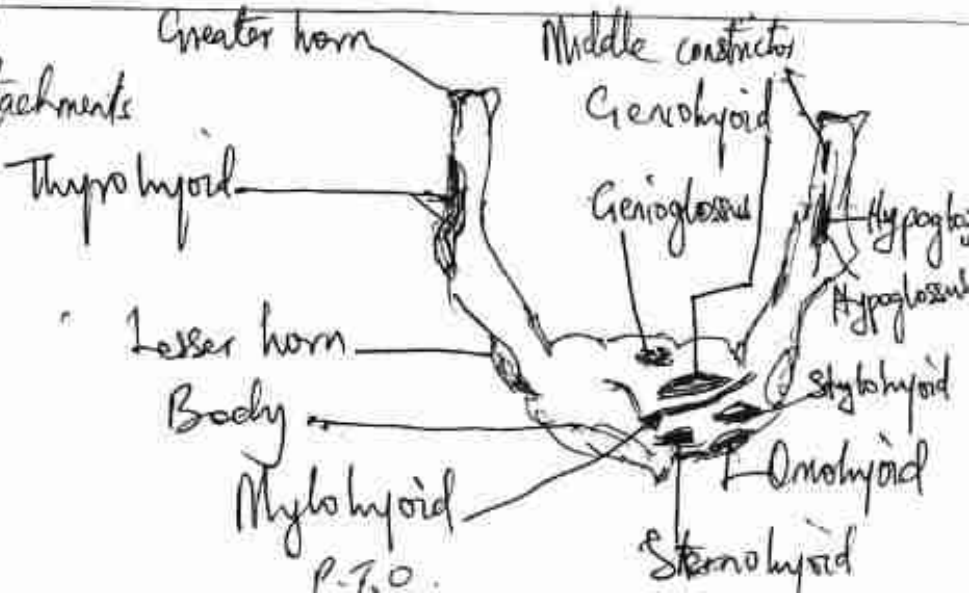
(2) Depression of larynx increases the volume of the resonating chambers during phonation and thus, affects vocalization and the quality of the voice.

(3) Infrahyoid muscles oppose the ELEVATORS OF THE LARYNX [Mylohyoid, Palato-pharyngeus, Stylopharyngeus and Salpingopharyngeus muscles] enabling them to act progressively and gradually.

(4) Infrahyoid muscles prevent ascent of the Hyoid bone when the Digastric and Geniohyoid muscle lower the Manchble.

HYOID BONE

From above with muscles attachments on the left side



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MUSCLE	ORIGIN	INSERTION	INNERVATION	ACTIONS	BLOOD SUPPLY
(1) DIGASTRIC — ANTERIOR BELLY	Digastric fossa of Mandible	Intermediate tendon through fibrous loop that attaches to the greater horn and the Body of Hyoid bone	Nerve to Mylohyoid from Mandibular nerve [V3]	Elevates Hyoid bones and base of tongue; fixes Hyoid bone; depresses Mandible	Submental Artery.
(2) DIGASTRIC — POSTERIOR BELLY	MASTOID NOTCH of TEMPORAL BONE	Intermediate tendon through fibrous loop that attaches to Greater Horn and BODY OF HYOID BONE.	FACIAL NERVE [VII]	Elevates Hyoid bone and base of the tongue; fixes hyoid bone; depresses Mandible	Muscular branches of occipital and posterior auricular arteries.
(3) STYLOHYOID MUSCLE	Styloid process of temporal bone	Hyoid bone at the junction of the body.	FACIAL NERVE [VII] → [Marginal Mandibular branch.]	Retracts hyoid bone and base of the tongue	Muscular branches of the FACIAL and Occipital arteries.
(4) MYLOHYOID MUSCLE	Mylohyoid line on Medial Surface of the Mandible	Median Mylohyoid Raphe.	Nerve to the Mylohyoid from Mandibular nerve [V3]	Elevates floor of the mouth and Hyoid bone and depresses Mandible.	Mylohyoid branch of Inferior Alveolar Artery, Submental branch of facial artery and Sublingual branch of Lingual artery.
(5) GENIOHYOID MUSCLE	Inferior Mental spine, Symphysis of Mandible	Anterior aspect of body of Hyoid bone.	Branch of C1 through Hypoglossal nerve (XII)	Protudes the Hyoid bone and the tongue	Sublingual branch of Lingual artery

SUMMARY OF CONTENTS OF SUBMANDIBULAR REGION.

(1) MUSCLES

(a) SUPRAHYOID MUSCLES
Digastric, Stylohyoid, Mylohyoid, Geniohyoid

(b) MUSCLES OF TONGUE:
Hyoglossus, Styloglossus, Genioglossus.

(2) SALIVARY GLANDS:
Submandibular and Sublingual

(3) NERVES:
Lingual, Hypoglossal, Glossopharyngeal

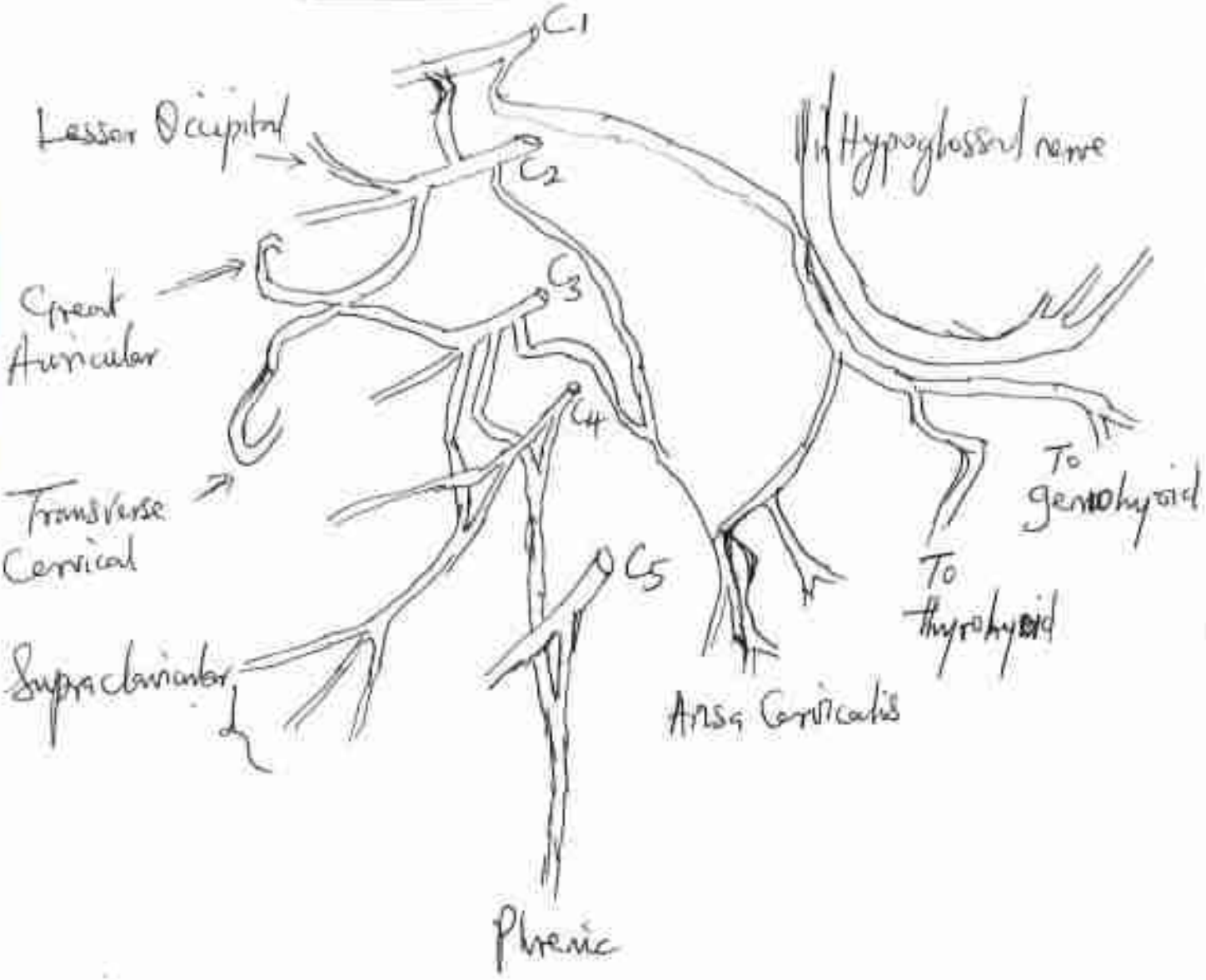
(4) BLOOD VESSELS:
Facial Artery, Lingual Artery, Veins of Tongue.

(5) GANGLION
Submandibular Ganglion.

