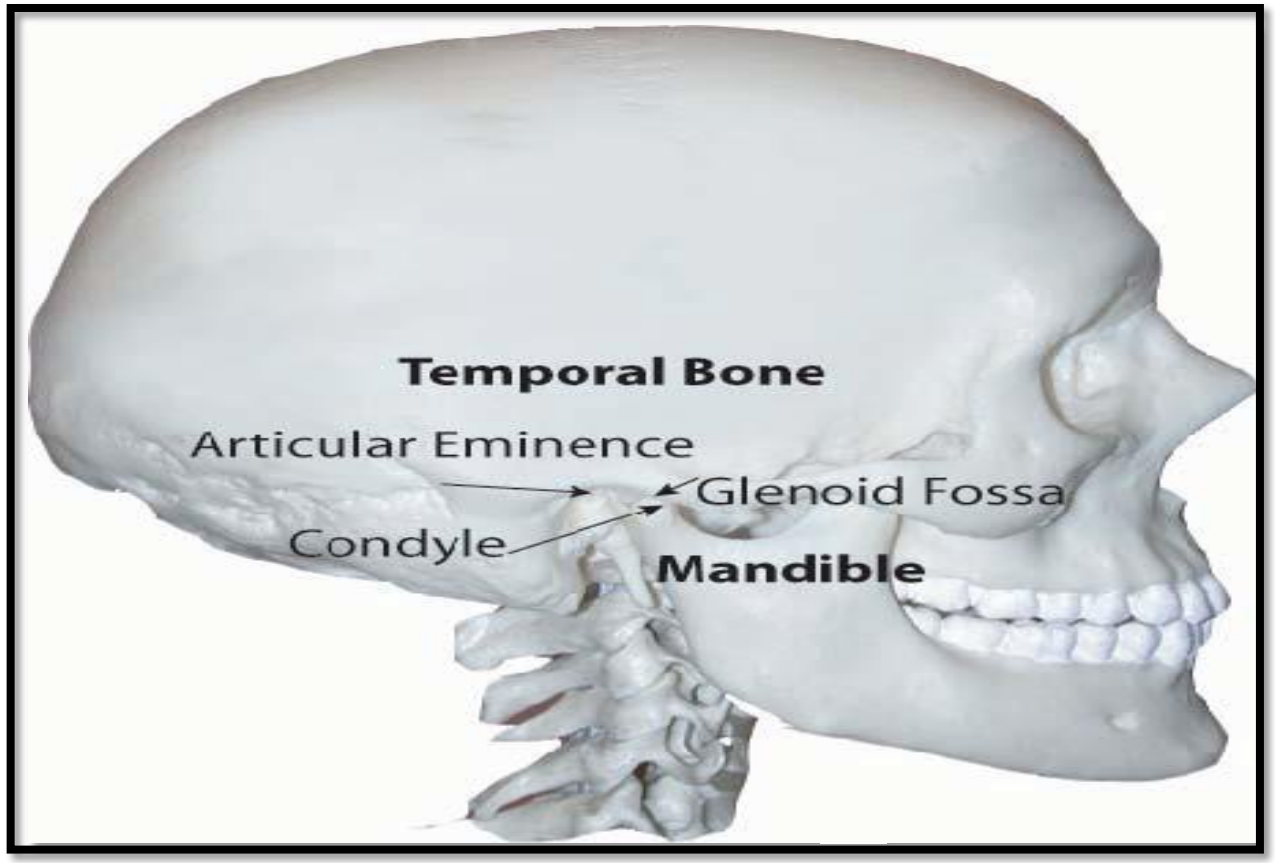
# TMJ - 1


Temporal Bone
Articular Eminence
Glenoid Fossa
Condyle
Mandible

# LEARNING OBJECTIVES

- Learn the Anatomy of TMJ.
- To understand anatomic relations of the TMJ and its association with the TMJ disorders.

# CONTENTS

- Classification of joints
- Functional classification
- Diarthroidal joint
- Embryonic development
- Post – natal development
- Components of TMJ
- Relations of TMJ
- Nerve and Blood supply
- Lymphatic drainage
- Muscles of mastication
- Clinical conditions of TMJ
- Screening examination of TMJ

NOTHING IS MORE FUNDAMENTAL TO TREATING PATIENTS THAN KNOWING THE ANATOMY

Jeffery Okeson

The knowledge of muscles and its action helps us to understand the movements of jaw and also the disorders associated with the muscles

The over all knowledge of anatomy, embryology and physiology helps us to understand the clinical significance of these structures and their by aids in the treatment of the disorders.

# Classification of Joints (by Mankin & Radin)

Structurally / Anatomical, based on the tissue joints are of 3 types

Fibrous

Cartilaginous (hyaline cartilage)

Synovial.

Functional classification is based upon movement and is of 3 types

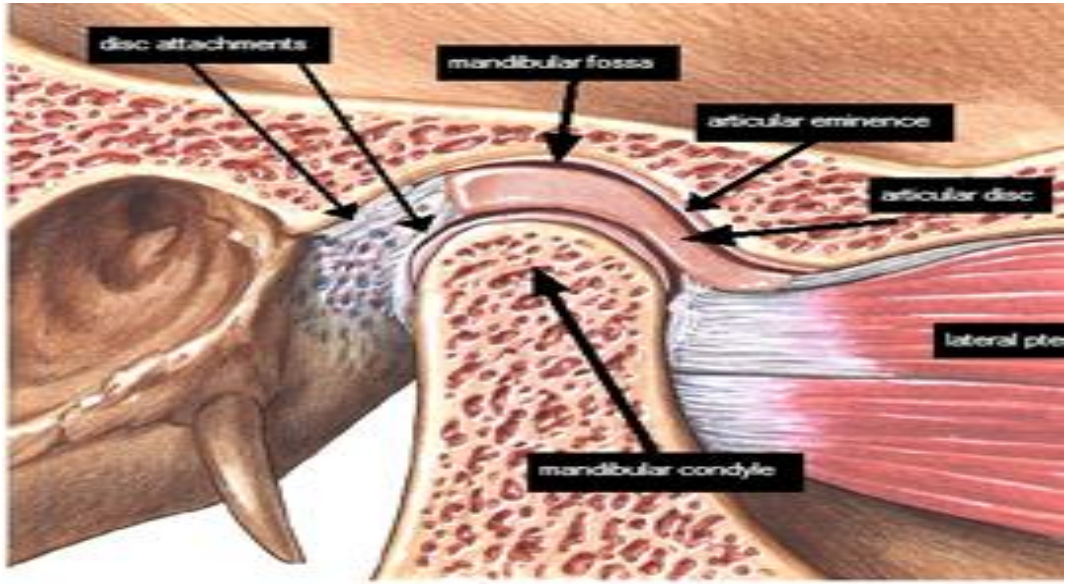
- Immovable **(** Synarthrosis**)**, eg:- sutures of cranium = it can be further sub divided into 5 types
- Slightly movable (Amphiarthrosis), eg:- Facet joint of the vertebrae
- Freely movable (Diarthrosis), eg:- Tmj, hip, shoulder & knee

# What is Diarthrodial joint or Synovial joint ?

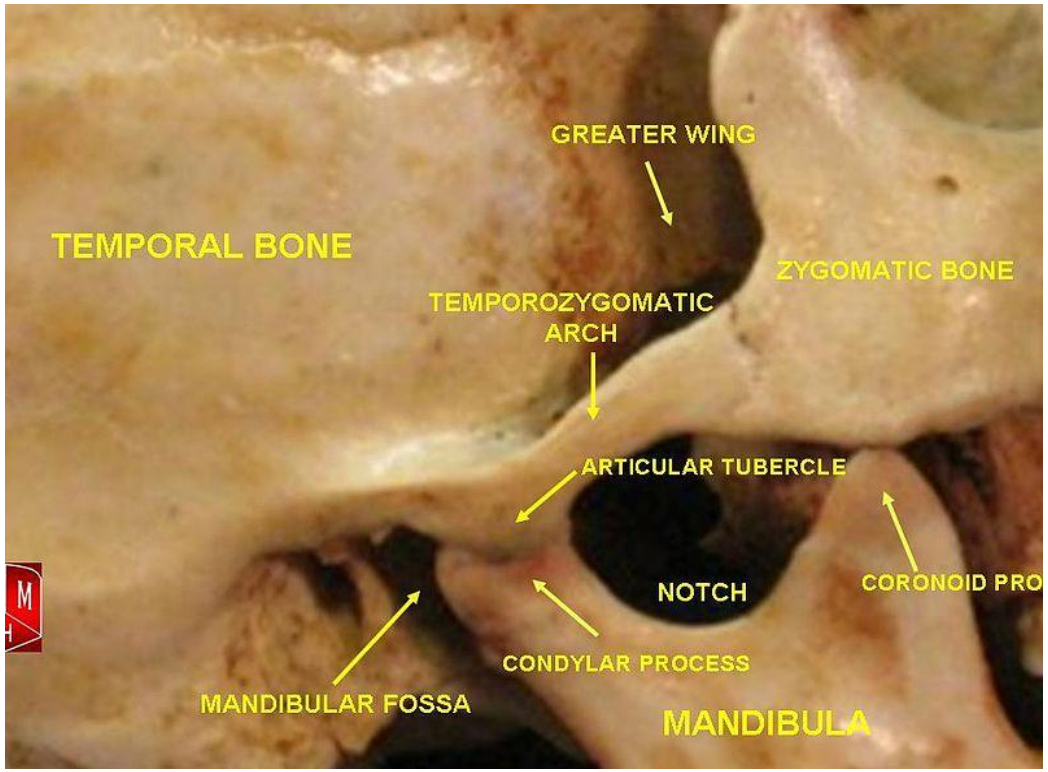
Diarthrodial joint are freely movable and the bony components are enclosed and connected to one another by a fibrous joint capsule.

The inner surface of capsule is lined by synovial membrane and the joint cavity is filled with synovial fluid.

For this reason, these joints are called synovial joints.



# TEMPERO-MANDIBULAR JOINT




# What is the Temporomandibular Joint?

The joint of the **first arch**.

The Temporomandibular joint connects the lower jaw (the mandible) with its condyle, to the bone at the side of the head—the temporal bone.

## It is also know by the name

Synovial joint
Diarthrodial joint
Ginglymo-diarthroidal joint
Compound joint
Bicondylar joint
Cranio-mandibular articulation

# Embryonic Development of the TMJ

Meckel's cartilage is important for the organization and differentiation of the facial structures during embryonic and fetal development.

TMJ development starts in the $7^{th}$ weeks of intrauterine life.

**Mandibular** arch  from the cartilaginous rod, (**Meckel's cartilage )** of both sides

The incus and malleus and the mandibular condyle are formed from the dorsal end of the Meckel's cartilage **(** the incus and malleus) develops superiorly in relation to the mandibular arch).

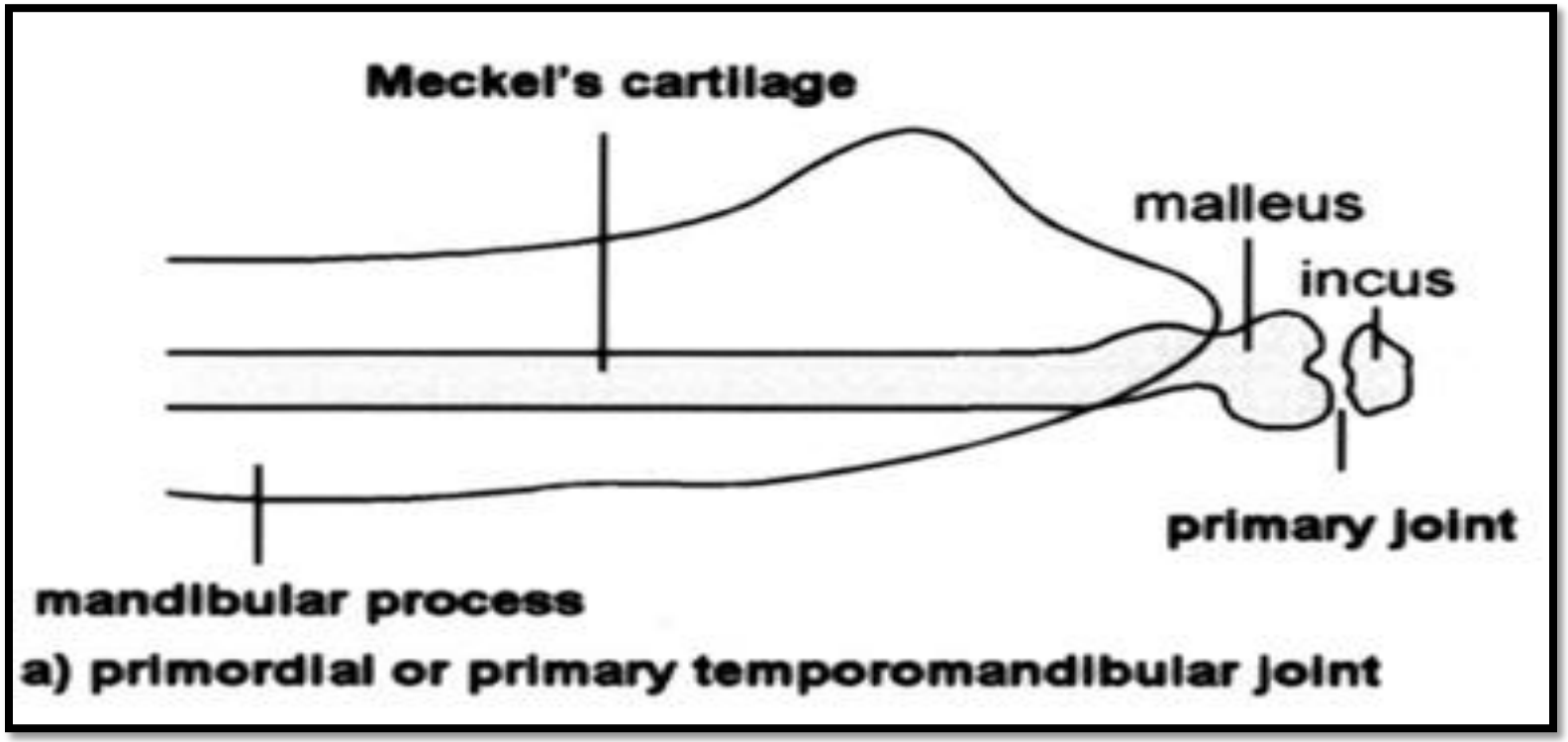
The Squamous part of the temporal bone appear as a mesenchymal condensations around the condyle .

## **Primary Temporomandibular / Malleoincudal joint** from the 8th until the 16th week

The primordial cartilage of the malleus is in direct contact with the primordial cartilage of the incus by means of a flat articulation plane.

From the 8th until the 16th week of development (4 months of IUL), these primordial cartilages function as the primary Temporomandibular or Malleoincudal joint

In mammals; later the malleus and incus are separated from meckel's cartilage and get ossified to become the middle ear ossicles



a) primordial or primary temporomandibular joint

This joint can perform only simple rotation movements, which appear in the 8th week of development.

