Temporomandibular Joint Disorders

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Case study

- 38 year-old female, constant jaw pain for the last 6 months after a motor vehicle accident. At examination, the patient shows no dental misalignment or malocclusion, pain in the TMJ w/ palpation, decreased mouth opening by 20% with clicking at mouth opening. X-ray reveals no changes on bony structures or anomalies. The patient was treated with night guard but no improvements.

Introduction to TMJ: Anatomy, Biomechanics and Pathomechanics

Definition

Temporomandibular Joint Disorder (TMD), are a group of conditions that cause pain and dysfunction in the jaw joint and the muscles that control jaw movement.

- National Institute of Dental and Craniofacial Research. National Oral Health Information Clearinghouse 2015.

TMD Statistics

- The most common cause of facial pain is Temporomandibular Joint Disorder (TMD), which causes recurrent or chronic pain and dysfunction in the jaw joint and its associated muscles and supporting tissues.

- TMD is the second most commonly occurring musculoskeletal condition resulting in pain and disability (after chronic low back pain).

- Affects approximately 5 to 12% of the population, twice as prevalent in women as men, with an annual cost estimated at $4 billion.

- About half to two-thirds of those with TMD will seek treatment. Among these, approximately 15% will develop Chronic TMD

Source: National Institute of Dental and Craniofacial Research.

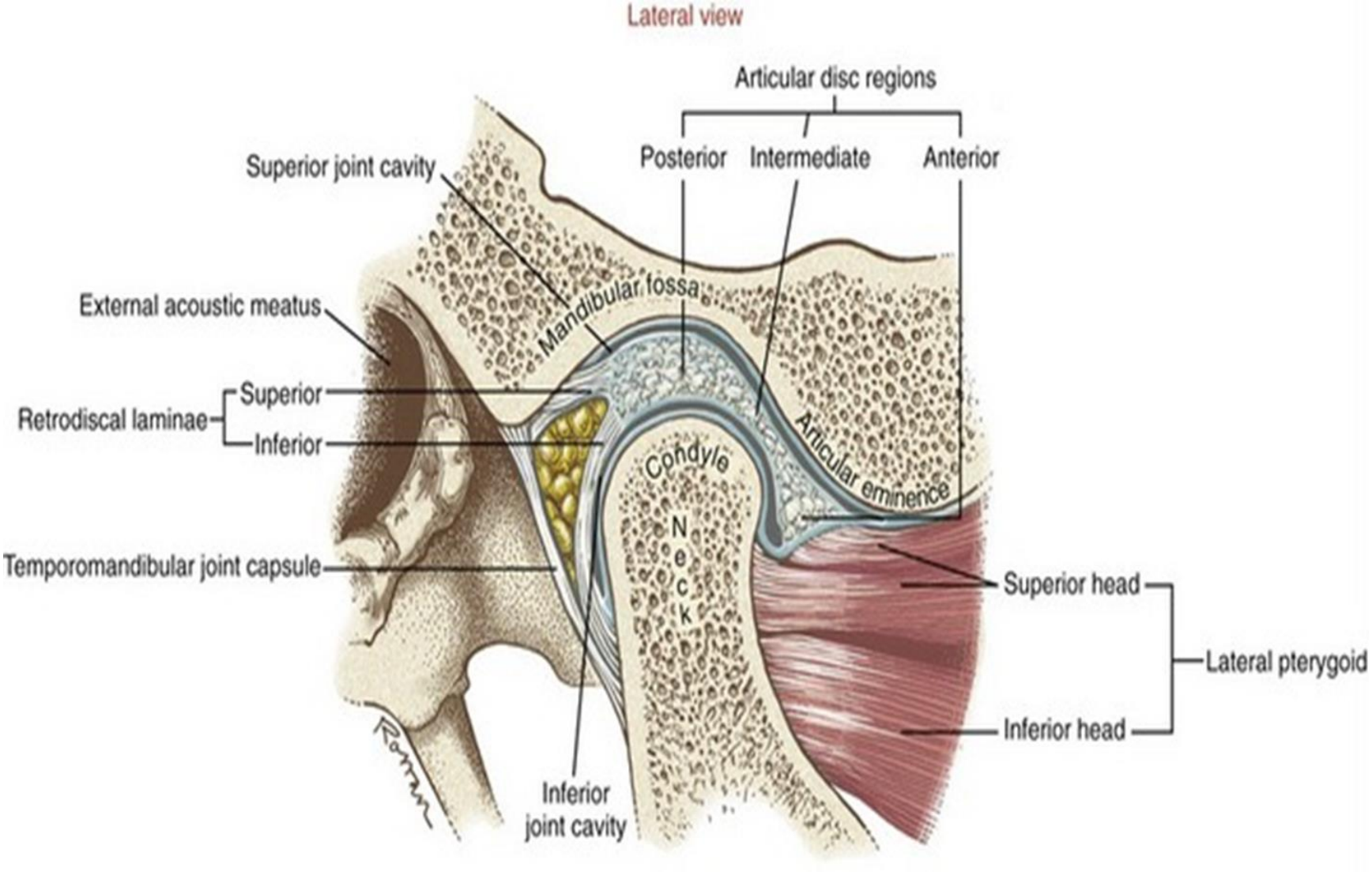
Who can treat Temporomandibular Disorders?