(6) NAMES OF STRUCTURES RELATED TO THE SUPERFICIAL SURFACE OF HYOGLOSSUS MUSCLE:
From above downwards are:
- Styloglossus muscle
- Lingual nerve
- Submandibular ganglion
- Submandibular gland with its ducts.
- Hypoglossal nerve (Cr. N. XII)

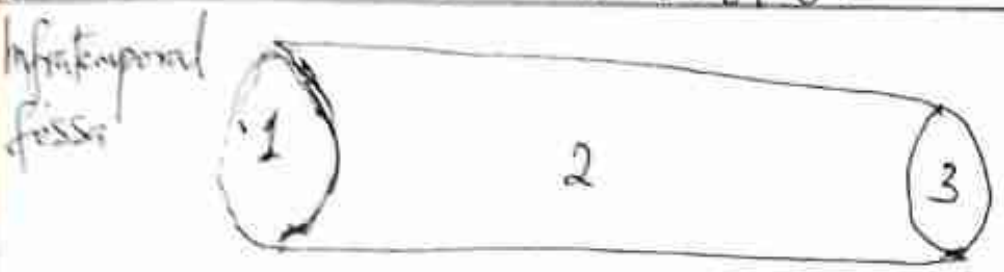
(7) NAMES OF STRUCTURES PASSING DEEP TO POSTERIOR BORDER OF HYOGLOSSUS MUSCLE ARE:
- Stylohyoid Ligament
- Glossopharyngeal nerve
- Lingual Artery.

RIGHT CERVICAL PLEXUS



PTERYGOPALATINE FOSSA.

BY DR MATTHEW A. OKEKE.



(1) Pterygomaxillary fissure
(2) Pterygopalatine Fossa
(3) Sphenopalatine Foramen

PTERYGOPALATINE FOSSA [PPF] OR REGION.

DEFINITIONS:

(1) It's a small clinically inaccessible fat-filled spaced located in the deep face that serves as a major neurovascular crossroad between the oral cavity, nasal cavity, nasopharynx, orbit, masticator space and the middle fossa.

(2) The fossa is a bilateral, cone-shaped depression extending from the infratemporal fossa 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.

(3) It's the indented area medial to the Pterygomaxillary fissure leading into the Sphenopalatine foramen.

(4) It's sometimes called the Sphenopalatine fossa. It's a cavity in our skull that sits behind the maxilla. It's an inverted

P.T.O.

Pyramidal-shaped fat-filled space located on the lateral side of the skull between the infratemporal fossa and the Nasopharynx. It is known as a major neurovascular crossroad between the orbit, nasal cavity, nasopharynx, the oral cavity, the infratemporal fossa and the Cranial fossa.

Given the importance and intricate complex location and connections of the Pterygopalatine fossa can act as a natural conduit for spread of inflammatory and neoplastic (cancerous) diseases in the head and neck.

It serves as a GATEWAY to other regions of the skull. Familiarizing with the complex anatomy of the pterygopalatine fossa, will give a better understanding of its involvement in major pathological conditions.

BORDERS OF PTERYGOPALATINE FOSSA:

They are formed by the palatine, maxilla and Sphenoid bones.

(1) Anteriorly:
Posterior wall of the maxillary sinus

(2) Posteriorly:
Pterygoid process of the Sphenoid bone.

(3) Inferiorly:
Palatine bone and Palatine canals.

(4) Superiorly:
Inferior Orbital fissure of the Eye.

(5) Medially:
Perpendicular plate of the Palatine bone

(6) Laterally:-
Pterygomaxillary fissure.

CONTENTS OF PTERYGOPALATINE FOSSA:

Its small volume combined with the numerous structures that pass through it, makes this a "COMPLEX REGION".

Pterygopalatine fossa contains many important Neurovascular structures viz-a-viz /such as:

① Maxillary Nerve [V2] via Foramen Rotundum.
② Pterygopalatine Ganglion (Largest Parasympathetic Ganglion)
③ Maxillary Artery
④ Foramina.

First of all, let us know the SEVEN FORAMINA OR OPENINGS that connect the Pterygopalatine fossa with the Orbit, nasal and oral cavities, Middle Cranial fossa and Infratemporal fossa. Note that these openings transmit blood vessels and nerves between the above mentioned regions.

① PTERYGOMAXILLARY FISSURE

Is between infratemporal fossa and Pterygopalatine fossa.
It transmits two (2) neurovascular structures:

a) POSTERIOR SUPERIOR ALVEOLAR NERVE:

This is a branch of Maxillary nerve.
It exits through the fissure into the infratemporal fossa where it goes on to supply the maxillary molars.

b) TERMINAL BRANCH, OR PART OF THE MAXILLARY ARTERY:

It enters the Pterygopalatine fossa via the Pterygomaxillary fissure.

2) FORAMEN ROTUNDUM [NOTE MAXILLARY NERVE PASSES THROUGH IT]

It connects the Pterygopalatine fossa to the Middle Cranial fossa
It is one of the three (3) Openings in the posterior boundary of P.T.O.

the Pterygopalatine fossa.
* It conducts a SINGLE STRUCTURE, THE MAXILLARY NERVE.

(3 & 4) PTERYGOID AND PHARYNGEAL CANALS.

These two canals, along with the foramen rotundum, are the THREE OPENINGS IN THE POSTERIOR WALL OF THE PTERYGOPALATINE FOSSA.

(a) PTERYGOID CANALS:-
Runs from middle Cranial fossa and through the Medial Pterygoid Plate.
It carries the nerve, artery and vein of the Pterygoid canal.

(b) PHARYNGEAL CANAL:
It communicates with the Nasopharynx.
It carries the Pharyngeal branches of the MAXILLARY NERVE AND ARTERY.

(5) INFERIOR ORBITAL FISSURE:-

It forms the Superior boundary of the Pterygopalatine fossa and communicates with the Orbit.
It is a space between the Sphenoid and Maxilla bones.
It transmits the following:-
(a) Zygomatic branch of the Maxillary nerve and
(b) Infraorbital Artery and Vein pass through this Inferior Orbital fissure.

(6) GREATER PALATINE CANAL.

This lies in the Inferior boundary of the Pterygopalatine fossa, and communicates with the Oral Cavity.
This canal is formed by a Vertical groove in the palatine bone which is closed off by an articulation with the maxilla.
Branching from the GREATER PALATINE CANAL are the ACCESSORY LESSER PALATINE CANALS.

the Greater Palatine Canal transmits the DESCENDING PALATINE ARTERY AND VEIN, THE GREATER PALATINE NERVE AND THE LESSER PALATINE NERVE.

(7) SPHENOPALATINE FORAMEN;

This foramen is the ONLY OPENING in the Medial boundary. It connects the Pterygopalatine fossa to the Nasal Cavity — specifically, the Superior Meatus.

It is formed by the:

ⓐ Sphenopalatine notch of the Superior aspect of the perpendicular plate of the Palatine bone and

ⓑ the Body of the Sphenoid.

Sphenopalatine foramen transmits ⓐ the Sphenopalatine Artery and vein, as well as the

ⓑ Nasopalatine Nerve [A large branch of the Pterygopalatine Ganglion — Cranial Nerve V_2 [V_2].

CLINICAL ANATOMY

① NOSEBLEED OR EPISTAXIS

Sphenopalatine Artery is often referred to as ARTERY OF EPISTAXIS [OR NOSEBLEED]

This occurs in the KIESSELBACH'S PLEXUS IN THE LITTLE'S AREA OF THE NOSE.

In chronic cases of Epistaxis, the Pterygopalatine fossa can be surgically approached via the MAXILLARY SINUS AND THE ARTERY LIGATED TO CONTROL BLEEDING.

P.T.O.

② ANAESTHESIA

In extensive Dental Surgeries requiring TOTAL NERVE BLOCK of the MAXILLARY BRANCH (V2) OF TRIGEMINAL NERVE, the MAXILLARY NERVE IN THE PTERYGOPALATINE FOSSA is most often approached intraorally via the GREATER PALATINE CANAL.

③ SLUDER NEURALGIA

SOMETIMES SPHENOPALATINE NERVE IS ATRIBUTED TO SLUDERS NEURALGIA, where there is Symptom Complex Consisting of neuralgic, motor, Sensory and gustatory Manifestations due to involvement of Spheropalatine ganglion.

Treatment of this Synchome is directed at the ganglion which successfully alleviates these Symptoms.

④ Pterygopalatine Ganglion is sometimes refered to as Ganglion of Sluder because it is ~~reported~~ as well as Sphenopalatine Ganglion too. can be referred again as Meckel's Ganglion, or Nasal Ganglion. It's responsible for housing the post-ganglionic parasympathetic neuronal cells bodies, in addition to acting as a Conduit for post-ganglionic Sympathetic and Sensory axonal fibres. The fibres that arise from the Pterygopalatine ganglion regulate Secretomotor functions to and provide sensation from various structures that include:

the Lacrimal glands,
Mucous membranes of the Oropharynx,
Nasopharynx,
Nasal cavity, and
Upper portion of Oral cavity.

Fibres from the Pterygopalatine ganglion are also responsible for providing innervation to the Cerebral and P.T.O.

Meningeal blood vessels. Any seasonal flen affects all these distribut
The Pterygopalatine ganglion is a structure that is morphologically formed during the third trimester of foetal life, with its neurones derived from Schwann cells precursors.

A group of Headache disorders referred to as TRIGEMINAL AUTONOMIC CEPHALALGIAS (TACS) which include CLUSTER HEADACHES, are thought to be influenced by the Pterygopalatine Ganglion.