# Secondary TMJ b/n the 7th and 20th week

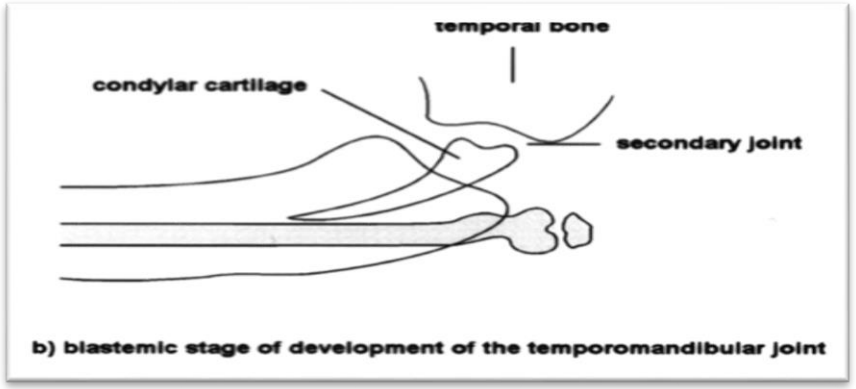
To begin with Temporal blastema and Condylar blastema appear:

Temporal blastema : appear 1st. It begins to ossify 1st and the cleft which appears in relation to the temporal ossification forms the superior joint cavity

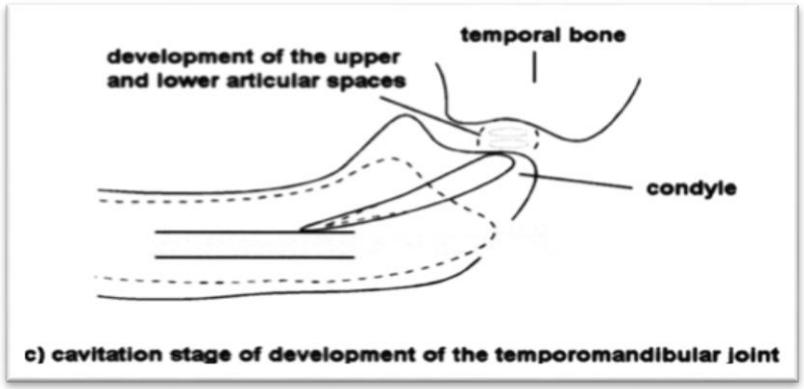
Condylar blastema : appears 2nd and ossifies 2nd to the temporal blastema and the cleft that occurs immediately above it forms the inferior joint cavity

Mutual approximation of the initial condylar and temporal blastemas takes place to reduce the gap and the appearance of superior and inferior joint cavity gives rise to the primitive articular disc

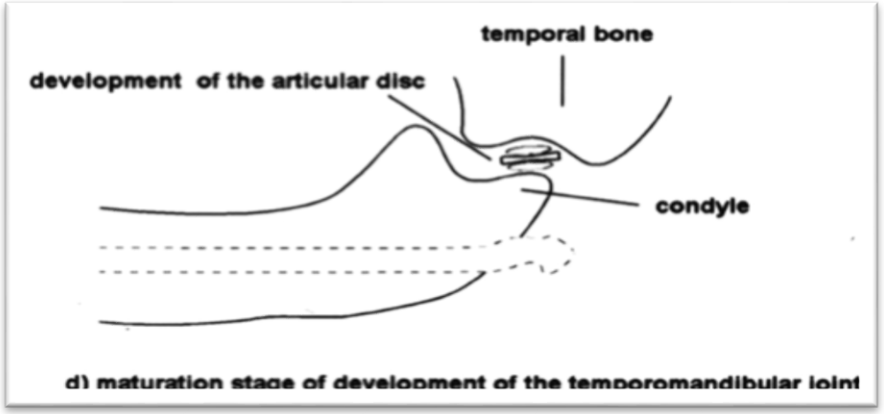
# In brief their are three stages in secondary TMJ development



b) blastemic stage of development of the temporomandibular joint



c) cavitation stage of development of the temporomandibular joint



d) maturation stage of development of the temporomandibular joint

## POSTNATAL DEVELOPMENT

At birth;
The glenoid fossa is relatively flat.
Grossly the disk is flat, vascular and generally of even thickness throughout.

During the $6^{th}$ to $8^{th}$ month of life ; resorption begins along the posterior slope of the articular tubercle with widening of the lateral rim of the articular tubercle and glenoid fossa.

The Depth of glenoid fossa progresses from
-----2mm seen at age of 6 months to a
---- 4 to 5 mm seen by 2 ½ years of age.

Between the age 4-18yrs ; many changes occur in the articular disc such as
-----formation of anterior band and anterior extension
-----Intermediate zone, posterior band and posterior extension.
-----The posterior extension splits into 2 to form bilaminar band.
-----plexus of veins are present between them.
-----The lower laminar is less elastic with respect to the upper lamina.

During the mixed dentition phase (9-12 yr), a slow pattern of condylar growth occurs
During the permanent dentition phase (around 12 yr), the condyle has developed the wedge shaped form
After adult form, by the age of 20 years significant remodelling occurs as an adaptation to the forces applied on the

Remnants of the meckel's cartilage ; most of it disappears except malleus and incus, the sheath of the intermediate part of the meckel's cartilage persists as the anterior ligament of malleus and sphenomandibular ligament.

The mesoderm of the first arch (mandibular arch) forms the muscles of mastication, tensor tympani, tensor veli palatine, mylohyoid and anterior belly of digastric. Hence they are supplied by the Mandibular nerve.

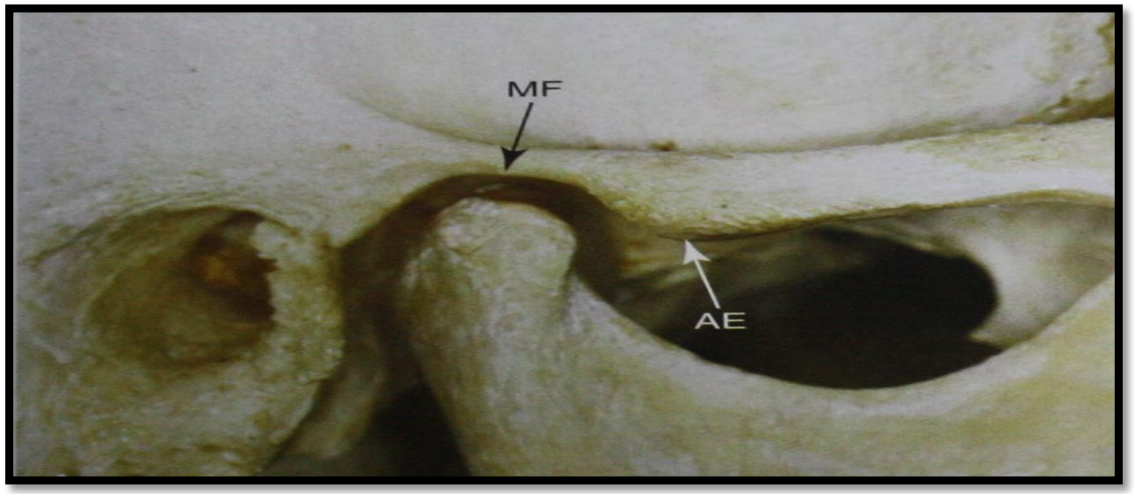
The articular disc of the TMJ and the lateral pterygoid muscle are developed from the same mesenchyme of the first arch. Therefore, we can see part of the insertion of the lateral pterygoid fibres to the articular disc of the TMJ.

# COMPONENTS OF TMJ

## Articular Bone :- 2 in number.

**Upper bone** – is the Glenoid / Mandibular fossa and Articular eminence /Eminentia articularis, they are part of temporal bone.
**Lower bone** – is the Condyle of the Mandible.

Articular eminence :- The anterior root of the zygomatic process of temporal bone forms articular eminence. It is the convex portion of the squamous temporal bone that forms the anterior limit of the joint.



The articular eminence, a transversely elliptical region sinuously curved in the sagittal plane and tilted forward at 25 degree to the occlusal plane forms most of the articular surface of the articular fossa.

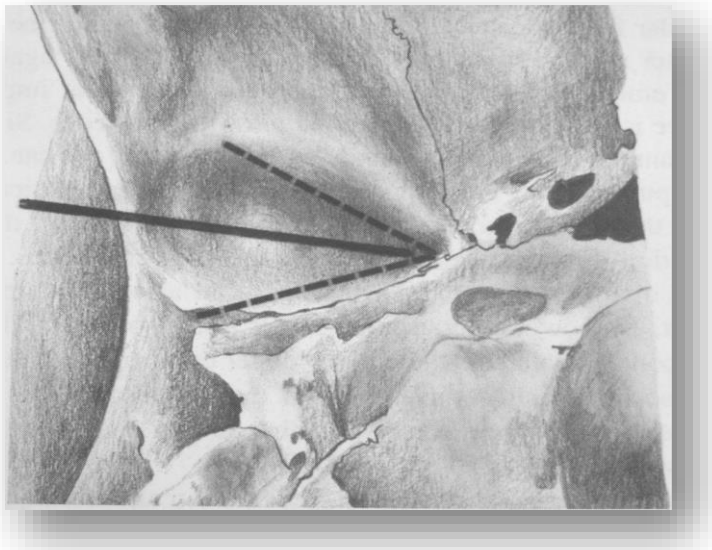
Its steepness is variable and it becomes flatten in the edentulous. Its anterior limit is the summit of the articular eminence, a transverse ridge that extends laterally out to the zygomatic arch as far as articular tubercle.

The two slopes of the articular eminence are considered to be a functional part of the joint. The posterior slope resorbs with edentulism

# Glenoid / Mandibular fossa :-

Is a well defined hallow (concave) area on the inferior portion of the squamous temporal bone.

It is triangular in shape with the apex related to the medial pole of the condyle.
The rotation of TMJ takes place when the axis passes through the medial pole of the condyle.



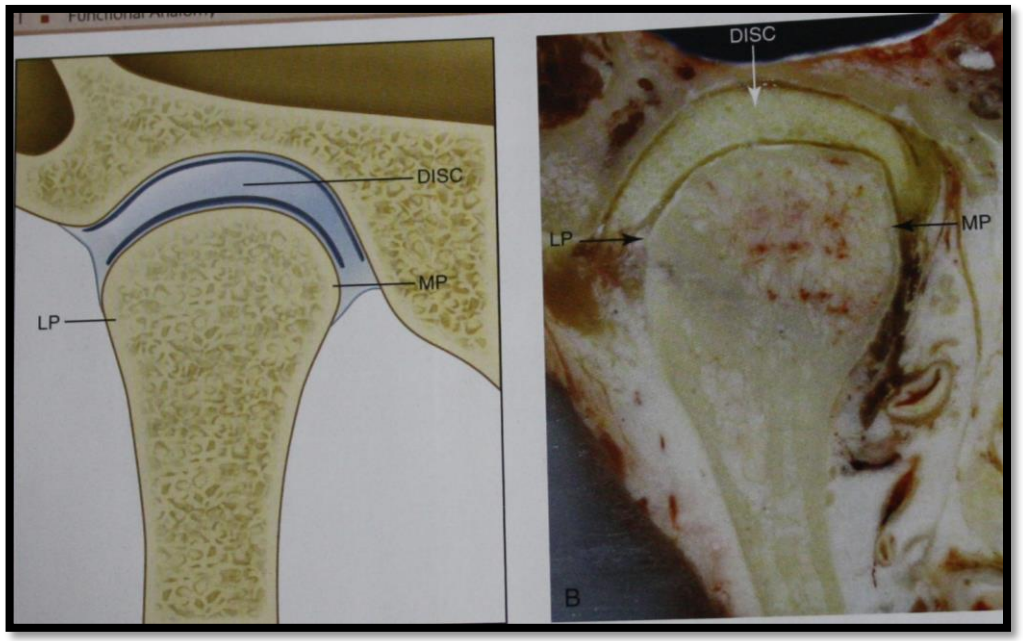
**Posteriorly :** squamo-tympanic ( petro-tympanic )fissures
**Anteriorly :** articular eminence.
**Medially :** by the spine of the sphenoid.
**Laterally :** root of the zygomatic process.

The middle part of the fossa is fairly thin whose upper surface forms the middle cranial fossa.

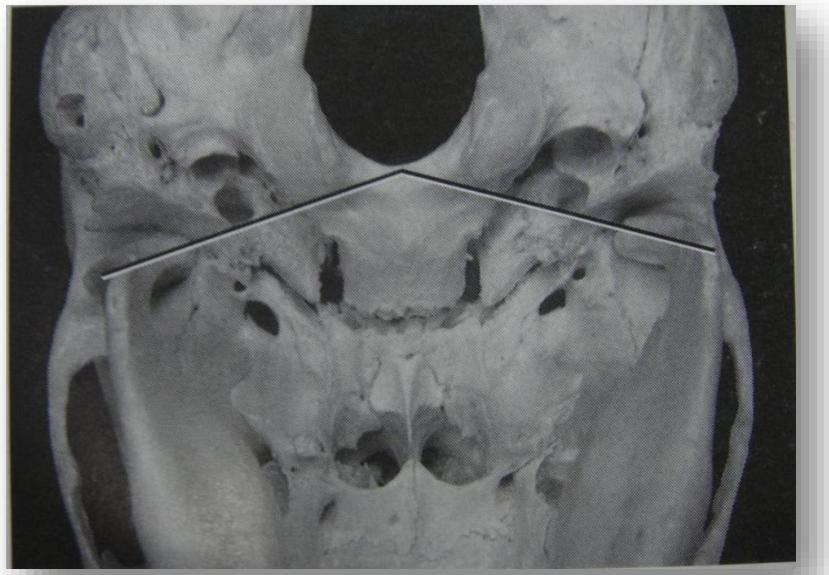
# Condylar head

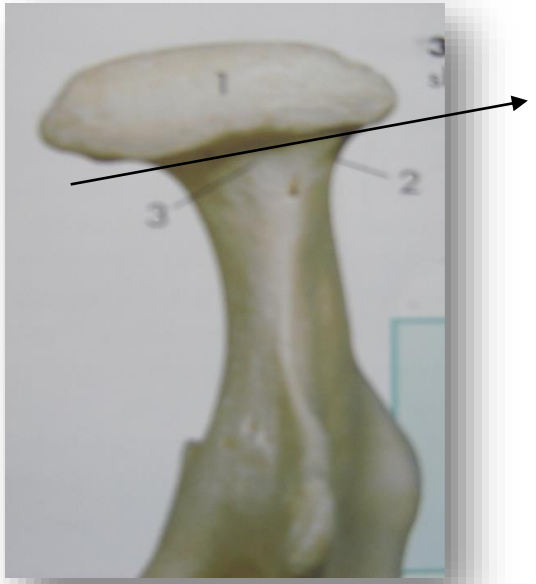
Condyle :- It’s the projection of the Mandible with its long axis oriented medio-laterally. The medial pole is more prominent than the lateral pole

The condyle is roughly 20mm in M-L direction and 8-10 mm in A-P direction.



The **medial pole extends farther beyond the condylar neck** than the lateral pole and is positioned more posteriorly, so that the long axis of the condyle deviates posteriorly and meets a similar axis when drawn from the opposite condyle at the anterior border of the foramen magnum.