Finding the Right Care:

Because there is no certified specialty for TMJ disorders in either dentistry or medicine, finding the right care can be difficult. Look for a health care provider who understands musculoskeletal disorders (affecting muscle, bone and joints) and who is trained in treating pain conditions. Pain clinics in hospitals and universities are often a good source of advice.

Source: National Institute of Dental and Craniofacial Research.

TMJ Anatomy


Lateral view
Articular disc regions
Posterior
Intermediate
Anterior
Superior joint cavity
External acoustic meatus
Mandibular fossa
Retrodiscal laminae
Superior
Inferior
Articular eminence
Condyle
Neck
Temporomandibular joint capsule
Superior head
Lateral pterygoid
Inferior head
Inferior
joint cavity

TMJ Components

1. Mandibular condyle
2. Articular surface of the temporal bone (mandibular Fossa)
3. Articular disc
4. Capsule
5. Ligaments:

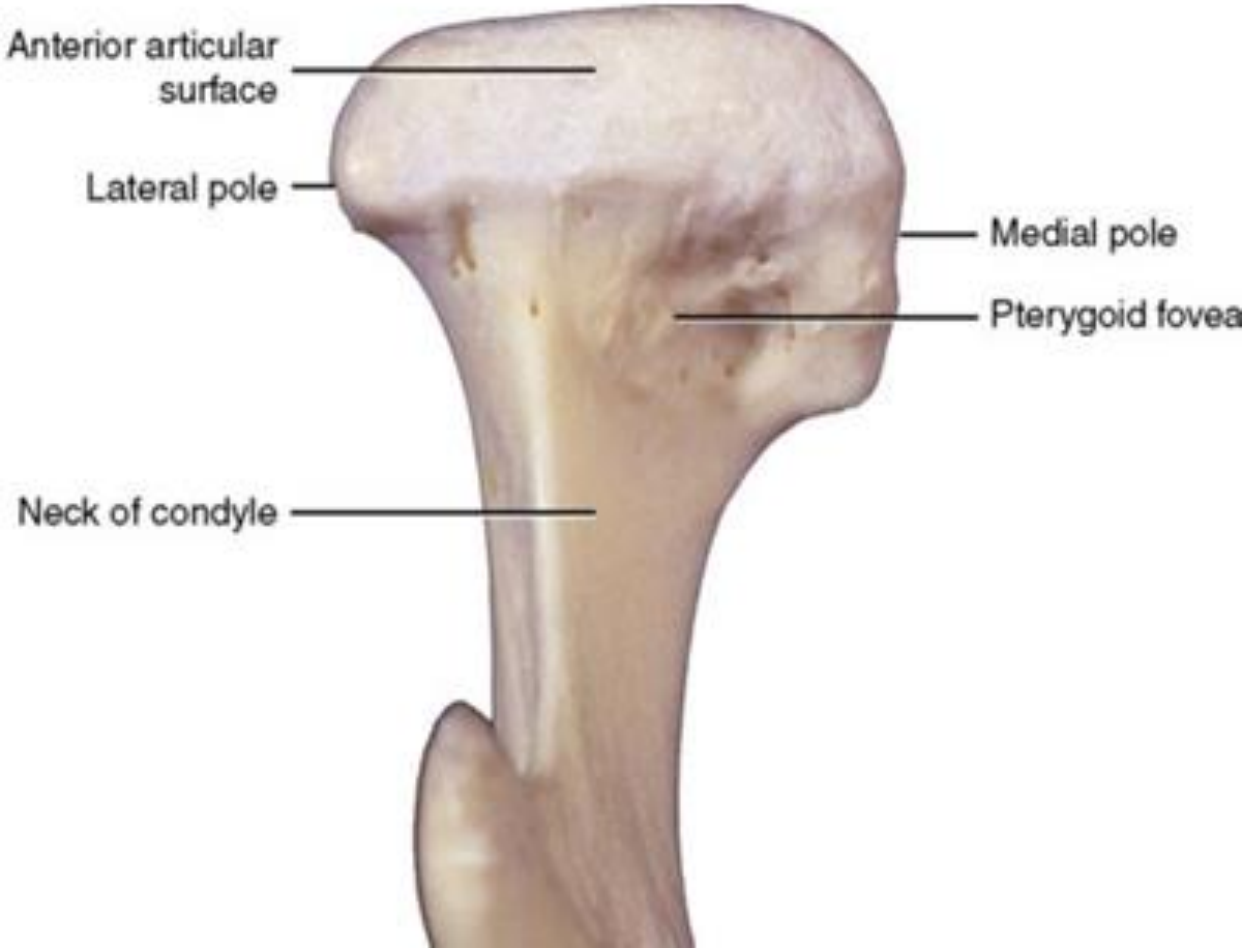
- Discal ligaments
- Temporomandibular ligaments
- Accessory ligaments
- Oto-malleolar ligaments