Rx / Treatment

Usage of Pterygopalatine Ganglion blockade,
Radiofrequency Ablation, or
Neurostimulation of the
Pterygopalatine ganglion relieve the CLUSTER HEADACHES

FINALLY,

Located within the pterygopalatine fossa (PPF), the Pterygopalatine ganglion comprises the largest parasympathetic ganglion and it is one of the four ganglia located within the head region.

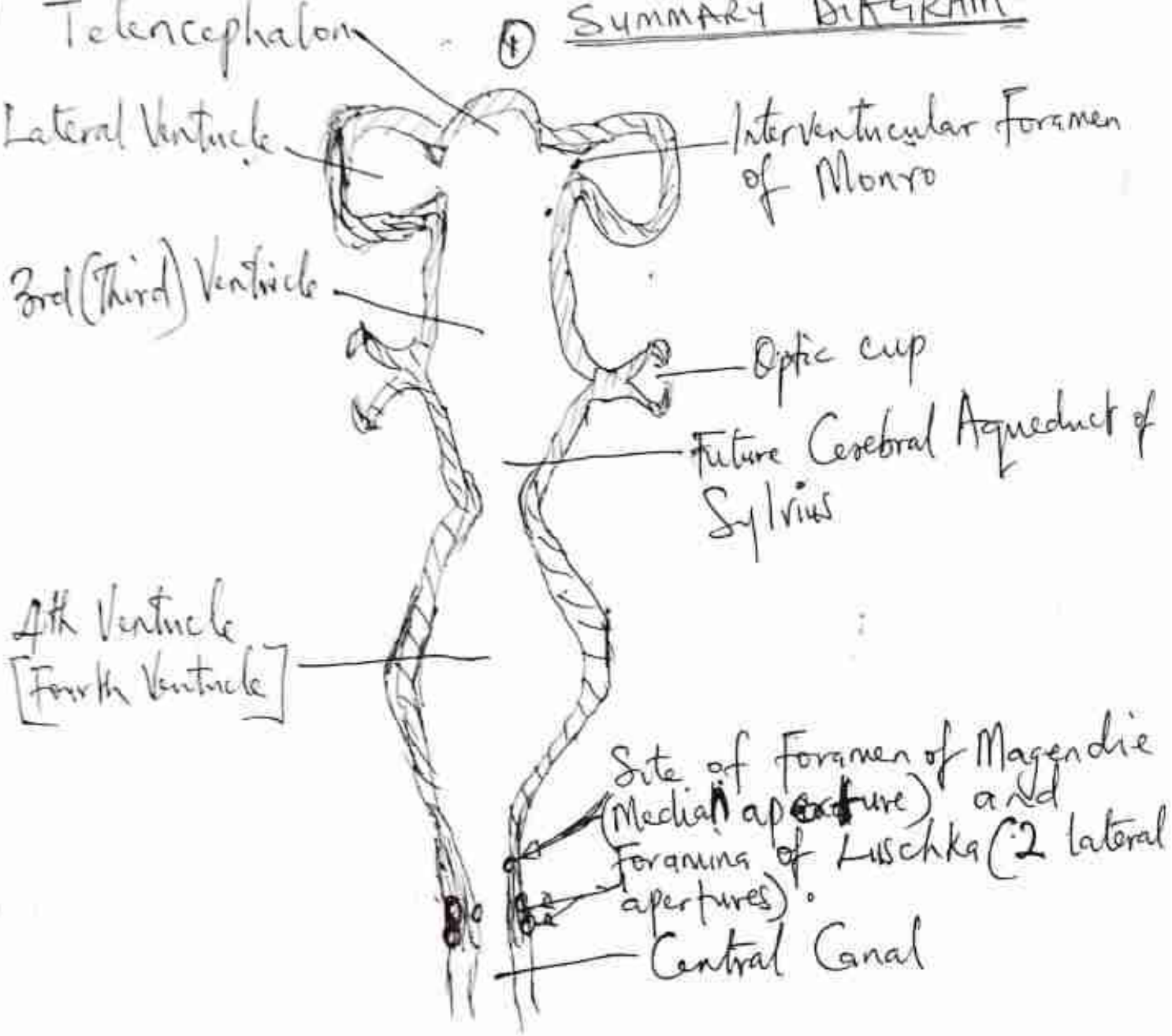
The Pterygopalatine ganglion includes an assortment of parasympathetic, sympathetic, and somatosensory nerve fibres

The Pterygopalatine ganglia exit as a bilateral pair, with each pterygopalatine located posterior to the lateral insertion of the middle nasal Concha, covered by a thin layer of mucosa in the Pterygopalatine fossa. The Pterygopalatine ganglion and Pterygopalatine fossa are bordered by the Maxillary Sinus anteriorly. the root of the Pterygoid process posteriorly; the perpendicular plate of the palatine bone medially; and the Pterygomaxillary fissure laterally.

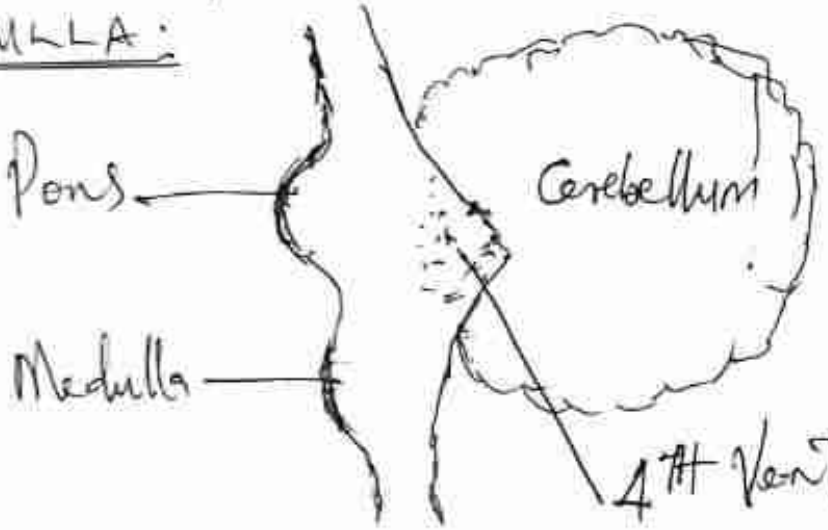
THE VENTRICLES OF THE BRAIN.

BY DR. MATTHEW AZUBUIKE OKERE.

① SUMMARY DIAGRAM:



② RELATIONSHIP OF FOURTH [4th] VENTRICLE TO PONS AND MEDULLA:



Bullet points:

- Lumen of the Spinal Cord is called the Central Canal, which is Continuous with that of the Brain vesicles.
- the cavity of the Rhombencephalon is known as the Fourth (4th) Ventricle.
- The cavity of the Diencephalon is the Third (3rd) Ventricle
- The cavities of Cerebral Hemisphere are the Lateral Ventricles (a cavity on each side).
- Communications:-

*— The Third (3rd) and Fourth (4th) Ventricles are connected to each other through the Lumen of the Mesencephalon, this lumen becomes very narrow and is then known as The Aqueduct of Sylvius.

*— The Lateral Ventricles communicate with the Third (3rd) Ventricle through the Interventricular Foramina of Monro.

*— The Fourth (4th) Ventricle communicate with the Central canal through medially by Foramen of Magendie and laterally by two (2) Foramina of Luschka (that is: Median aperture (midline) and 2 lateral apertures respectively). via Subarachnoid space for absorption by Arachnoid villi.

— FOURTH (4TH) VENTRICLE

Is located behind the pons and the upper aspect of medulla in the brainstem. It's continuous with the Aqueduct of Sylvius within the midbrain. It helps the Diamond-shaped Floor by the dorsal part of these parts of the brainstem. The Roof, or posterior wall is projected backwards like a tent Lying on its side, and covered by the Cerebellum. P.T.O.