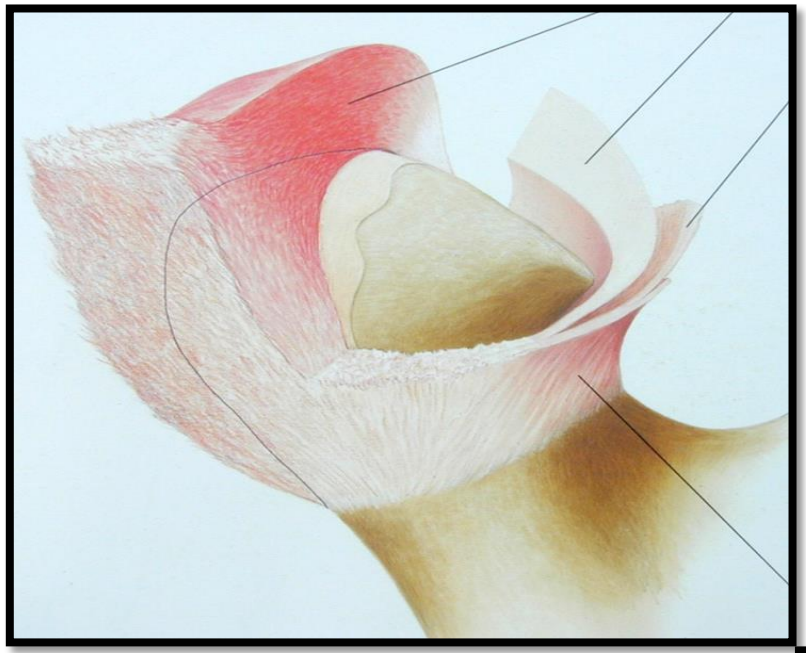
## Articular disc / meniscus / plate :-

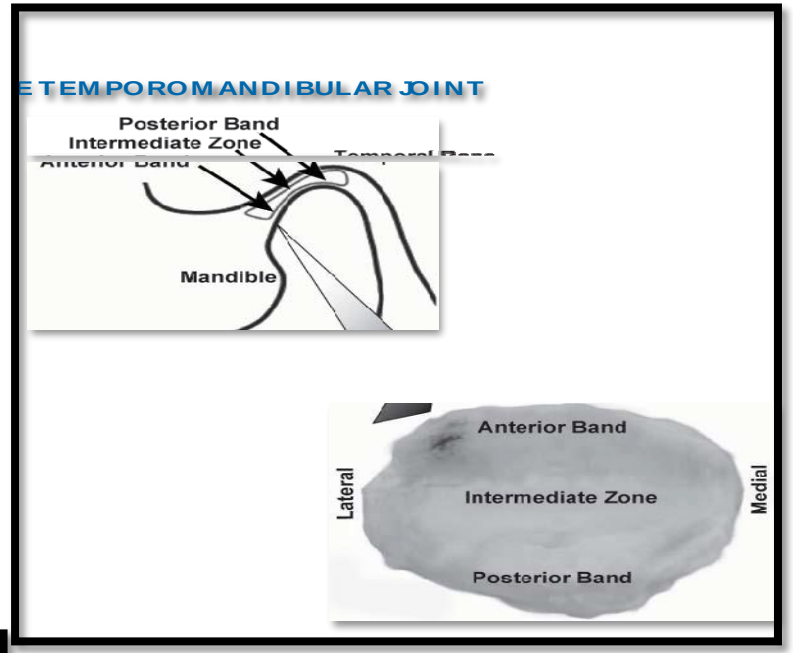
Disc is Biconcave and is made of fibrocartilage
Disc separates the condylar head from the glenoid fossa and divides the joint cavity into superior and inferior joint spaces.

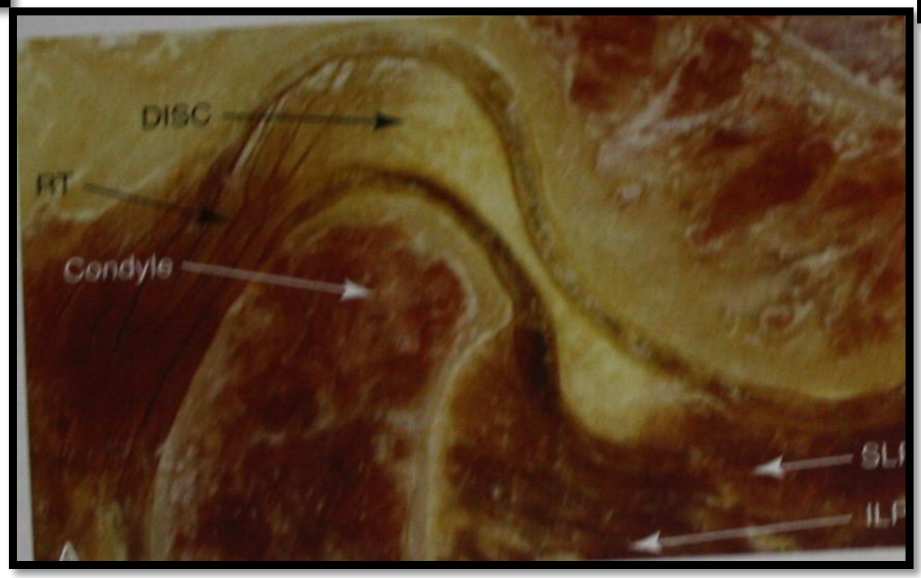
It is a hypo-vascular and devoid of nerve supply, hence can with stand load and stress

The disc provides stability of the joint and gives it the ability for both rotational and translatory movement

The disc acts as a shock absorber to counteract the forces originating on the joint during functional and parafunctional activity.




E TEMPOROMANDIBULAR JOINT
Posterior Band
Intermediate Zone
Mandible
Anterior Band
Lateral
Intermediate Zone
Medial
Posterior Band


DISC
RT
Condyle

The disc has thick posterior  band (at 12° clock position above the condyle in the closed mouth position) then the anterior bands.

The thick bands prevent the displacement of disc during translation.

The disc thickens medially and laterally and is tightly attached to the Capsular ligament.

Functional disharmony between disc and condyle leads to TMD

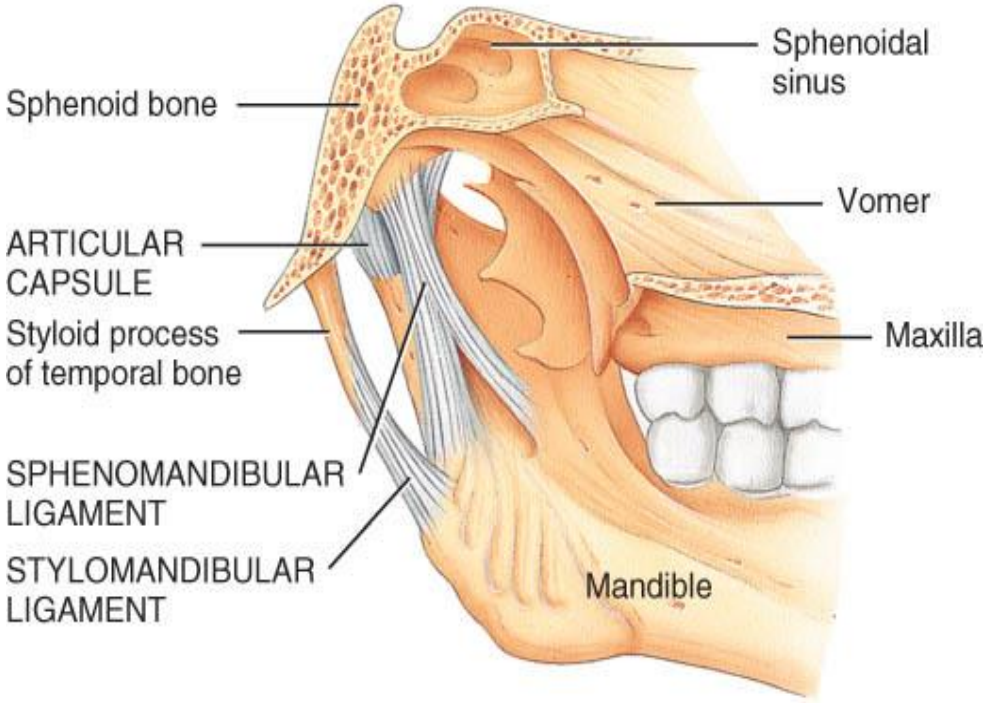
# Articular / Fibrous Capsule

Articular capsule covers the articular eminence and the condylar head and as noted forms the articular disc.

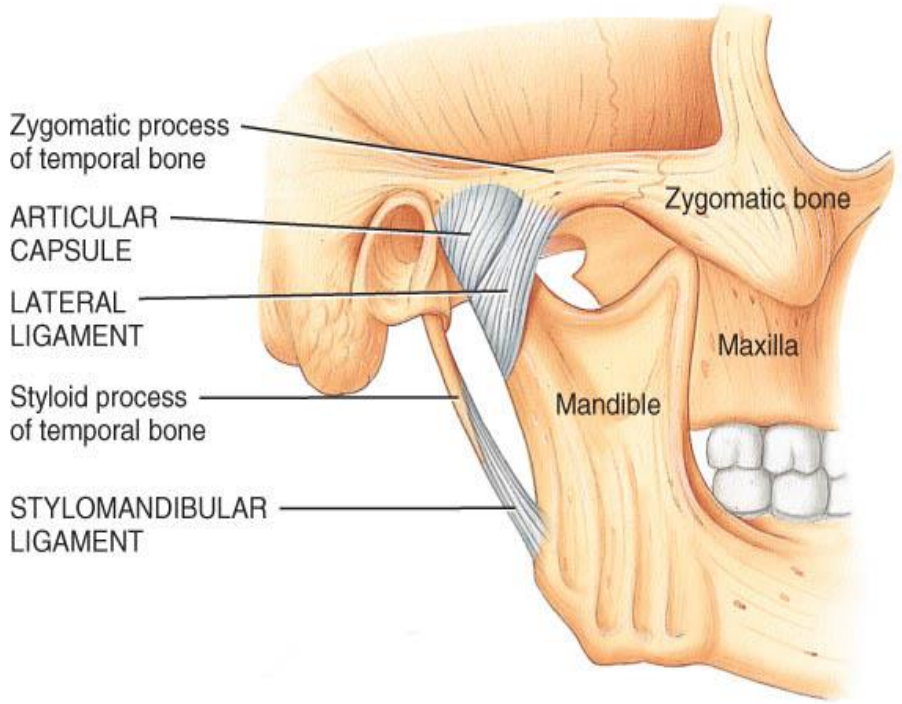
The articular capsule is a fibrous, non-elastic membrane that defines the anatomical boundaries of TMJ.
Surrounds the joint and unites the articulating bones.
encloses the synovial cavity, and confines the synovial fluid

The articular capsule is composed of two layers –
the outer fibrous capsule (which may contain ligaments)
the inner synovial membrane (which secretes a lubricating and joint-nourishing synovial fluid).

# Medial and lateral view showing the articular capsule




(b) Medial view




(a) Right lateral view

**Capsule attachment:-**
Inferiorly it is attached to the articular eminence, articular disc and the neck of the condyle
Superiorly it is attached to the temporal bone

**Capsule extension:-**
Extensions of the capsule into to the joint cavity forms the articular disc.

# Synovial lining / membrane / tissue :-

Synovial tissue is a vascular connective tissue

Lines the inner surface of the fibrous joint capsule.

The lining inserts into the periosteum and extends along the margin of the articular cartilage.

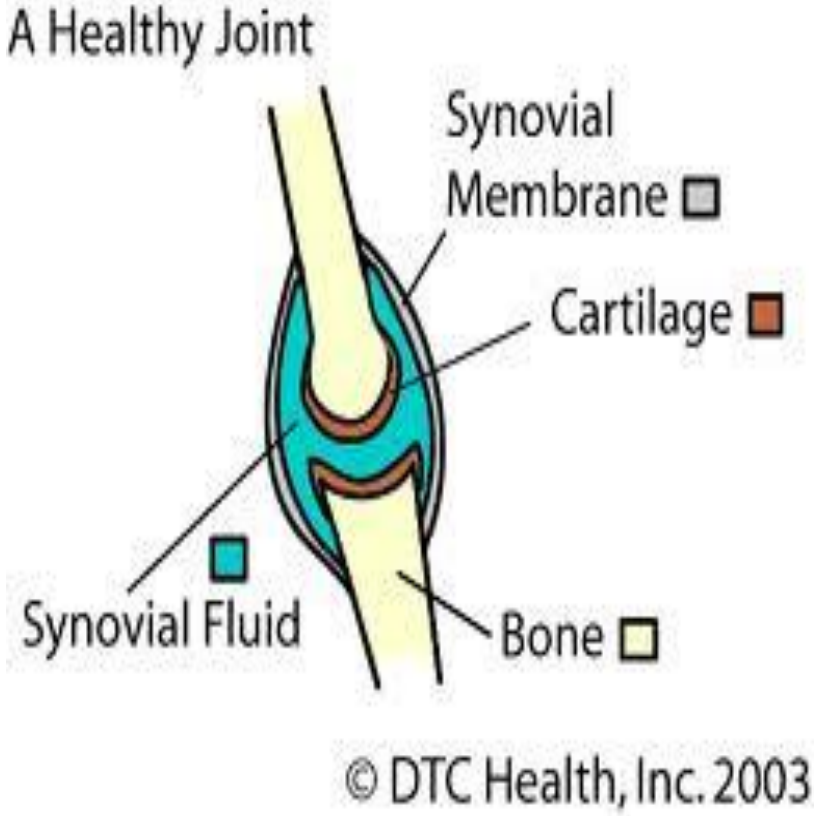
The large area of synovial membrane is seen on the superior and inferior part of retrodiscal lamina.

The synovial surfaces are non-adherent.

The surface made of cartilage and the surface covered synovial tissue can move over each other with little resistance.

The articulating surface of the temporal bone, the condyle and the disc, that is (functional surface) are not covered by the synovial membrane

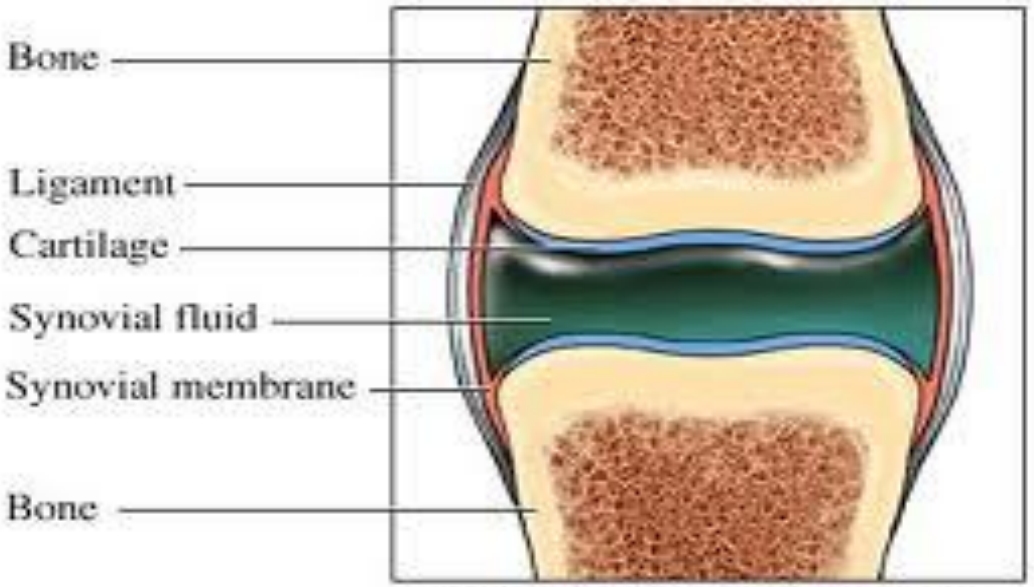
Both the upper and lower joint compartment are lined by the synovial tissue.