6. Masticatory muscles

Mandibular condyle

- The condyle presents an articular surface for articulation with the articular disk of the temporomandibular joint
- The space between the mandibular condyle and the articular disc is considered inferior TMJ compartment.
- It is convex in sagittal and coronal plane, and extends farther on the posterior than on the anterior surface.

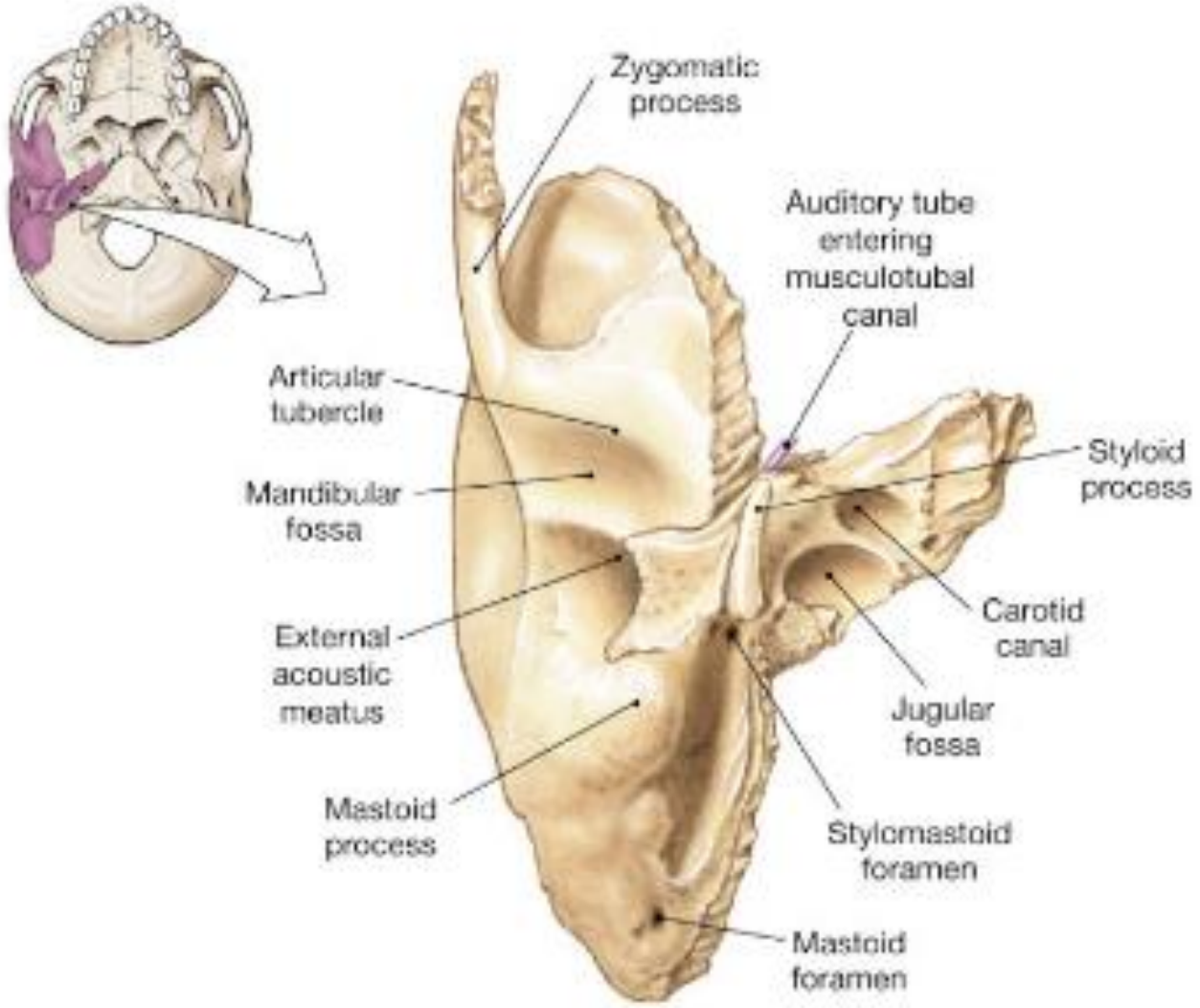
Mandibular Condyle AP View



Articular surface of Temporal bone

- The mandibular fossa (glenoid fossa) is the depression in the temporal bone that articulates with the mandible.
- The mandibular fossa is bounded, in front, by the articular tubercle; behind, by the tympanic part of the bone, which separates it from the external acoustic meatus.
- The space between the mandibular fossa and the articular disc is considered superior TMJ compartment.