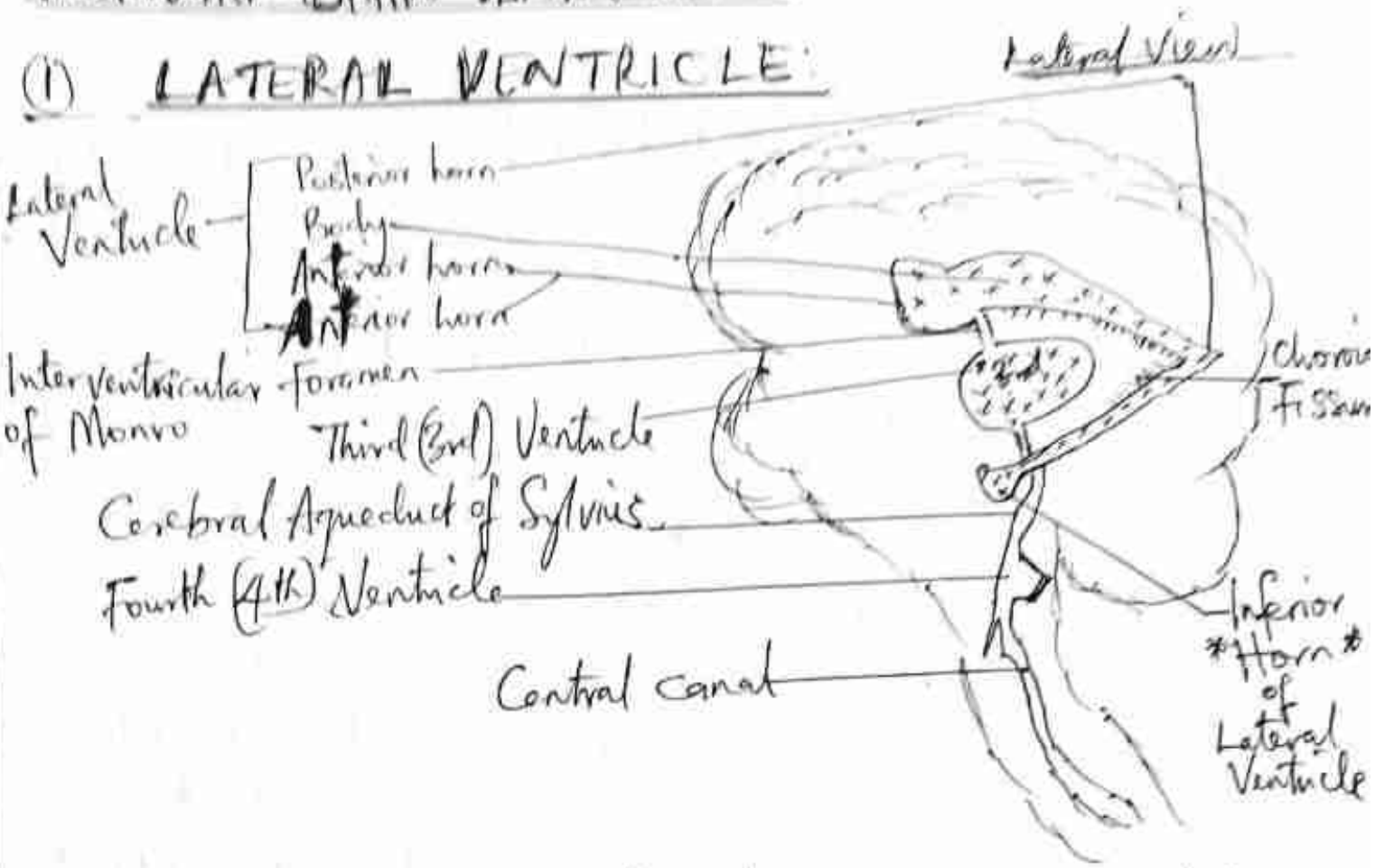
The cavity of the ventricle is triangular in Sagittal Section.
-the caudal part of each lateral borders is formed by the Gracile and Cuneate tubercles and the Inferior Cerebellar peduncle.
The Cranial part is formed by the Superior Cerebellar peduncle.
Part of the roof is perforated by a midline slit called the Median aperture [called Foramen of Magendie], by which Cerebrospinal fluid (CSF) escapes into the Cerebello-medullary Cistern. This cavity is prolonged laterally as a narrow lateral recess behind and around the Inferior Cerebellar peduncle.
The narrow tubular Lateral recess has a patent extremity, the Lateral aperture [called Foramen of Luschka], which opens anteriorly, just posterior or behind the Eight (8th) Cranial Nerve into the Pontine cistern.
Note that through these three apertures (One Median and two (2) Lateral), the CSF escapes from the Ventricular system into the Subarachnoid Space for absorption by the Arachnoid villi of the granulation.

*- Clinically:
These are the only exits from the Ventricular system and if they are blocked, following inflammation or disease for example Meningitis or lesion like Cancer, HYDROCEPHALUS Results (CSF accumulation in the cavities of the brain) with its Complications.

(1° 16)

INDIVIDUAL BRAIN VENTRICLES:

(1) LATERAL VENTRICLE:



Lateral ventricles are two irregular cavities situated one in each Cerebral hemisphere. Each ventricle communicates with the third (3rd) Ventricle through an Interventricular foramen of Monro [Also called Foramen of Monro].

Each Lateral Ventricle consists of:-

(1) Central part
(2) Three (3) horns: Anterior, Posterior and Inferior as seen above.

(1) CENTRAL PART

This extends from the Interventricular foramen of Monro in front to the splenium of the Corpus Callosum posteriorly or behind.

ANATOMY OF THE CENTRAL PART OF LATERAL VENTRICLE:

(1) Roof
Formed by the undersurface of the Corpus Callosum.

P.T.O.

(2) Floor
Formed by: From Lateral to Medial (inside):-
(a) Body of Caudate nucleus
(b) Stria Terminalis
(c) Thalamo-striate Vein
(d) Lateral part or portion of the Upper Surface of the thalamus.
(e) Choroid plexus
(f) Upper Surface of Symmetric half of body of fornix.

(3) Medial Wall of the Central portion of Lateral Ventricle:
It is formed by:
(a) Septum pellucidum
(b) Body of fornix

CHOROID FISSURE AND CHOROID PLEXUS:-

Choroid fissure is the line along which the choroid plexus invaginates into the lateral ventricle. It's a C-shaped slit in the medial wall of the Cerebral hemisphere. It starts at the interventricular foramen of Monro (above and in front) and passes around the thalamus and Cerebral peduncle to the Uncus (in the temporal lobe), therefore, it is present ONLY in relation to the **Central part** and **Inferior horn** of the lateral ventricle. Its convex margin is bounded by the fornix (body and crus), the fimbria and the hippocampus and its concave margin is bordered by the thalamus (Superior and posterior surfaces), the tail of the Caudate nucleus and the stria terminalis.

Note that at the choroid fissure, the **pia mater** and the **ependyma** come into **contact** with **each other** and both are invaginated into the ventricle by the choroid plexus.

P.T.O

In the central part of lateral ventricle, the choroid fissure is a "narrow gap" between the edge of the fornix and the upper surface of the thalamus. This narrow gap is invaginated by the choroid plexus which produces the Cerebrospinal fluid (CSF).

④ ANTERIOR HORN OF LATERAL VENTRICLE:
This lies in front of the interventricular foramen of Monro and extends into the frontal lobe. It is directed forwards, laterally and downwards, and it is triangular in shape.

ANATOMY OF ANTERIOR HORN OF THE LATERAL VENTRICLE:

ⓐ Anteriorly:
It is formed by the posterior surface of the genu and rostrum of the Corpus Callosum.

ⓑ Roof:
It is formed by anterior part of the trunk of the Corpus Callosum

ⓒ Floor:
It is formed by:
① Head of the Caudate nucleus.
② Upper surface of the rostrum of the Corpus Callosum.

ⓓ Medial Wall:
It is formed by the:
① Septum pellucidum
② Column of fornix.

(2B)

POSTERIOR HORN OF LATERAL VENTRICLE
It lies behind the Splenium of Corpus callosum and extends into the occipital lobe. It is directed backwards and medially too.

P.T.O.

ANATOMY OF POSTERIOR HORN OF LATERAL VENTRICLE:-

(A) FLOOR AND MEDIAL WALL:-

Formed by:

① Bulb of the posterior horn raised by the forceps major.

② Calcar avis raised by the Anterior part of the Calcarine Sulcus.

(B) ROOF AND LATERAL WALL

They are formed by the Tapetum fibres of Optic radiation.

(Q C)

INFERIOR HORN OF LATERAL VENTRICLE.

This is the Largest horn of the lateral Ventricle, beginning from the junction of the Central part with the posterior horn of the lateral Ventricle and extends into the temporal lobe.

ANATOMY OF INFERIOR HORN OF LATERAL VENTRICLE.

(A) ROOF AND LATERAL WALL:-

They are formed by the:

① Chiefly by the Tapetum

② Tail of Caudate nucleus

③ Stria Terminalis

④ Amygdaloid body.

(B) FLOOR:

It's formed by:-

① Collateral eminence raised by the Collateral Sulcus.

② Hippocampus, medially.

GENERAL NOTE:

In the Inferior horn of the lateral ventricle, which is the longest, the line of ependymal invagination by the Choroid plexus (i.e the choroid fissure) lies between the stria terminalis and the fimbria.

THIRD (3RD) VENTRICLE

GENERAL NOTE

It is very important to note that the Third (3rd) and Lateral Ventricles of the brain secrete the Cerebrospinal fluid (CSF) with the help of their choroid plexuses [Choroid tissue].

Location of Third Ventricle:

It is situated in the median cleft between the two THALAMI.

Embryology / Development:

It represents the cavity of Diencephalon, EXCEPT for the area in front of the Interventricular Foramen of Monro which is derived from the Median part of the TELENCEPHALON.

Histologically, the cavity is lined by EPENDYMA.

COMMUNICATIONS OF THIRD (3RD) VENTRICLE

Anterosuperiorly on each side, it communicates with the Lateral Ventricle through the INTERVENTRICULAR FORAMEN OF MONRO. This interventricular foramen of Monro is anteriorly bordered by the Column of the fornix and posteriorly by the tubercle of the thalamus.

Posteroinferiorly in the median plane, it communicates with the fourth (4th) Ventricle through the CEREBRAL AQUEDUCT OF SYLVIUS.