# Synovial fluid

Synovial fluid :- is a filtrate of plasma and is viscous, contains hyaluronic acid and lubricin secreted by the synovial cells

Function of the synovial fluid:- is to  nourish the avascular articulating cartilage & provide lubrication b/n articulating surface during friction



Cross section of a healthy joint

Weeping lubrication - During movement under condition of loading, the synovial fluid held with in the cartilage is squeezed out mechanically to maintain a layer of fluid on the cartilage surface.

Boundary lubrication - During movement under condition of little or no-loading, a “lubricating protein” its a kind of glycoprotein that binds to the surface of the cartilage. It keeps the surface of the joint moist from making contact.

# Ligaments – 2 types

## Functional ligaments

Collateral ligaments (Discal)

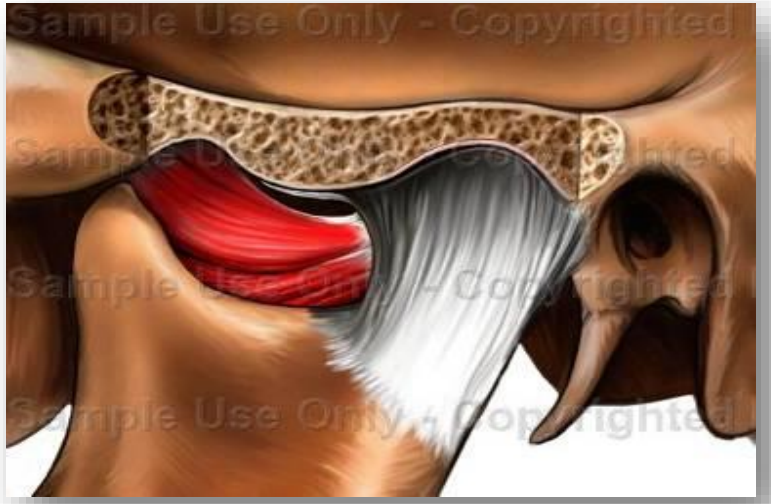
Temperomandibular (TM) / Lateral ligament

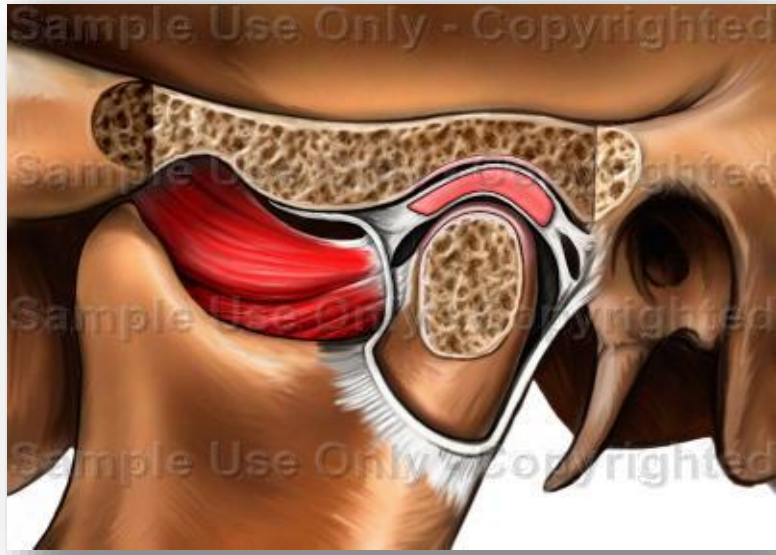
Capsular ligament

## Accessory ligaments

Stylomandibular ligament.

Sphenomandibular ligament





# Discal or Collateral Ligaments

The medial and lateral portions of the articular disc are attached to the corresponding pole of the condyles via a non-elastic, short discal ligaments.

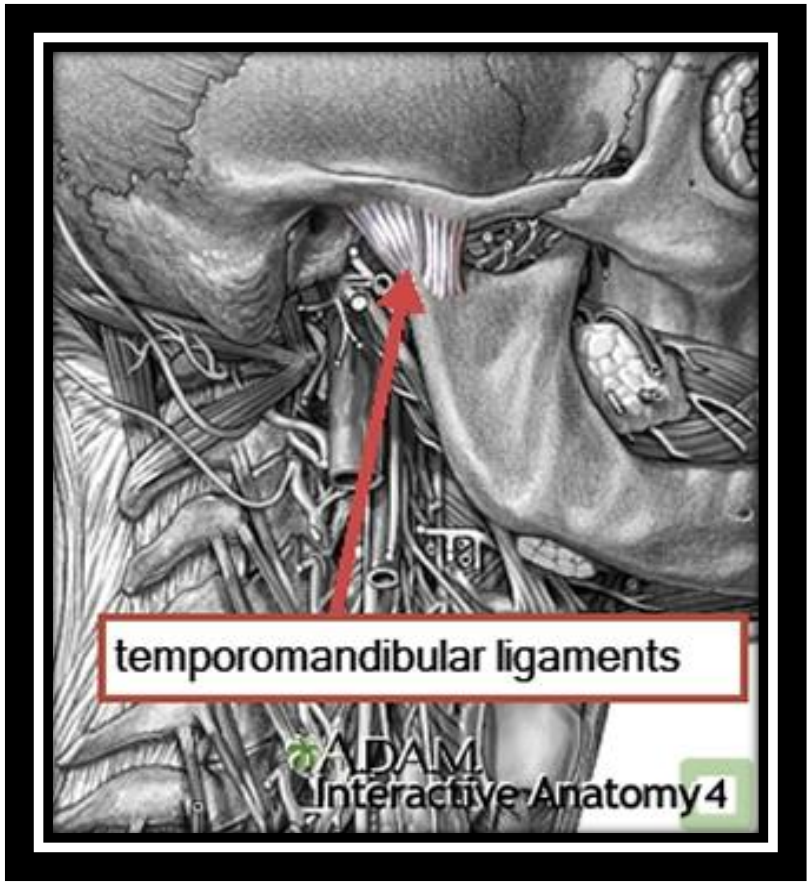
These ligaments are vascularized and innervated.

## Functions of the discal ligaments:-

These ligaments restrict the movements in the lower joint cavity when performing the hinge action
Discal ligaments cause the disc to move passively with the condyle in the translation action.
These ligaments permits very little lateral excursion.

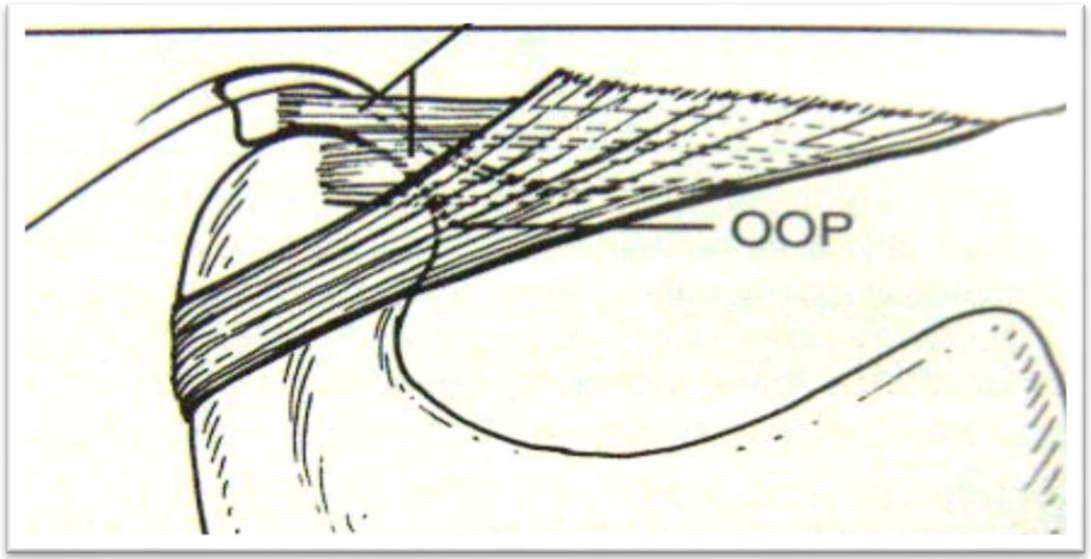
# Temporomandibular /Lateral ligament

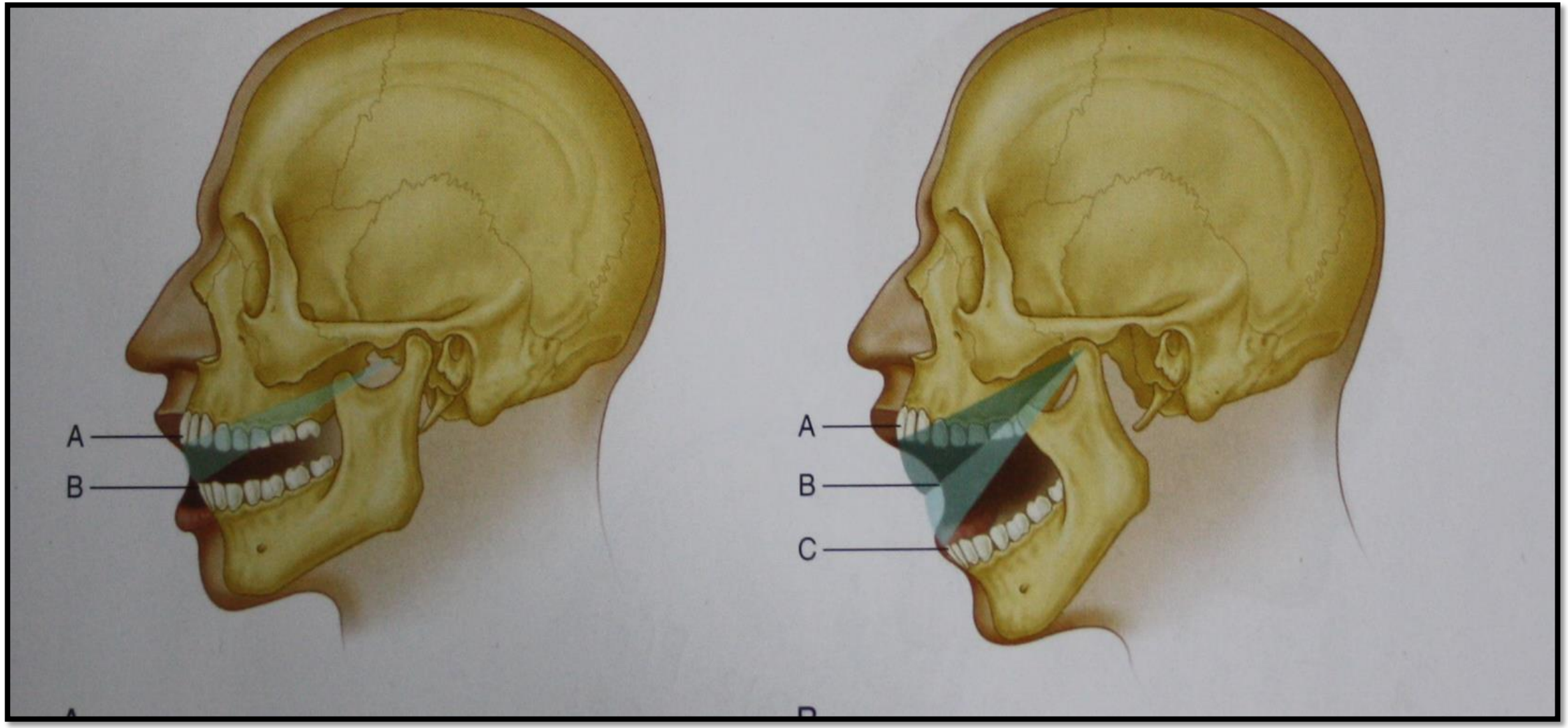
The lateral aspect of the capsule is thickened to form a fan-shaped ligament known as the Temporomandibular ligament or lateral ligament.



The ligament has **two** parts;-

1. An outer/superficial oblique portion arising from the articular eminence and zygomatic bone and extends backward and downward to insert into the outer surface of the condylar neck.
2. An inner/deep horizontal portion, has the same origin but inserts into the lateral pole of the condyle.




A
B
A
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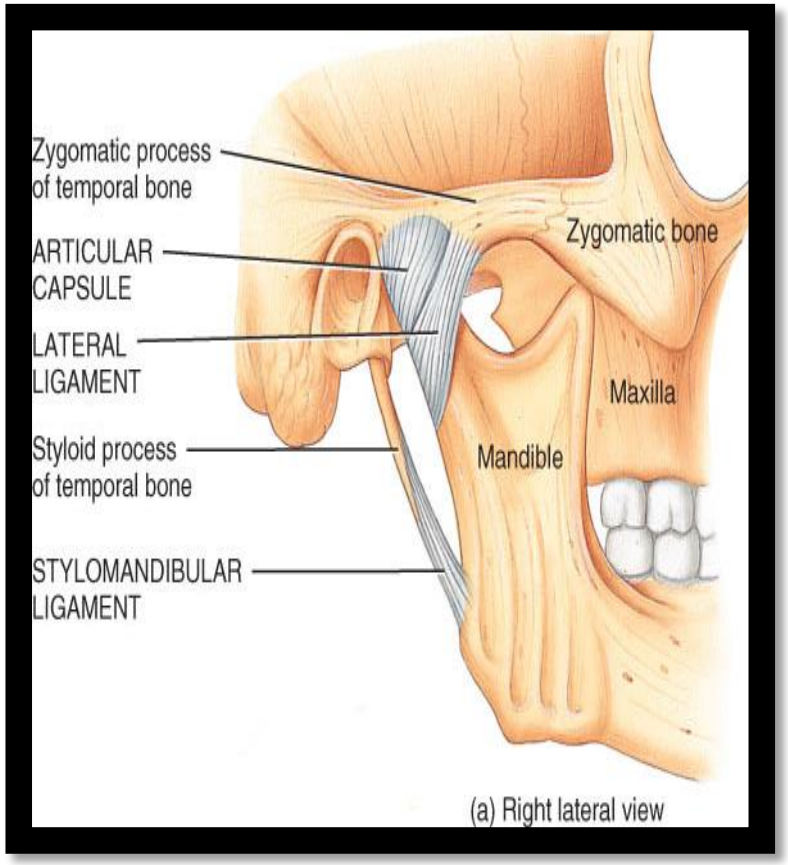
C

# Functions of TM ligament

The ligament restricts the displacement of the mandible in 3 planes.

1. By preventing the lateral dislocation of one joint it prevents the medial dislocation of the other.
2. Its oblique component limits the amount of inferior displacement.
3. Its horizontal component prevents the posterior displacement.