Right Articular surface of Temporal bone in IS view



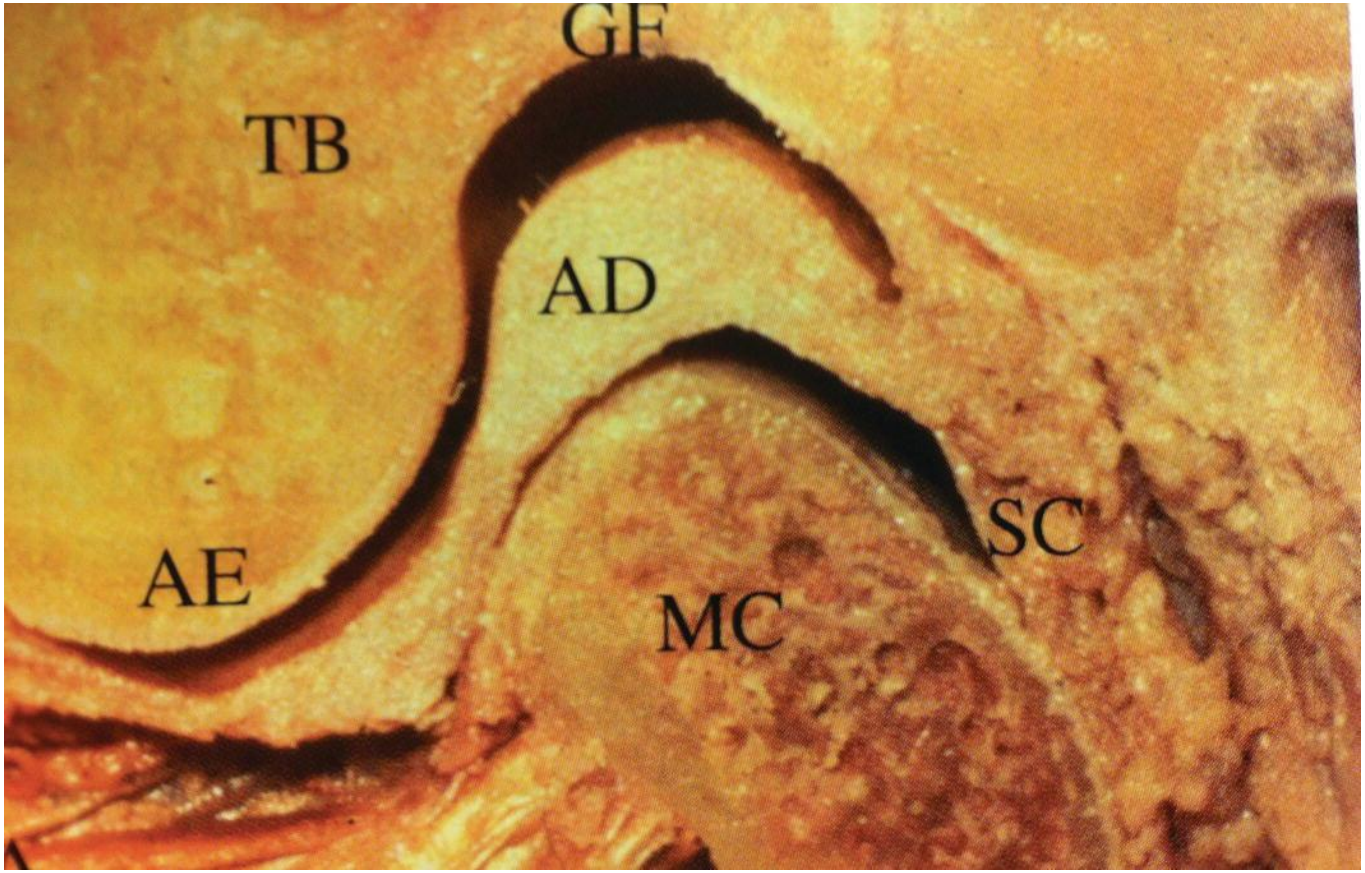
Articular Disc

- The articular disc is a dense fibrous connective tissue that is positioned between the two articular surfaces of the temporomandibular joint.
- The disc divides the joint into two sections, each with its own synovial membrane.
- Rotational movement occurs in lower joint compartment and translation movement occurs in upper joint compartment

- The central area of the disc is avascular and lacks innervation. The peripheral region has both blood vessels and nerves.