The third Ventricle is a VERY NARROW SPACE which is frequently and easily obstructed by local brain tumours, or by developmental defects. This obstruction leads to raised intracranial pressure in adults and Hydrocephalus in infants.

GENERAL NOTE:

The tumours in the lower part of the third Ventricle give rise to the hypothalamic symptoms like Diabetes insipidus, obesity, sexual disturbance, sleep disturbance, hyperglycaemia and Dysfunction. P.T.O

The choroid plexus of the third ventricle projects downwards from the roof. At the junction of the roof with the anterior and the lateral walls, there are the INTERVENTRICULAR FORAMINA.

(D) FLOOR

It is formed by hypothalamic structures:-

1. Optic chiasma
2. Tuber cinerium
3. Infundibulum [Pituitary stalk].
4. Mammillary bodies
5. Posterior perforated substance
6. Tegmentum of the midbrain.

At the junction of the floor with the anterior wall, there is the Optic recess.

(E) LATERAL WALL:

It is formed by the following:-

1. Medial surface of the thalamus (in its posterosuperior part).
2. Hypothalamus — (in its anteroinferior part).
3. the Hypothalamic sulcus — which separates the Thalamus from the Hypothalamus. This hypothalamic sulcus extends from the interventricular Foramen of Monro to the Cerebral Aqueduct of Sylvius.

GENERAL NOTE:

(a) the interthalamic adhesion connects the medial surfaces of the two thalami and crosses the ventricular cavity.
(b) The habenular stria lies at the junction of the roof and the lateral wall. The two stria join posteriorly at the habenular commissure.
(c) the columns of the fornix, as already indicated, run downward and backwards to reach the mammillary bodies.
The columns lie beneath the lateral wall of the ventricles.

Note
* — Dilatation of the third Ventricle would indicate obstruction at the lower level eg at the Cerebral Aqueduct of Sylvius.
* If the obstruction is in the third Ventricle, both the lateral Ventricles are dilated symmetrically
* — Obstruction at the interventricular foramen of Monro causes unilateral dilatation of the lateral Ventricle of that side asymmetrically.

RECESSES.

These are extensions of the Cavity. They are:-
(1) Suprapineal
(2) Pineal — upper lamina of the recess is traversed by habenular Commissure and lower lamina by the posterior Commissure.
(3) Infundibular [Latin word: Funnel]
(4) Optic
(5) Vulva — between the diverging columns of fornix.

BOUNDARIES OF THIRD (3RD) VENTRICLE

(A) ANTERIOR WALL:

(1) Lamina terminalis
(2) Anterior Commissure
(3) Anterior columns of fornix. The two columns of the fornix diverge, pass downwards and backwards, and sink into the lateral wall of the third Ventricle to reach the mammillary body.

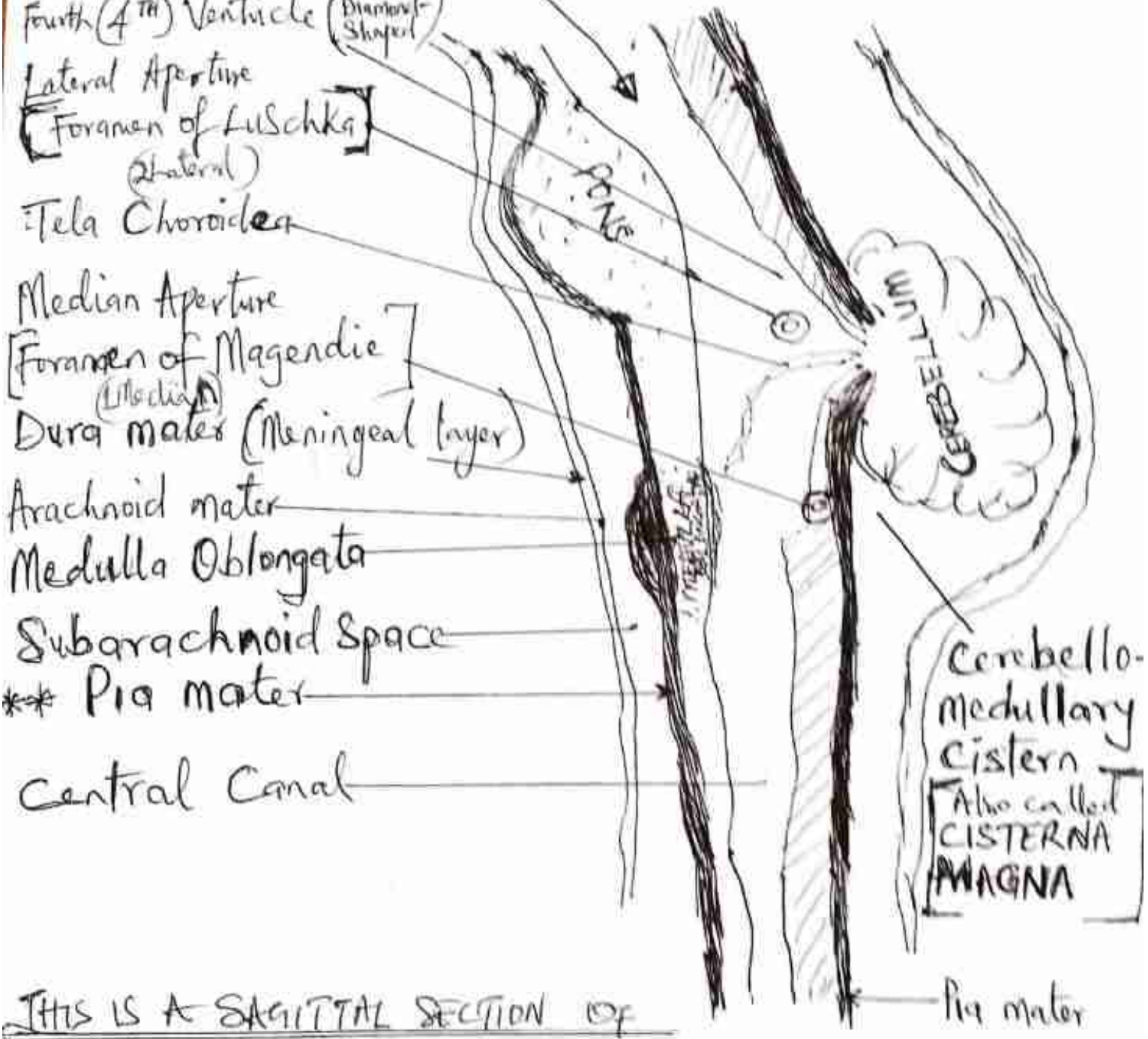
(B) POSTERIOR WALL:

(1) Pineal body
(2) Posterior commissure (in the lower lamina of the pineal stalk).
(3) Cerebral Aqueduct.

(C) ROOF:

It is formed by the body of fornix and the ependyma lining the under surface of the tela Choroidea of the third Ventricle. P.T.O

FOURTH (4TH) VENTRICLE:



THIS IS A SAGITTAL SECTION OF THE BRAINSTEM AND CEREBELLUM TO SHOW THE FOURTH (4TH) VENTRICLE.

Location:

The cavity of the fourth (4th) Ventricle is situated ♦ DORSAL TO PONS AND UPPER PART OF THE MEDULLA OBLONGATA AND VENTRAL TO THE CEREBELLUM.

P.T.O.

BORDERS / BOUNDARIES OF FOURTH (4TH) VENTRICLE:

(1) Lateral boundaries:
Gracile tubercle, Cuneate tubercle, Inferior Cerebellar peduncle and Superior Cerebellar peduncles.

(2) Floor:

(a) Upper Part:-
Facial colliculus on the dorsal surface of the pons.

(b) Intermediate Part:-
Vestibular nuclei, medullary striae.

(c) Lower Part:-
Upper part of Medulla oblongata containing Hypoglossal and Vagal triangles (i.e. Cranial nerves XII and X triangles) respectively.

(d) ROOF
Superior medullary velum, thin sheet of pia mater and ependyma with median aperture [Foramen of Magendie], inferior medullary velum

(e) RECESSES IN THE ROOF:-
One median dorsal; two lateral dorsal and two lateral.

(f) OPENINGS OR APERTURES:-
One Median — called Foramen of Magendie.
Two Lateral — called Foramen of Luschka left and right.

(g) COMMUNICATIONS OF FOURTH (4TH) VENTRICLE:-
Its cavity communicates with the Central canal inferiorly and superiorly, it communicates with the Cerebral Aqueduct of Sylvius. In afterwards, above with Cerebral Aqueduct of Sylvius and below with the P.T.O. Central canal of Spinal cord.

① Superiorly: It communicates with the Third (3rd) Ventricle through the Cerebral Aqueduct of Sylvius.

② Inferiorly: It is continuous with the Central canal of the medulla and the Spinal cord.

③ Dorsally:- In the lower part of the roof, there is a median aperture [Foramen of Magendie]. Through this aperture, the 4th Ventricle communicates with the Subarachnoid space (Cisterna Magna). The Subarachnoid space has villi in the granulation for reabsorption of Cerebrospinal fluid (CSF) on the Arachnoid granulation mainly

④ ON EITHER SIDE: Again, the 4th ventricle communicates with the Subarachnoid space through two lateral apertures called Foramina of Luschka where villi of Subarachnoid via granulation, re-absorb cerebrospinal fluid in Arachnoid granulation.