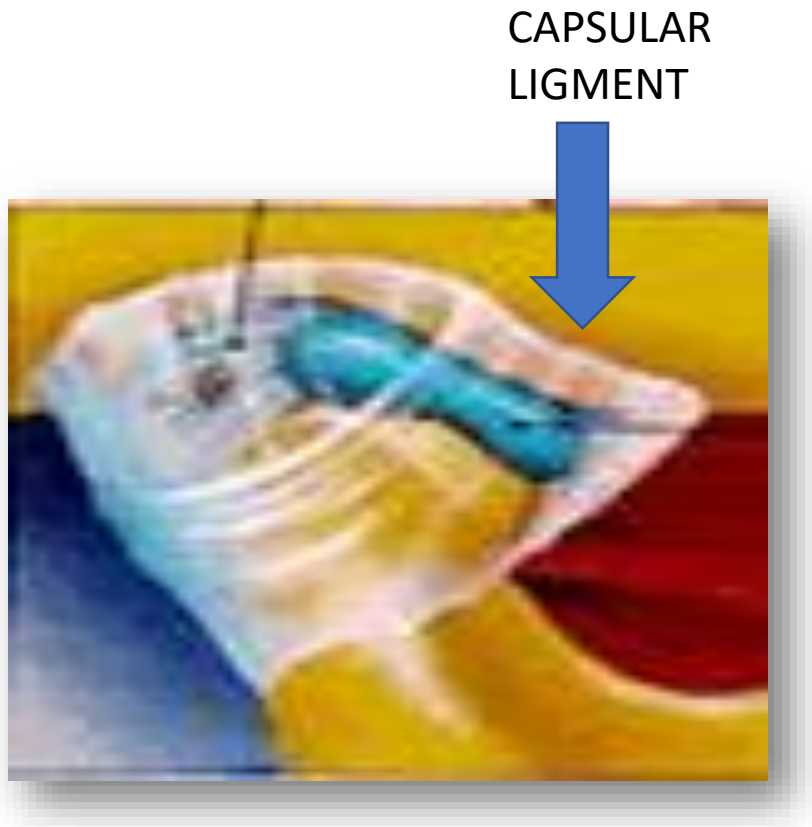


•**Capsular ligament**: The entire TMJ is surrounded and encapsulated by the capsular ligament

A significant function:
to encloses the joint and retain the synovial fluid.
To resist any lateral or inferior forces that tend to separate/dislocate the articular surfaces.

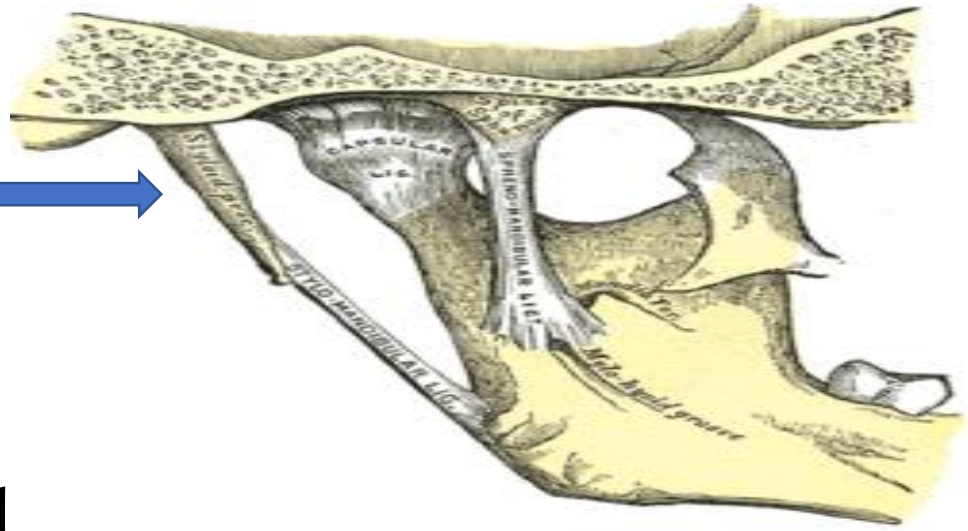
very well vascularized
well innervated and
provides proprioceptive feedback

regarding the position and movement of the joint.



# Stylomandibular ligament

Runs from the styloid process downward and forward to the medial surface of the angle of the mandible.



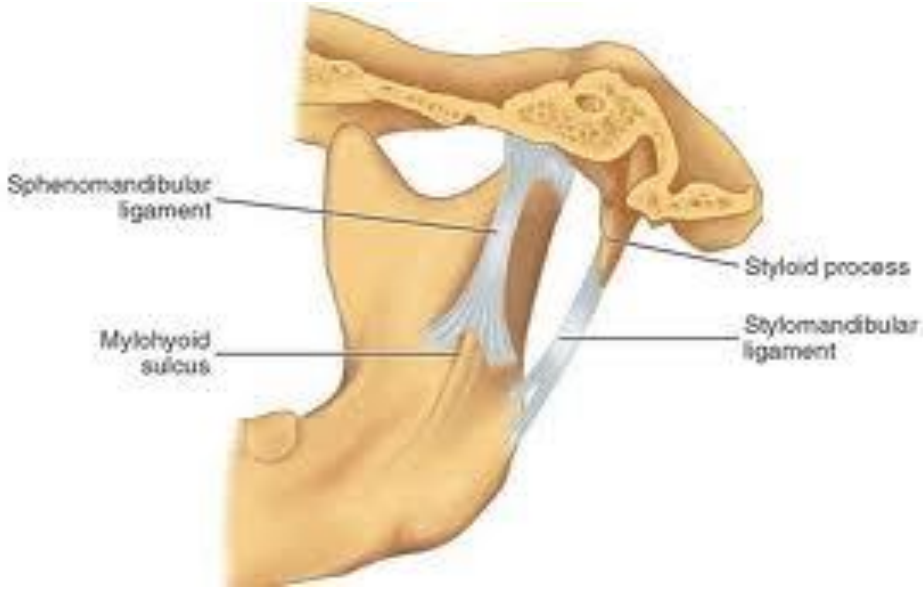
It is a thickened part of investing layer of deep cervical fascia

It becomes taut when mandible is protruded and thus It limits excessive mandibular protrusion.

## Sphenomandibular ligament

Runs from the spine of the sphenoid bone downward and forward to the lingula of the mandible. It is a remnant of Mackle's cartilage.

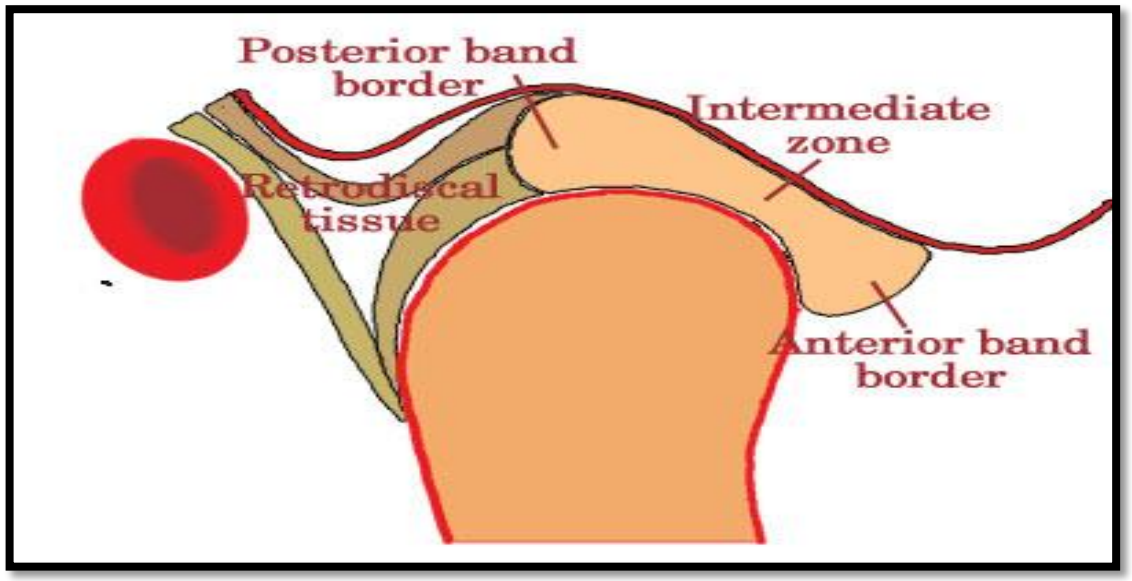
It limits the protrusive, medio-trusive as well as passive jaw opening.



# Retrodiscal tissue / Bilaminar zone :-

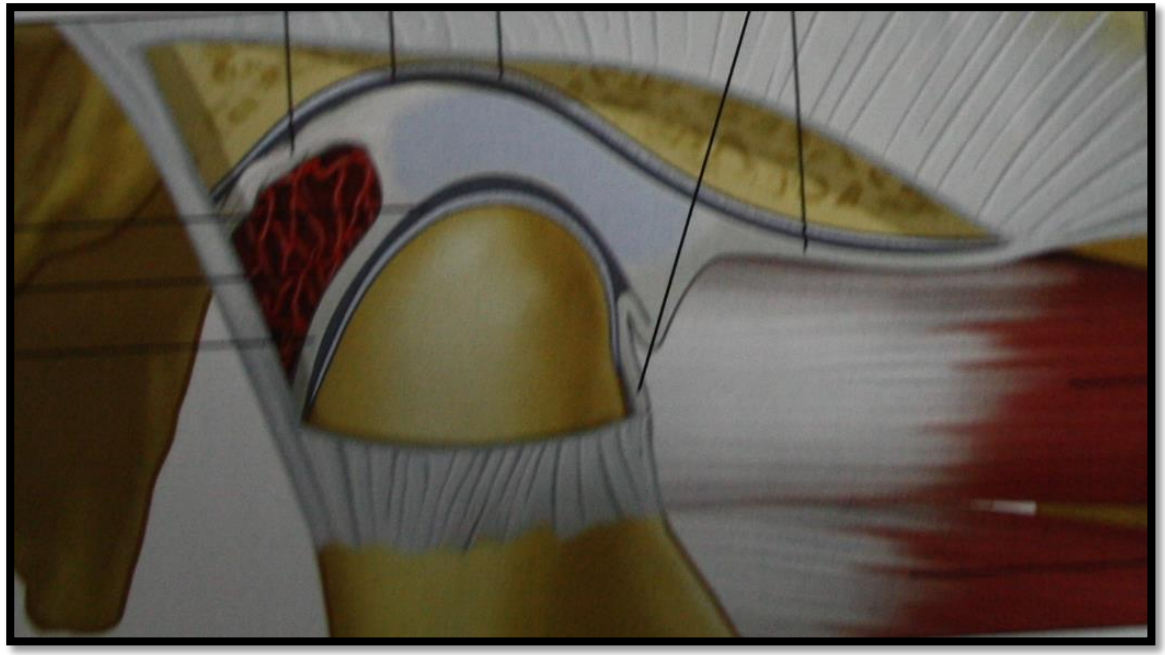
## the name implies it consists of two laminae

It's a mass of soft tissue in the space b/n the articular disc and the posterior wall of the articular capsule.
It is a posterior extension of articular disc that splits into 2 lamina, with central layer of loose areolar, highly vascular and well innervated tissue.



# Superior lamina / upper retrodiscal lamina:-

It originates from the posterior band of the disc and attaches to the suqamo-tympanic fissure.
It is mainly elastic in nature,
Function:- is to counter the forward pull of superior belly of the lateral pterygoid muscle on the articular disc. (posterior traction



## The inferior retrodiscal lamina /lower lamina:-

it is the posterior-inferior extension of the discal tissue.

It is mainly composed of collagenous fibers with very little elastic tissue and hence will not stretch

Function:- to stabilize the disc on top of the articular surface of the condyle (restricts forward rotation of disc on condyle)

Physiologically, the retrodiscal tissue ensures structural flexibility and stability of the disc during function and supplies synovial fluid for the joints as to be lubricated and nourished.

# RELATIONS OF THE TEMPOROMANDIBULAR JOINT

## LATERAL

Skin and fasciae
Parotid gland
Temporal branches of facial nerve

## MEDIAL

Tympanic plate separates the joint from the internal carotid artery.
Spine of the sphenoid with the upper end of the sphenomandibular ligament.
Auriculotemporal and chorda tympani nerves.
Middle meningeal artery

## ANTERIOR

Lateral pterygoid
Masseteric nerve and vessels

## POSTERIOR

Parotid gland separates the joint from the external auditory meatus.
Superficial temporal vessels
Auriculotemporal nerves

## SUPERIOR

Middle cranial fossa
Middle meningeal vessels

## INFERIOR

Maxillary artery and vein

# Nerve Supply

Joint capsule and ligaments contain pain fibers and sensory receptors
Most of the innervation is by

The Auriculotemporal nerve

The deep temporal nerve-2 in number, they are from the anterior division of V3 of Tg nerve

Masseteric...branch of mandibular nerve.

# Blood Supply

Blood supply to the structures of a joint are mainly branches

External carotid (Superficial temporal artery & Ascending pharyngeal)

Maxillary artery

# Lymphatic Drainage

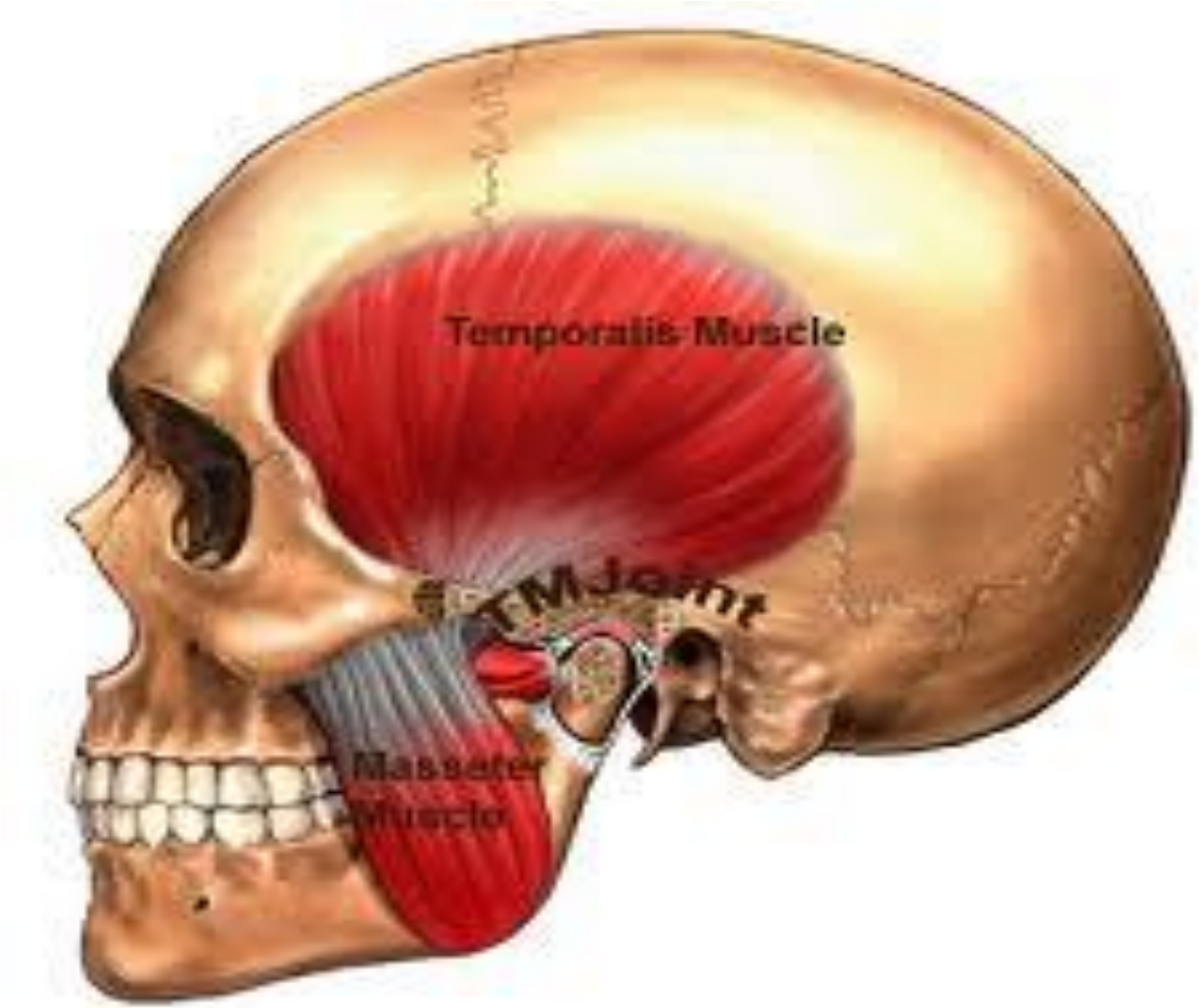
Lymph vessels on anterior surface drain into PAROTID lymph nodes.