- The disc is also attached to the condyle medially and laterally by the collateral ligaments (also called discal ligaments).
- Medial disc ligaments attaches the medial edge of the disc to the medial pole of the condyle.

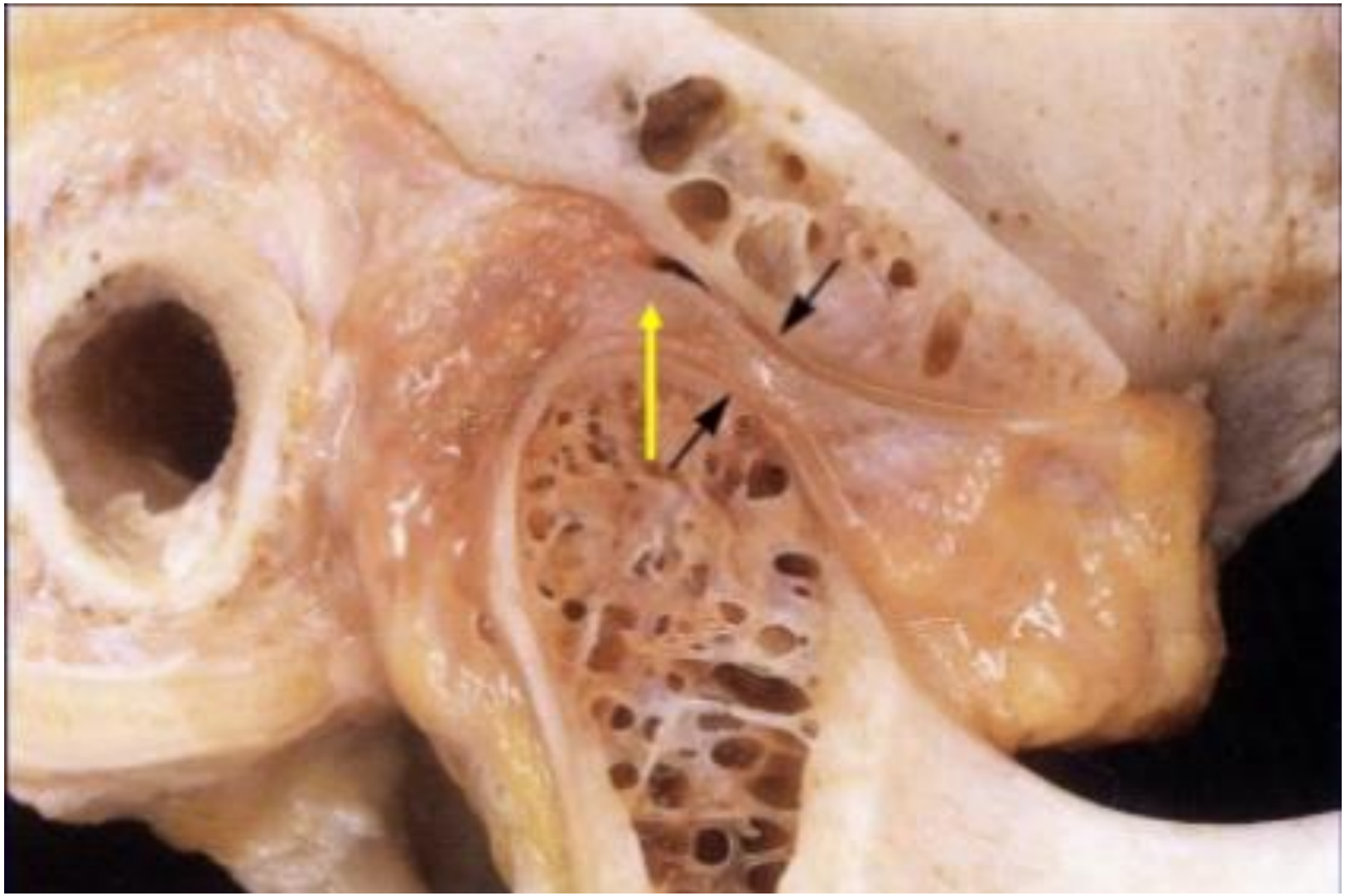
- Lateral disc ligaments attaches the lateral edge of the disc to the lateral pole of the condyle.
- The anterior disc attaches to the joint capsule and the superior head of the lateral pterygoid.
- The posterior portion attaches to the mandibular fossa and is referred to as the retrodiscal tissue.