Note: Spinal Subarachnoid space is relatively large, accommodating about half (½) of the total volume of Cerebrospinal fluid (CSF) (75ml out of 150ml). It communicates through the Foramen Magnum with the Subarachnoid space of the posterior Cranial fossa. Some Cerebrospinal fluid percolates all way along the meningeal sheaths of the spinal nerves.

However, total production of Cerebrospinal fluid is over 500ml per day via choroid plexuses mainly those of the third and lateral Ventricles, but there is constant production and reabsorption which takes place mainly through the Arachnoid granulations. There is also some drainage through the CRIBRIFORM PLATE OF THE ETHMOID BONE in the anterior CRANIAL FOSSA INTO THE TISSUES OF THE NOSE AND SO INTO THE CERVICAL LYMPHATICS.

P.T.O

SPINAL ARACHNOID MATER

The spinal arachnoid mater lines the inner surface of the spinal dura, with only a potential space between these two membranes. Below the level of the spinal cord (i.e. over the Cauda equina) the arachnoid is nothing but a delicate membrane that is supported by the dura mater, but over the spinal cord itself the arachnoid sends many delicate processes across the subarachnoid space to the pia mater on the cord, forming a lace-like arrangement.

SPINAL SUBARACHNOID SPACE

It's relatively large, accommodating about half of the total volume of cerebrospinal fluid (CSF) [75 ml out of 150 ml]. It communicates through the Foramen Magnum with the subarachnoid space of the posterior cranial fossa. Some cerebrospinal fluid percolates away along the meningeal sheaths of the spinal nerves.

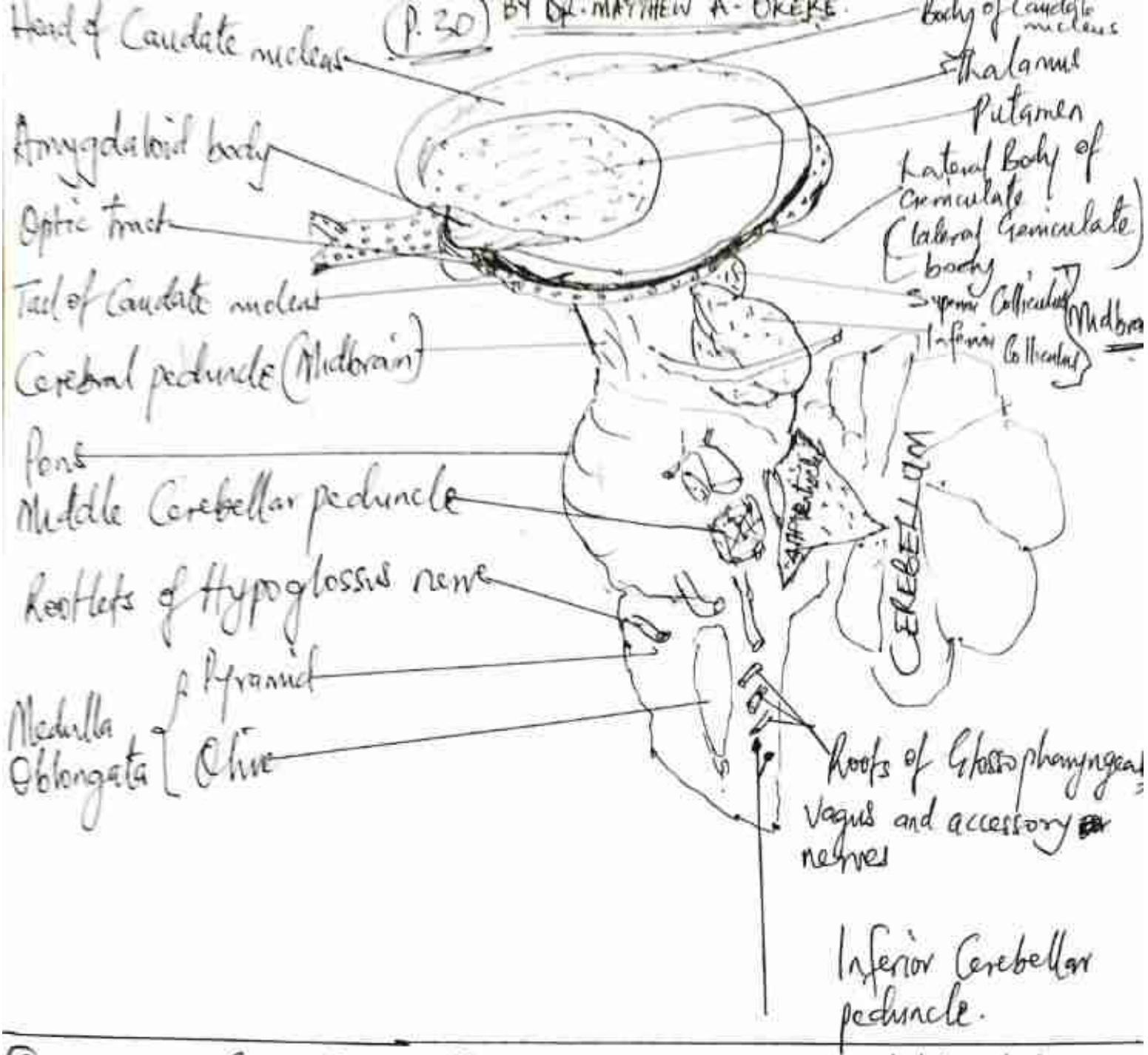
Below the level of the **conus medullaris** the space contains only the **Cauda equina** and **filum terminale**, in addition to cerebrospinal fluid, and it ends at the level of S2 vertebra.

SPINAL PIA MATER

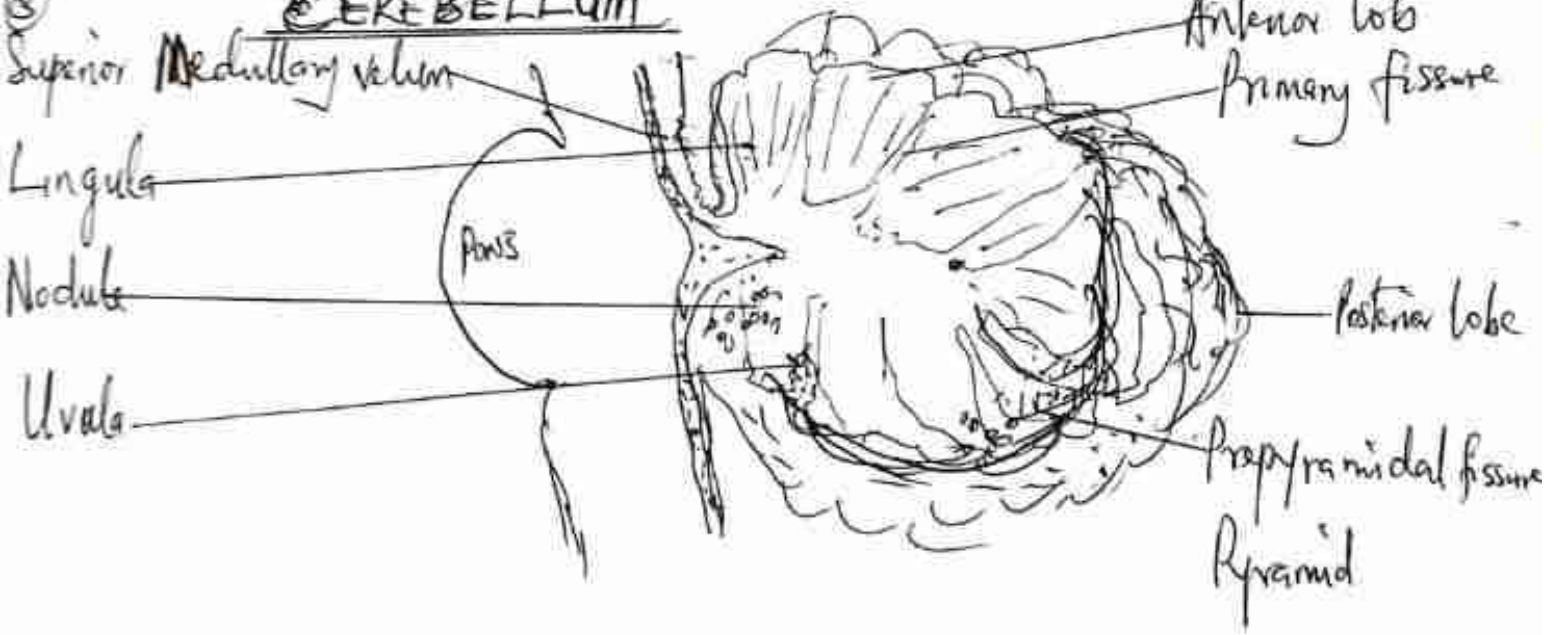
As in the cranium, spinal pia mater invests the surface of the central nervous system (CNS). It clothes the spinal cord and lines the anterior median sulcus. It is prolonged over the spinal nerve roots until where the dura blends with the epineurium of the mixed spinal nerves. It is projected below the apex of the Conus Medullaris, whence it extends as the filum terminale to perforate the spinal theca at the level of S2 vertebra. It then descends to the back of the Coccyx. The filum terminale lies centrally in the Cauda equina, but is not part of the Cauda which consists of nerve roots only. A lateral projection of pia mater on each side forms the **denticulate ligament**. This flange crosses the subarachnoid space between the anterior and posterior nerve roots and, piercing the arachnoid, connects the side of the spinal cord to the dura mater.