Lymph vessels on posterior surface drain into SUBMANDIBULAR lymph nodes.

Lymph vessels on lateral surface drain into PREAURICULAR and PAROTID lymph nodes.

Lymph vessels on medial surface drain into SUBMANDIBULAR lymph nodes.

# Muscles of Mastication & Movements of TMJ



These are muscles that develop from the mesoderm of the first  pharyngeal arch.

They are attached to the mandible and move the mandible during mastication & speech.

They are 4 pair:

Masseter
Temporalis
Lateral pterygoid
Medial pterygoid

These muscles are innervated by mandibular nerve, it is the nerve of first arch.

# Masticatory muscles

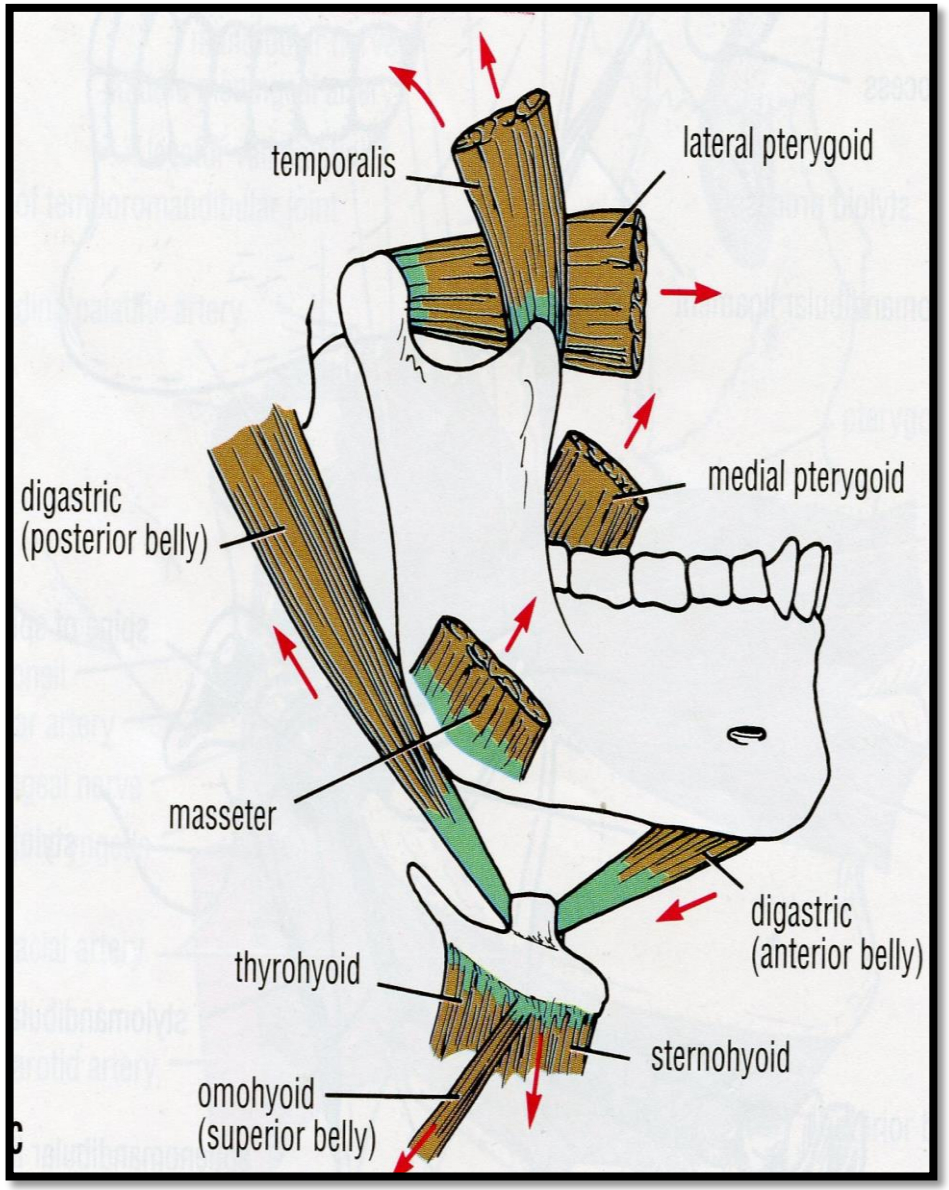
**ELEVATION** : all 3 muscles except Lateral pterygoids,

**DEPRESSION** : Lateral pterygoids, assisted by all hyoid muscles

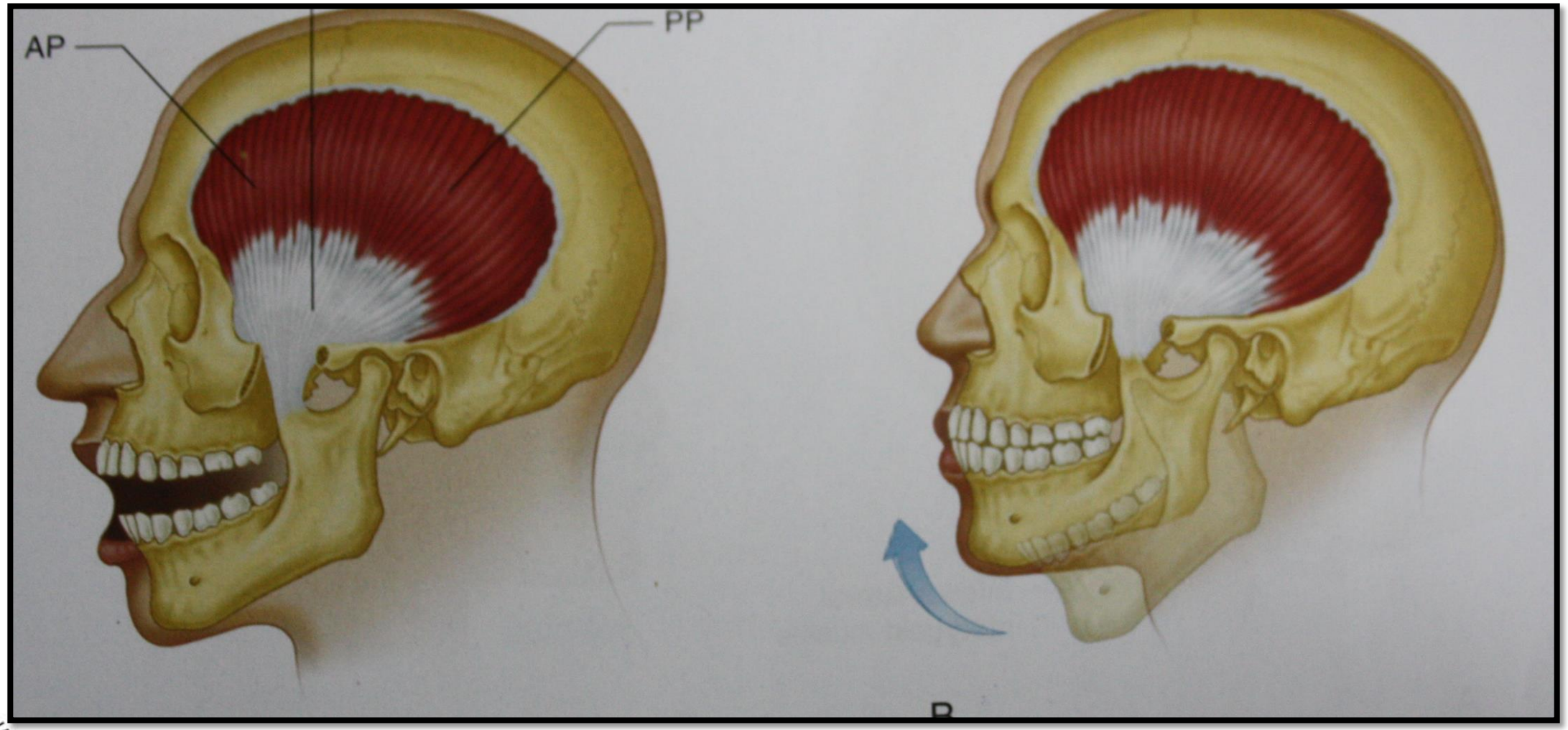
**PROTRUSION**: all masticators except Temporalis,

**RETRUSION**: Temporalis & Masseter,

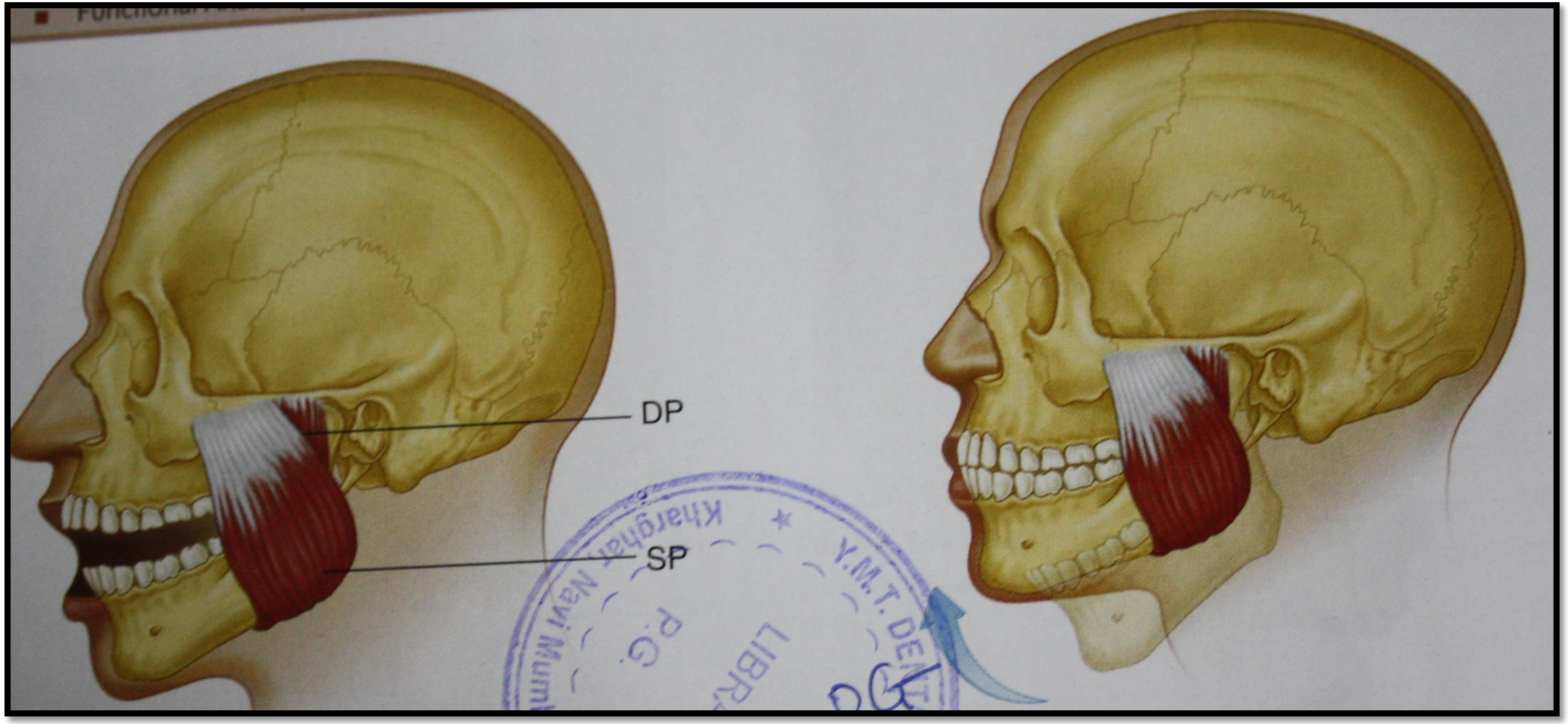
**LATERAL MOVEMENTS**: Temporalis of same side, Pterygoids of opposite side & both Masseter