Articular Disc



Bony components and articular disc of the TMJ: glenoid or mandibular fossa (GF), temporal bone (TB), articular disc (AD), articular eminence (AE), mandibular condyle (MC), and synovial capsule (SC).

Articular Disc Position



TMJ Capsule

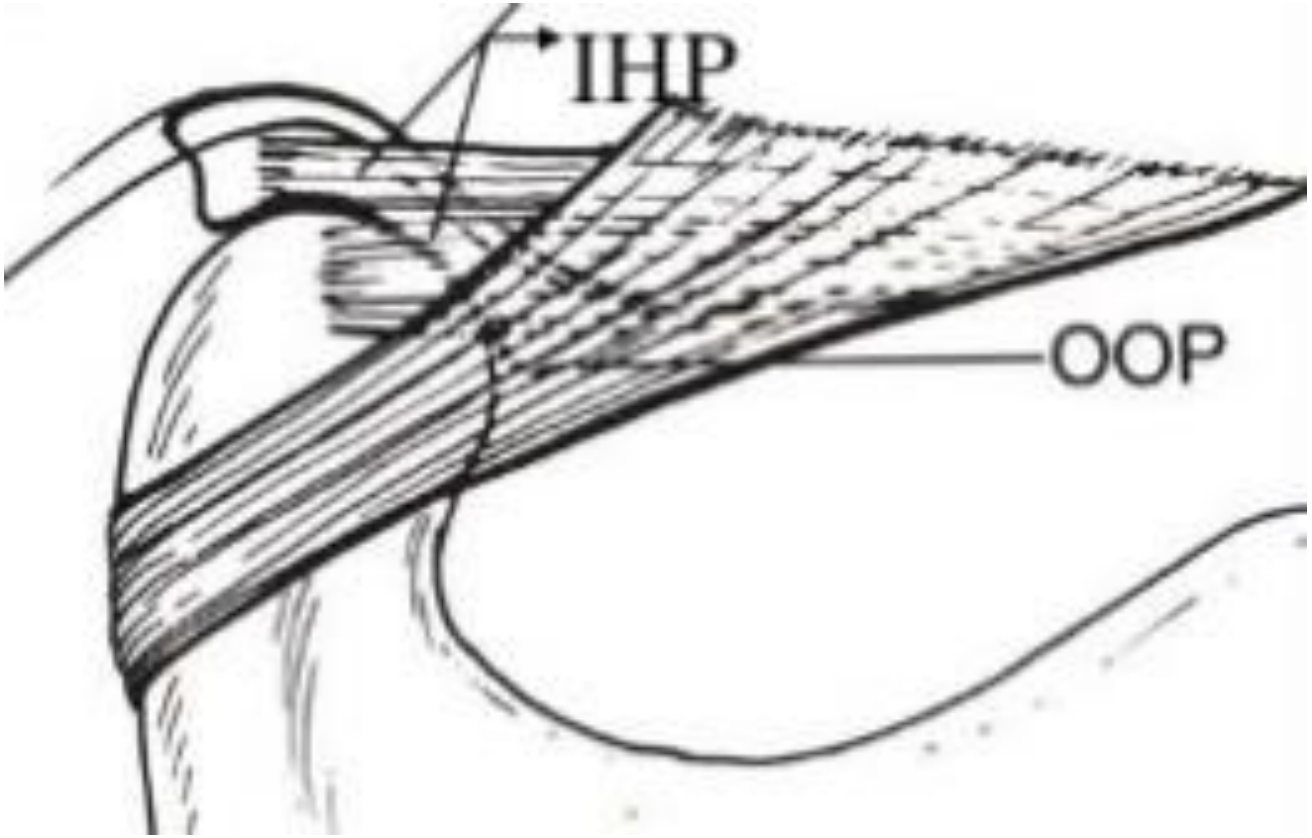
- The capsule is a dense fibrous membrane that originates from the border of the mandibular fossa, encloses the articular tubercle of temporal bone and inserts at the neck of mandible above the pterygoid fovea.
- Resist forces that separates articulating surfaces