It is attached in an unbroken line along the spinal cord from the foramen magnum to the conus medullaris, but its lateral edge has a series of teeth-like projections, which are attached to the dura between successive nerve roots. There are usually twenty-one (21) such **dentate ligaments** on each side. The highest is attached to the dura just above the foramen magnum, behind the vertebral artery and in front of the spinal root of the accessory nerve. The lowest **dentate ligament** lies between the twelfth (12) Thoracic (T_{12}) and first (1st) Lumbar (L_1) nerve roots.

(P. 20) BY DR. MATTHEW A. OKEKE.



(2) CEREBELLUM



OSSIFICATION OF SKULL

It occurs in BOTH MEMBRANE AND CARTILAGE for example the cranial vault develops in membrane, while the skull base mainly in cartilage and the facial bones in membrane.

Accordingly, the frontal and parietal bones develop in membrane. At birth, the frontal bone is in two parts separated by the Metopic Suture. Fusion of this suture starts in the second (2nd) year and is completed by 7 years [However note, that the suture may persist in a small proportion of persons in which it must not be mistaken for a fracture line].

The mandible, maxilla, vomer, inferior concha and the zygomatic, nasal, lacrimal and palatine bones ossify in Membrane.

- Mandible is the second (2nd) bone (after the Clavicle which is the first bone to ossify in the body) to start ossifying in the foetus; it does so in the sixth (6th) week by an ossification Centre located lateral to Meckel's Cartilage (produced by first (1st) Arch before the chondrification).

As intramembranous bone formation continues, this first branchial arch cartilage becomes incorporated in the developing mandible. Only the Lingula and so occasional ossicles in the chin region of the mandible develop from Meckel's cartilage.

A cone-shaped secondary condylar cartilage appears in the tenth (10th) week and, although it is largely replaced by bone before birth, growth continues here until 20 to 25 years of age.

The squamous part of the occipital bone above the superior nuchal line ossifies intramembranously and the rest of the bone endochondrally.

The skull base component of the occipital bone develops from the sclerotomes of the four (4) occipital somites and a pair of parachordal cartilages on either side of the cranial end of the notochord.

At birth, the bone is in four (4) parts

① the Squamous part
② the median basiocciput and
③ A pair of (lateral) exoccipital parts

The Squamous and exoccipital parts fuse by the third (3rd) year and by the sixth (6th yr) year, while the whole bone is one entity.

Body of the sphenoid bone develops from pre-sphenoidal and post-sphenoidal cartilages, the latter forming the Sella turcica and dorsum sellae.

Endochondral ossification in the adjacent ala orbitalis and ala temporalis give rise to the lesser wing and a part of the Greater wing. The rest of the greater wing and the medial and lateral pterygoid plates ossify in membrane

At birth, the Sphenoid is in three parts:

① the greater wing being separate from a central part comprising of the body and lesser wings.

The three parts unite during the first year.

"At birth, the body of the Sphenoid is separated from the basiocciput by cartilage. this spheno-occipital synchondrosis (primary cartilaginous joint) begins to fuse between 12 and 14 years of age, allowing ossification to complete, that is ossification is not complete until 20 to 25 years of age, allowing for backward extension of the hard plate as more teeth erupt and providing space for the growing nasopharynx.

Premature fusion between the Sphenoid and occipital bones results in a depressed nasal bridge and a flat face.

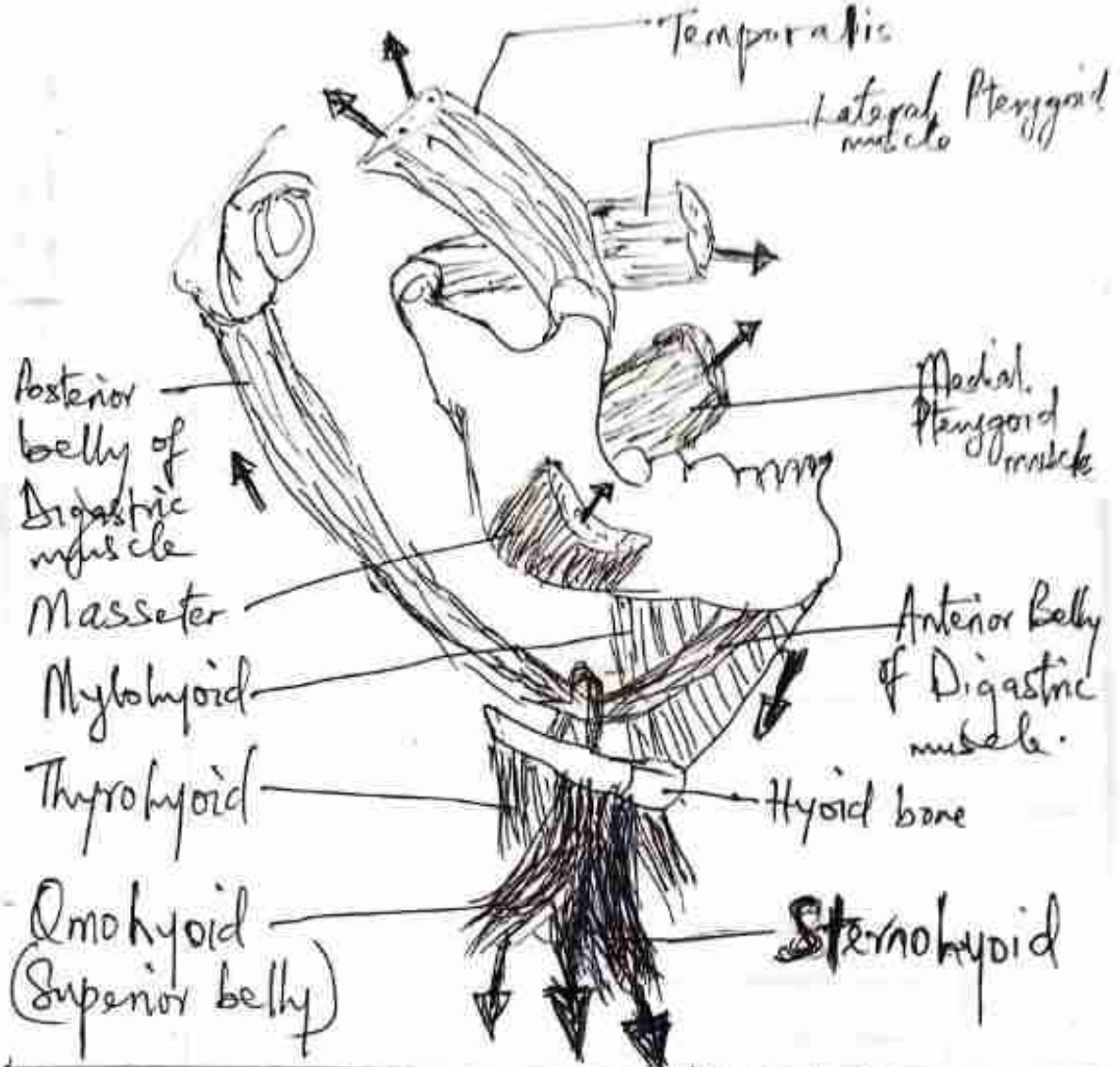
the Squamous and tympanic parts of the temporal bone ossify in membrane, while the petrous and styloid elements ossify in cartilage. the petrous part develops by ossification of the otic capsule. that houses the VESTIBULOCOCHLEAR APPARATUS.

(P. 23)

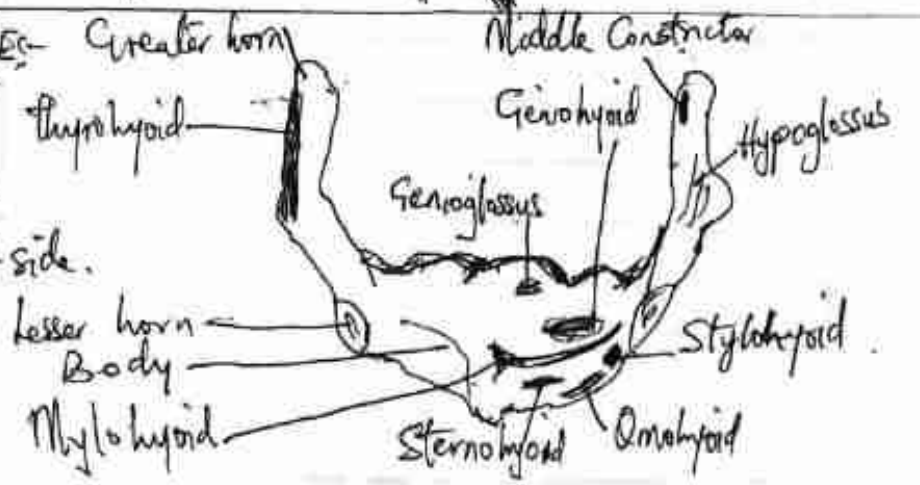
At birth, the temporal bone is in three parts; the squamous and tympanic components have united but are separate from the petrous part and styloid process.