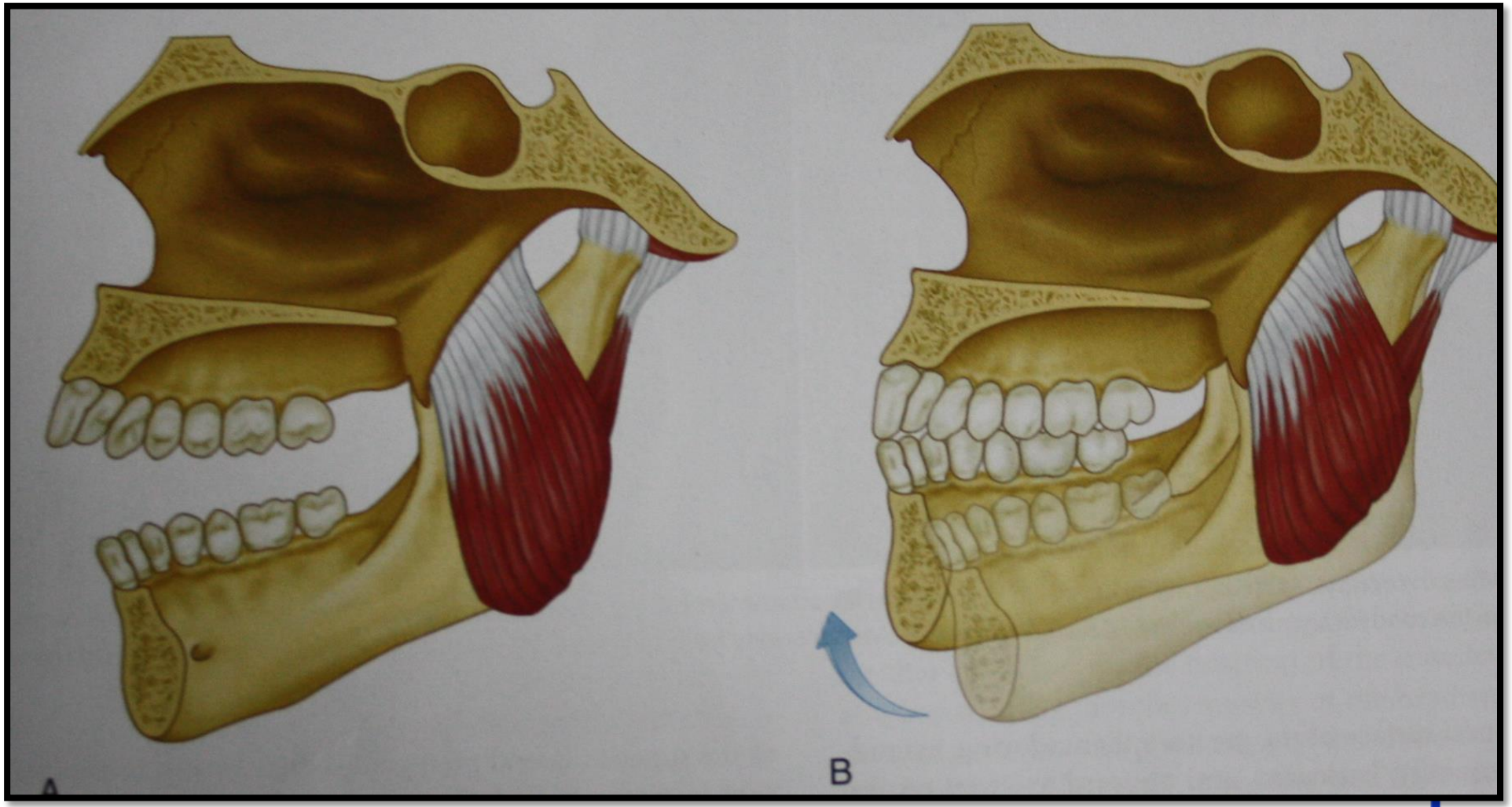
# Temporalis:



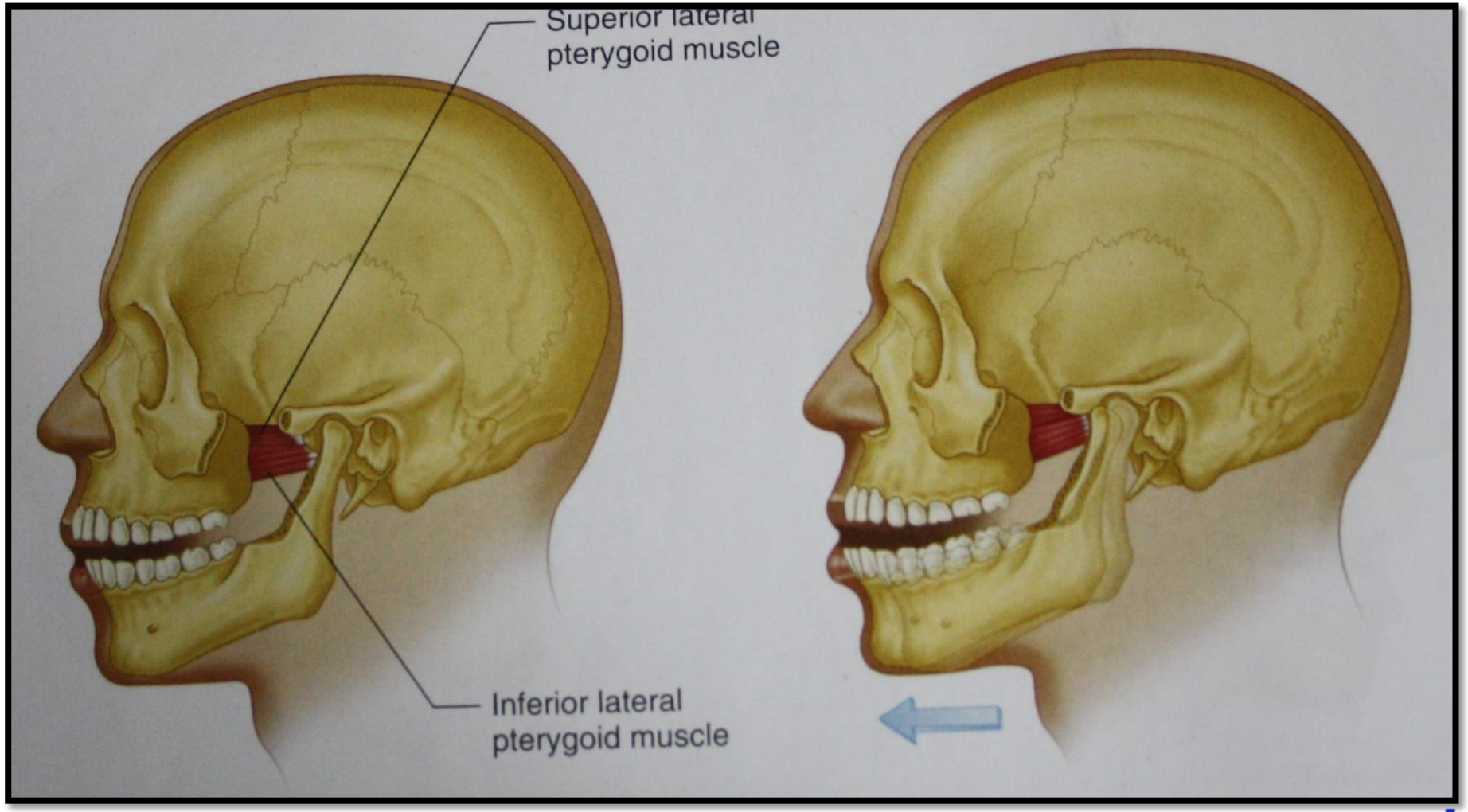
# Masseter:



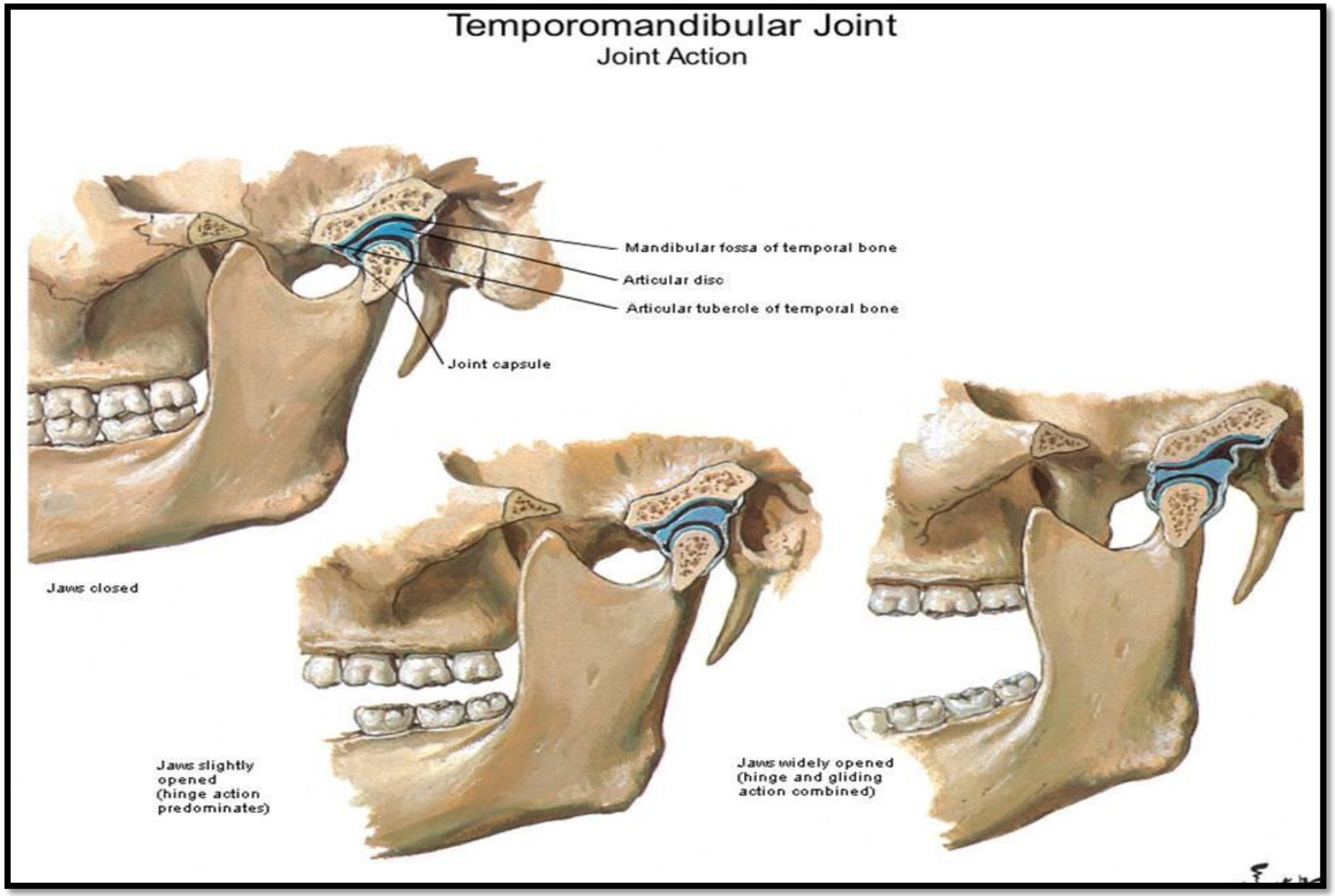
# Medial pterygoid



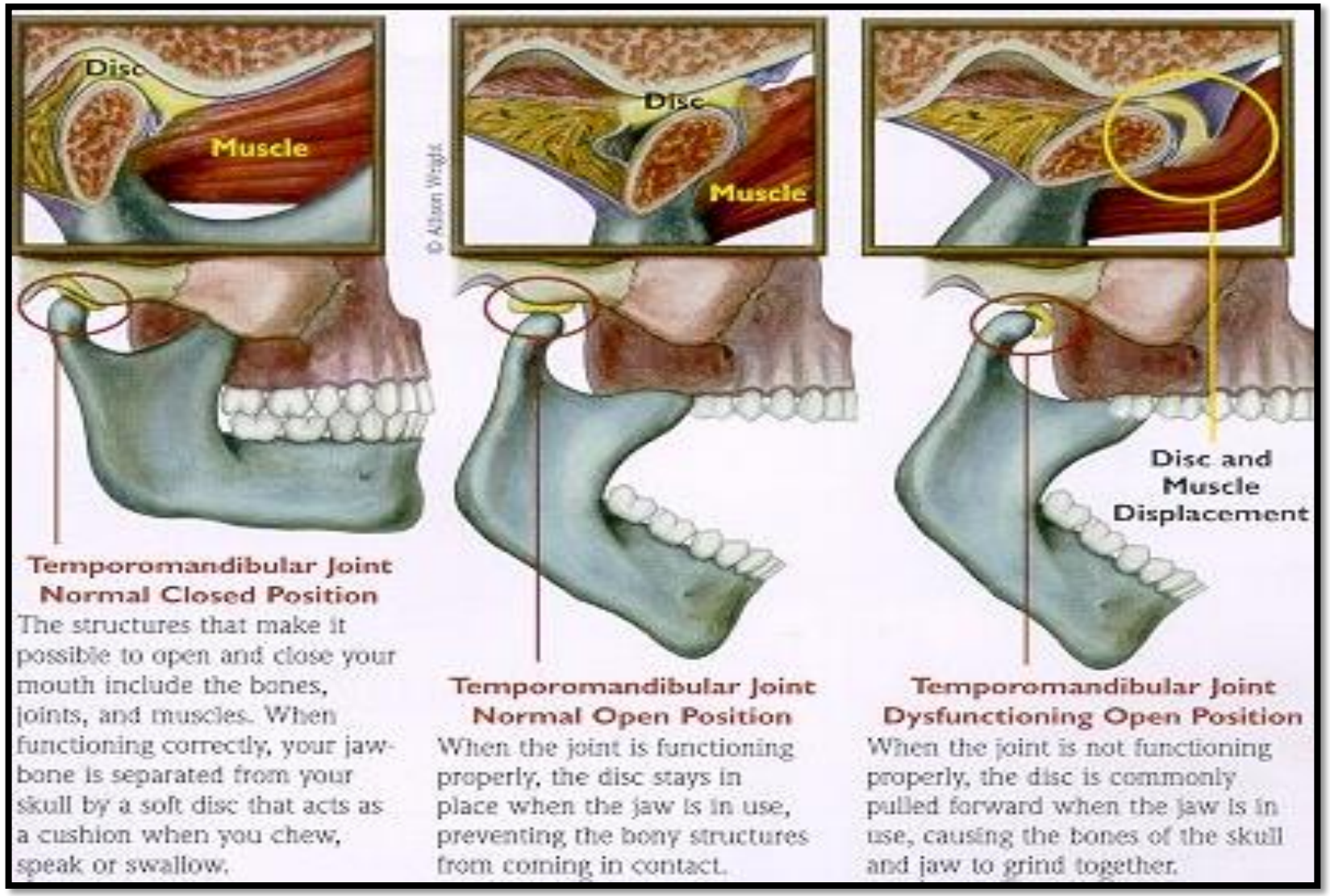
# Lateral pterygoid



# NORMAL TMJ IN ACTION



# NORMAL TO ABNORMAL ACTION OF TMJ

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KNOWLEDGE TO EMPOWER

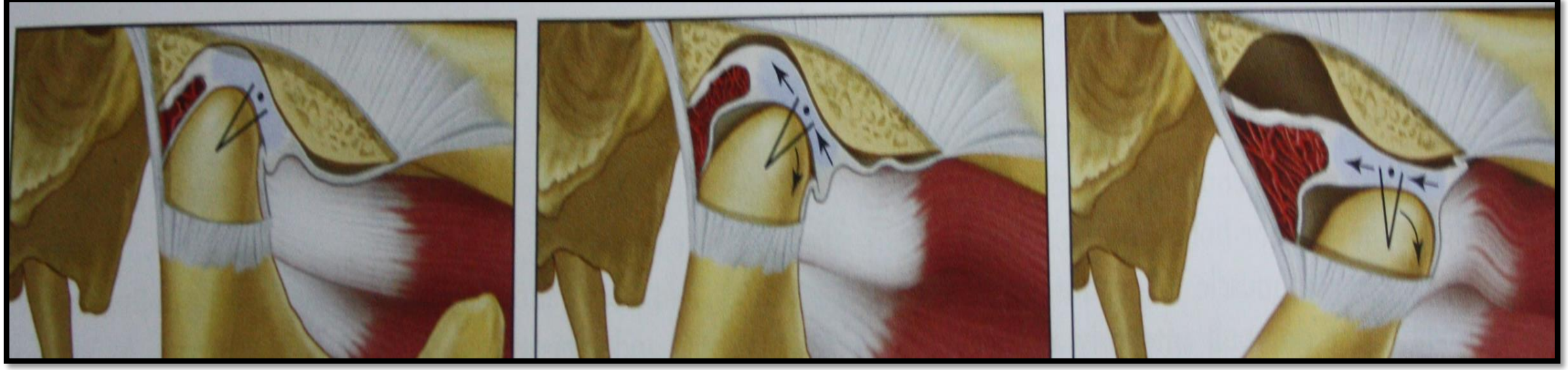
# CLINICAL CONDITIONS OF TMD

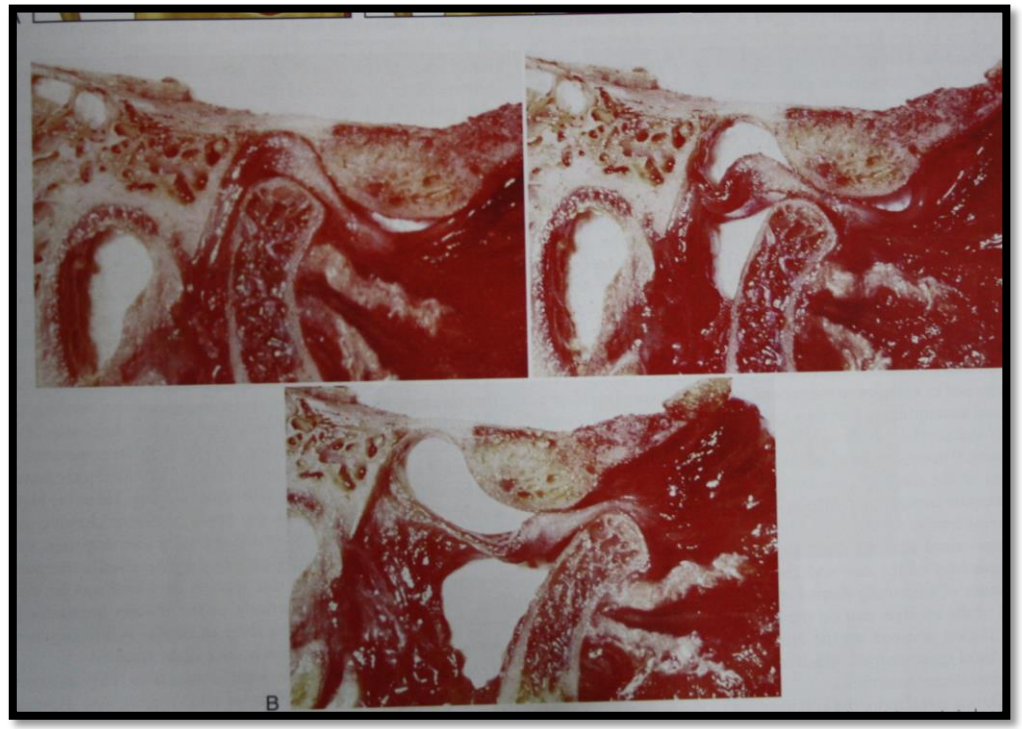
The most common cause of TMJ pain is **myofascial pain dysfunction syndrome**, primarily involving the muscles of mastication.

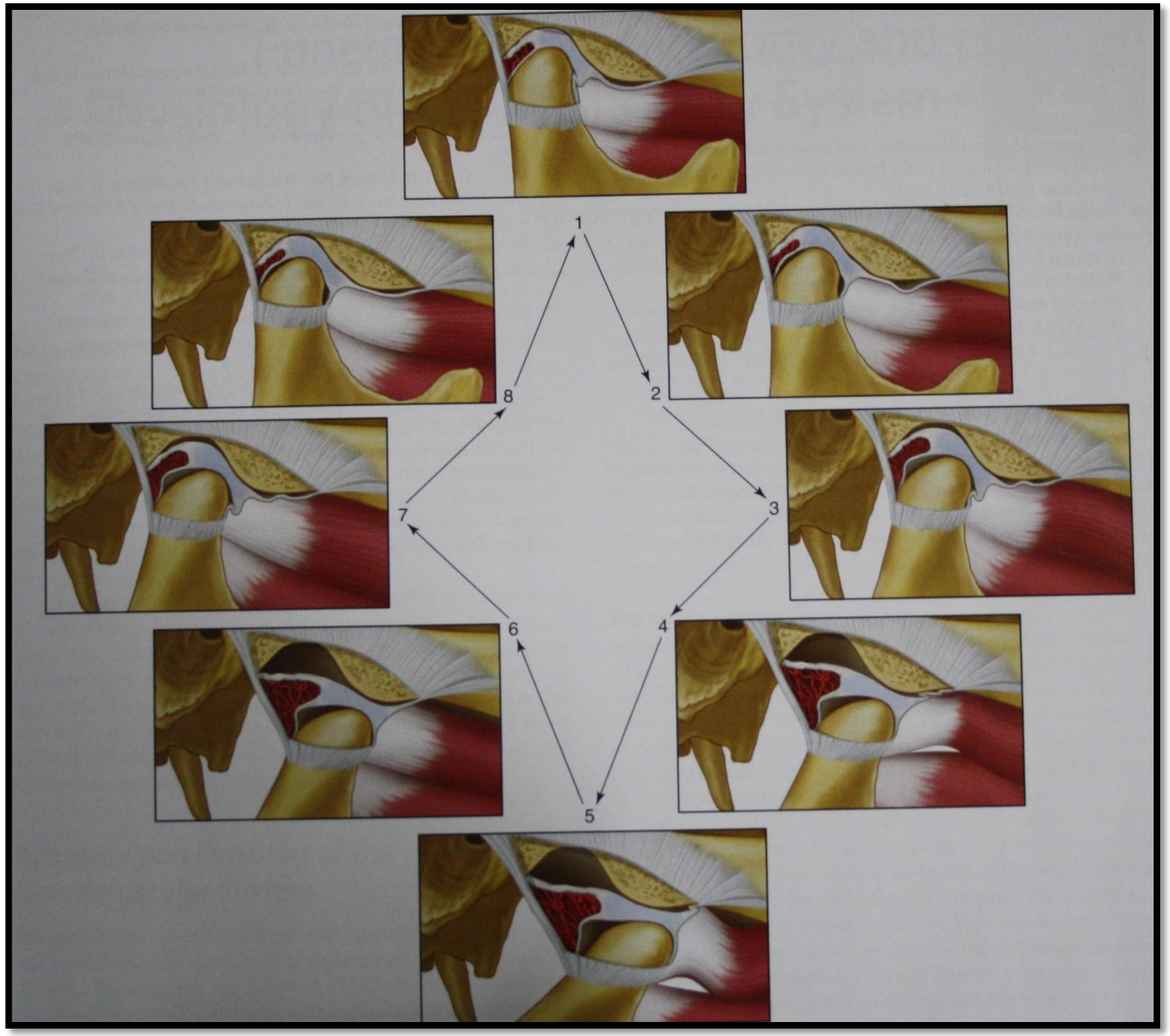
**Internal derangements** is defined as an abnormal relationship of the disc to any of the other components of the TMJ. Disc displacement is an example of internal derangement.

**Degenerative joint disease**, otherwise known as **osteoarthritis** is the organic degeneration of the articular surfaces within the TMJ.

TMJ pain remains one of the most reliable diagnostic criteria for **temporal arthritis.**







# Screening examination

1. Pain on palpation

--TMJ

--Masticatory muscles

2. Range of mandibular motion

3. TMJ noise

4.Occlusion

5.Parafunctional habits

6.Diagnostic local anesthetic nerve block

# TMJ examination procedure

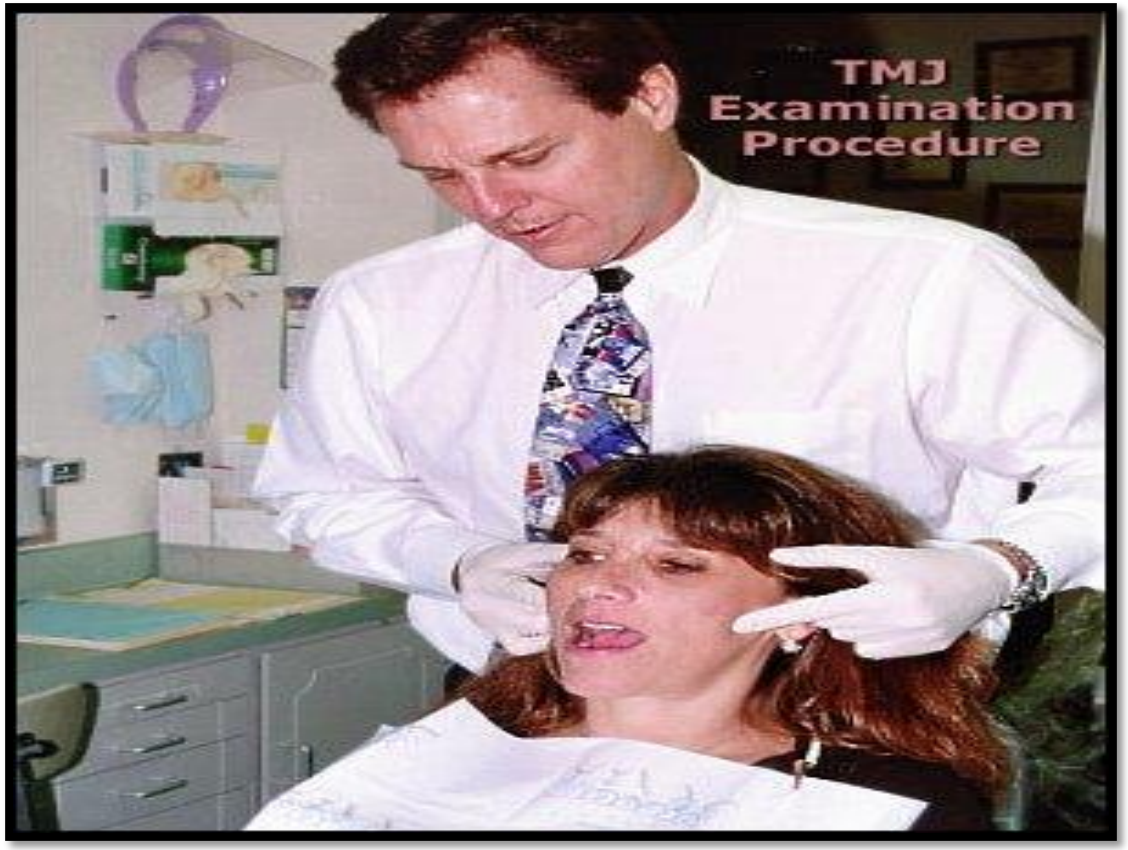


FIGURE 4- Palpation of anterior and posterior temporalis muscle

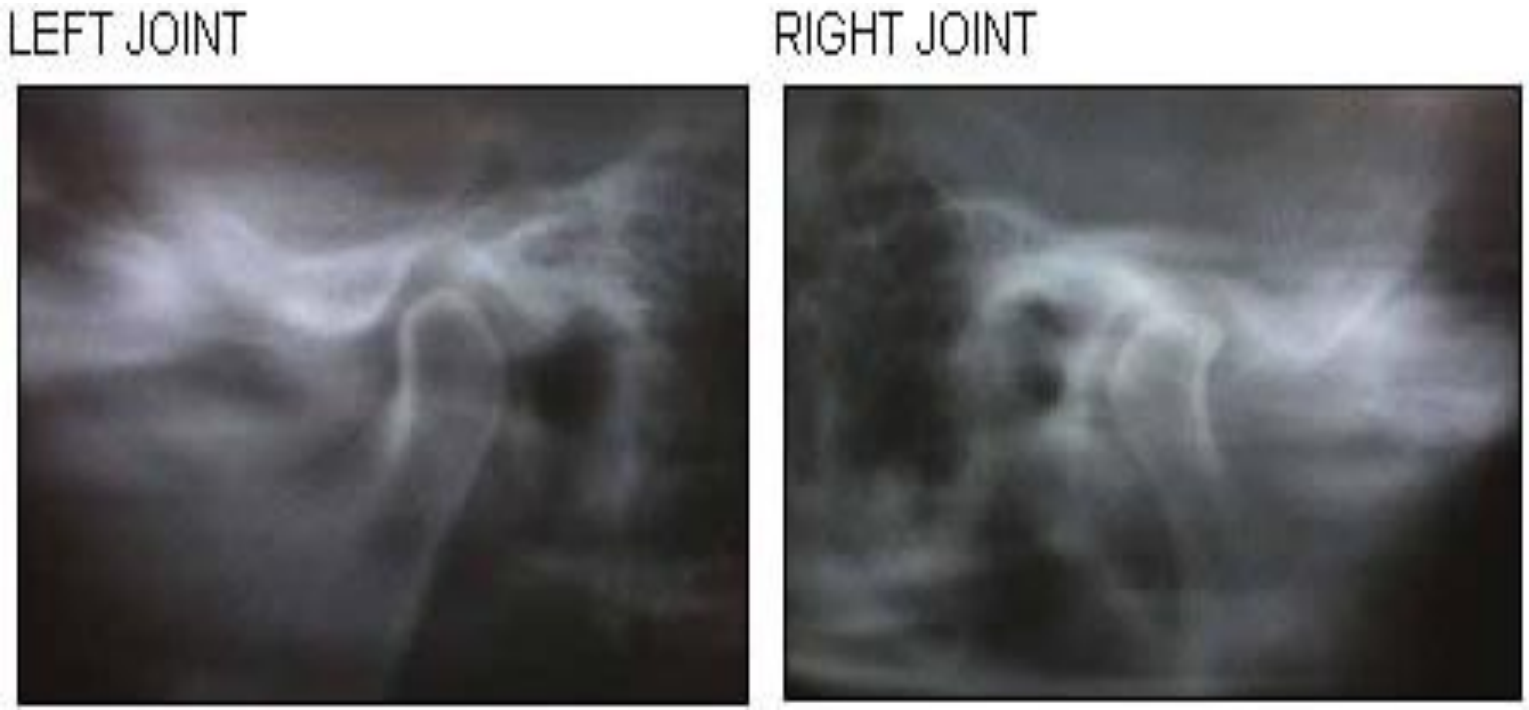
Temporal muscle examination

Masseter muscle examination

Medial pterygoid muscle examination


Lateral pterygoid muscle examination

**Tomography and CT** are the imaging choice to document osteodegenerative joint disease.
It provides details of  bony abnormalities when considering the Ankylosis, fractures, tumors of bone and osteodegenerative joint disease



# CONCLUSION

- It is impossible to comprehend the fine points of occlusion without an in depth awareness of anatomy and bio mechanics of TMJ.
- The first requirement for successful occlusal treatment is stable, comfortable TMJ.
- The jaw joint must be able to accept maximum loading by the elevator muscles with no signs of discomfort.
- It is only through an understanding of how the manual, healthy TMJ functions that we can make sense out of what is wrong when it isn't functioning comfortably.

# TAKE HOME MESSAGE

The challenges posed by TMJ disorders span the research spectrum, from causes to diagnosis through treatment and prevention. Researchers throughout the health sciences are working together not only to gain a better understanding of the temporomandibular joint and muscle disease process, but also to improve quality of life for people affected by these disorders.

# Probable SAQs & LAQs

SAQs:

- Temporomandibular ligaments.
- Muscles of mastication.
- TMJ screening examination

LAQ:

Explain the type of Temporomandibular joint. Add a note on muscles of mastication and examination of the joint.