Temporomandibular Ligament

- The temporomandibular ligament consists of two portions: an outer oblique portion (OOP) and an inner horizontal portion (IHP).
- Both originate at the outer surface of the articular eminence and zygomatic process.
- The OOP extends posteroinferiorly to the outer surface of the condylar neck
- The IHP extends backward to the lateral pole of the condyle and posterior portion of the disc

- IHP prevents posterior displacement of the condyle
- OOP Prevents excessive dropping of condyle. Limits extent of mouth opening.

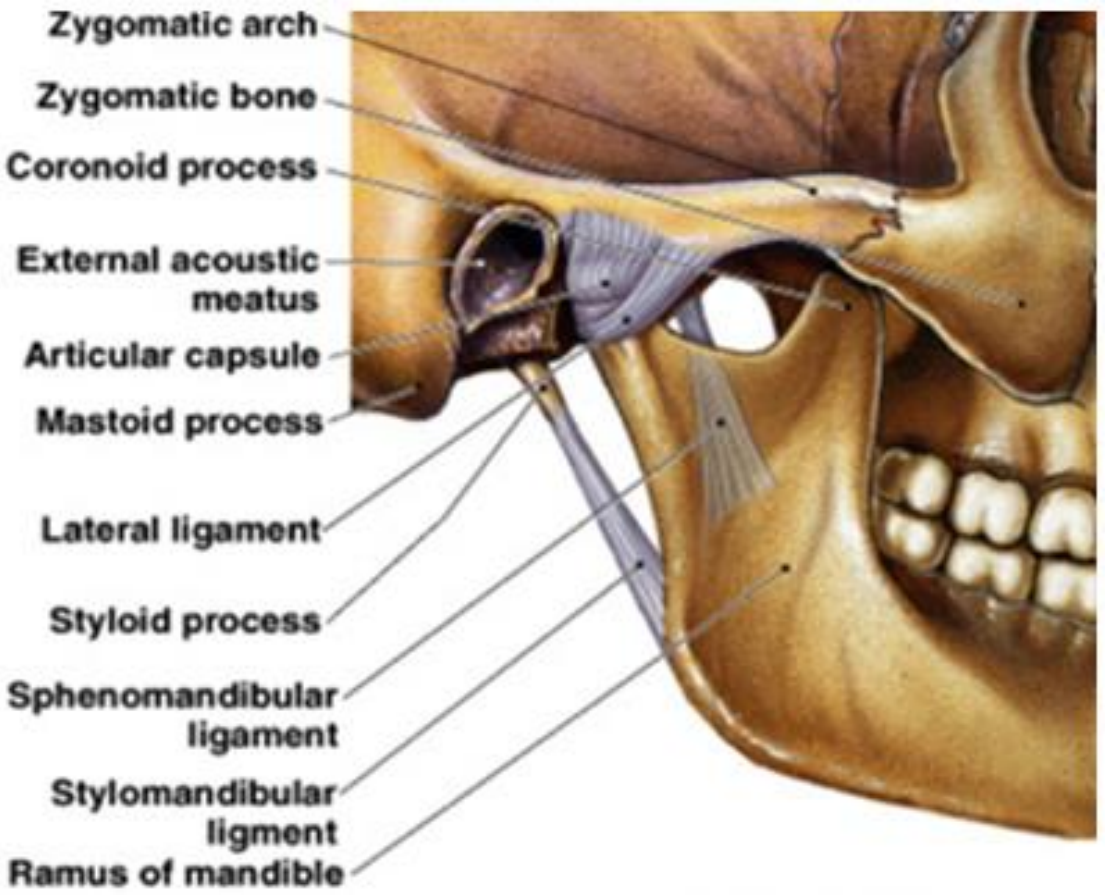
Temporomandibular Ligament



Stylomandibular Ligament and Sphenomandibular ligament

- The stylomandibular ligament runs from the styloid process to the angle of the mandible.