All parts unite during the first (1st) year.

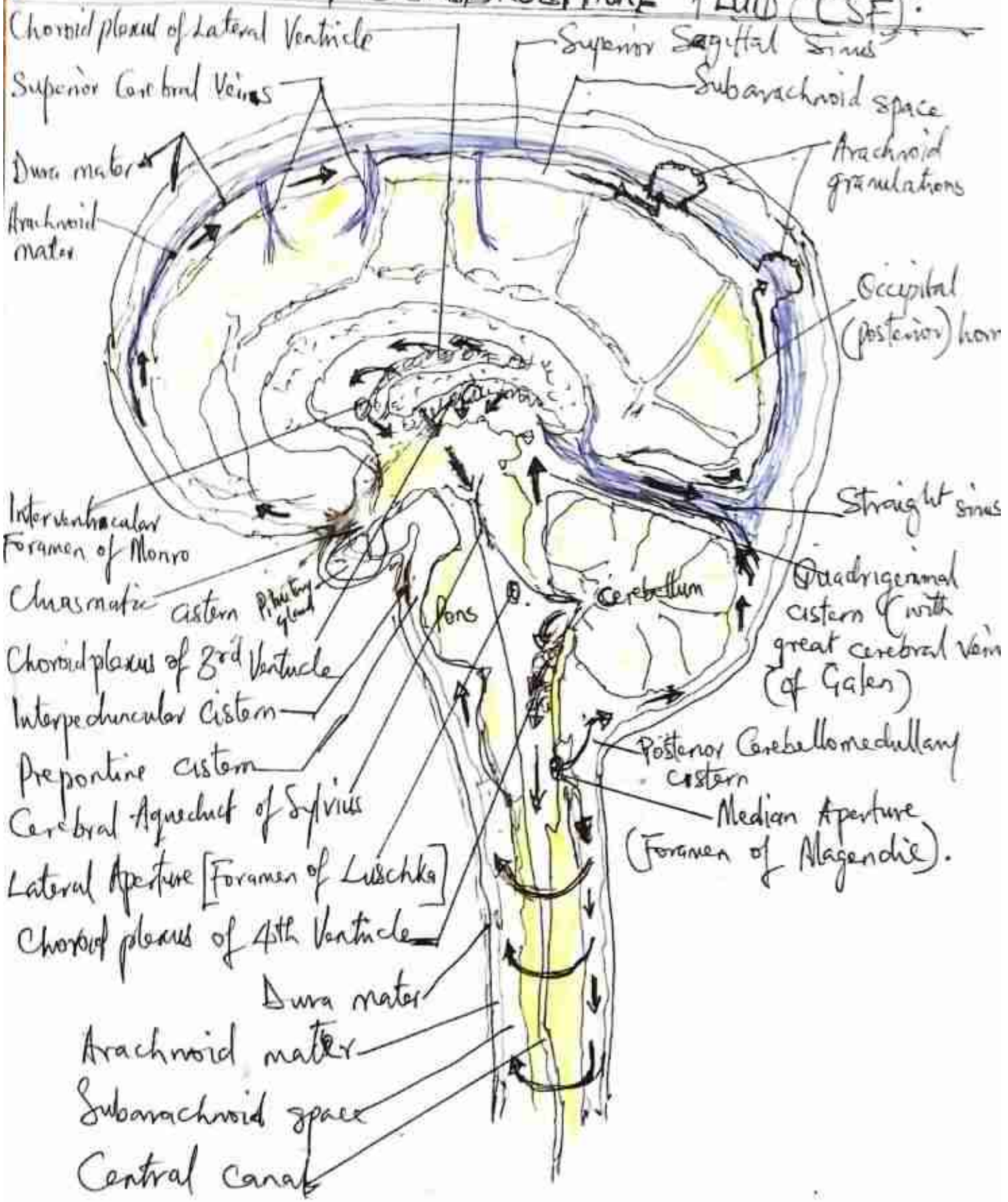
The secondary ossification centre for the styloid fuses with the rest of the process after puberty.



HYOID BONE:- From above with muscle attachments on the left side.



CIRCULATION OF CEREBROSPINAL FLUID (CSF):



INTRODUCTION

The cerebrospinal fluid (CSF) is the fluid that maintains the homeostasis in the brain in many of its functions. It provides a protective buffer for the neural tissues and acts as shock-

absorber, serves as waterbath of the brain, so that the brain can float and then reduces its (brain) weight from 1,500g weight to 50g weight, removes brain metabolites and through tight junction it helps in selective transport, a specialized form of active transport via the ependymal cells.

PRODUCTION, CIRCULATION AND COMPOSITION OF CEREBRO-SPINAL FLUID (CSF):-

Cerebrospinal fluid (CSF) is largely and mainly produced by the choroid plexuses of the lateral, third and Fourth Ventricles in the range of 70%.
The remaining 30% comes from other brain capillaries and seeps into the system via or through the extracellular fluid (ECF)

① CHOROID PLEXUSES — OF LATERAL, 3RD AND 4TH VENTRICLES (70% of production).

② OTHER BRAIN CAPILLARIES VIA EXTRACELLULAR FLUID (ECF) ⟹ 30%

Note
Total Volume of Cerebrospinal fluid is about 130mL [at a pressure of approximately 130 mm of water (i.e 130mm H_2O)], of which about 30mL are WITHIN THE VENTRICULAR SYSTEM and 100mL are in the SUBARACHNOID SPACE which is further divided into 75mL IN THE SPINAL PART and 25mL IN THE BRAIN OR CRANIAL PART.

FOR MEMORY SAKE:
TOTAL VOLUM ≃ 130 mL at 130mm H_2O pressure

CSF (P36)

FOR MEMORY SAKE:

TOTAL VOLUME ≥ 150mL at 130mm H_2O pressure.

30 mL — In the Ventricular System
100 mL — In the Subarachnoid space :-
which is shared a divided into:-
75mL — In the Spinal part.
25mL — In the cranial part.

Recall, these round numbers are only approximation for ease of remembering.

PRODUCTION AND REABSORPTION PROPER:

Total production per day is ≥ or above 500mL, but there is constant circulation and reabsorption which takes place MAINLY in ARACHNOID GRANULATIONS (reabsorption).

Note equally that there is also some drainage through the CRIBRIFORM PLATE OF THE ETHMOID BONE in the Anterior Cranial fossa into the tissues of the nose and so into the CERVICAL LYMPHATICS.

CIRCULATION AND COMMUNICATIONS:

Choroid plexuses of the Lateral, 3rd and 4th Ventricles produce 70% of the cerebrospinal fluid and the remaining 30% is by various brain capillaries which seeps in the system through the extracellular fluid (ECF).

The CSF in the two lateral ventricles drain into the 3rd Ventricle through the Interventricular foramen of Monro. While in the 3rd Ventricle, the choroid plexus of the cavity produces its own CSF to join, then through the Cerebral Aqueduct of Sylvius seeps into the 4th Ventricle. this chamber produces its own CSF to add to the one from third ventricle. The CSF in the 4th ventricle exits through the Foramina of one Median called foramen of Magendie and

the two lateral apertures or openings called Foramen of Luschka left and right, flow into the Cerebral canal after seeping into the Subarachnoid space which but villi and then is reabsorbed in the Arachnoid granulations. The cycle continues throughout life.

HOW EFFECTS OF PRESSURE AFFECTS CEREBROSPINAL FLUID CIRCULATION:

Please, Know the differences between the ARTERIAL and VENOUS PRESSURES here

① Changes in Arterial pressure have LITTLE effect on CSF pressure, but,

② Increases in Venous pressure with the accompanying distension or stasis of veins and venous sinuses within Skull, are rapidly and quickly reflected in CSF pressure increases or rises.

EQUALLY NOTE:

there is no BRAIN-CSF BARRIER.

RATHER, PLEASE, DON'T CONFUSE IT WITH SELECTIVE TRANSPORT MECHANISMS BY EPENDYMAL CELLS OF THE VENTRICLES.

HERE IT IS:

Ependymal cells cover the choroid plexuses of the Ventricles, have selective transport mechanisms and TIGHT JUNCTIONS BETWEEN ADJACENT CELLS that provide a BLOOD-CSF ~~BARRIER~~ (similar in other parts of body, Similar to BLOOD-BRAIN-BARRIER [BBB]).

FUNCTIONS OF CSF:-

① Provides protective buffer for neural tissues.
② Serves as waterbath to the brain to float.
③ Reduces the actual weight of brain from 1,500 g weight ≈ 50g because of the floatation acting as shock-absorber.
④ Removes the brain metabolites.
⑤ Contributes in BLOOD-CSF-BARRIER via actions of the ependymal cells and tight junctions between adjacent cells.