- The sphenomandibular ligament runs from the spine of the sphenoid bone to the lingula of mandible.
- These ligaments becomes accentuated and taut when the mandible is protruded.
- Both ligaments limit the excessive opening of the mandible.

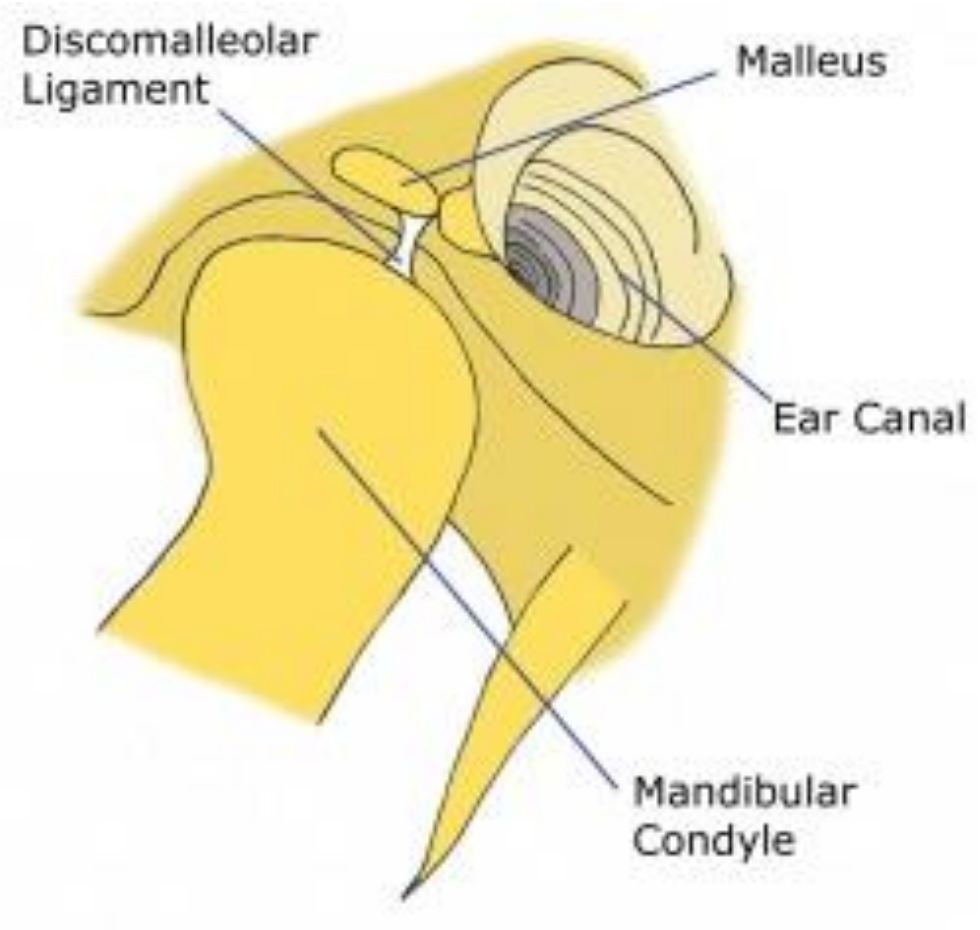
Stylomandibular Ligament and Sphenomandibular ligament



Oto-mandibular ligaments

- Discomalleolar ligaments (DML) runs from malleus to the medial retrodiscal tissue of the TMJ.
- Anterior malleolar ligaments (AML) runs from malleus to the lingula of the mandible.
- The oto-mandibular ligaments may be implicated in tinnitus associated with TMD.
- It has been proposed that a TMJ disorder may stretch the DML and AML, thereby affecting middle ear structure equilibrium.

Discomalleolar Ligament



Masticatory Muscles

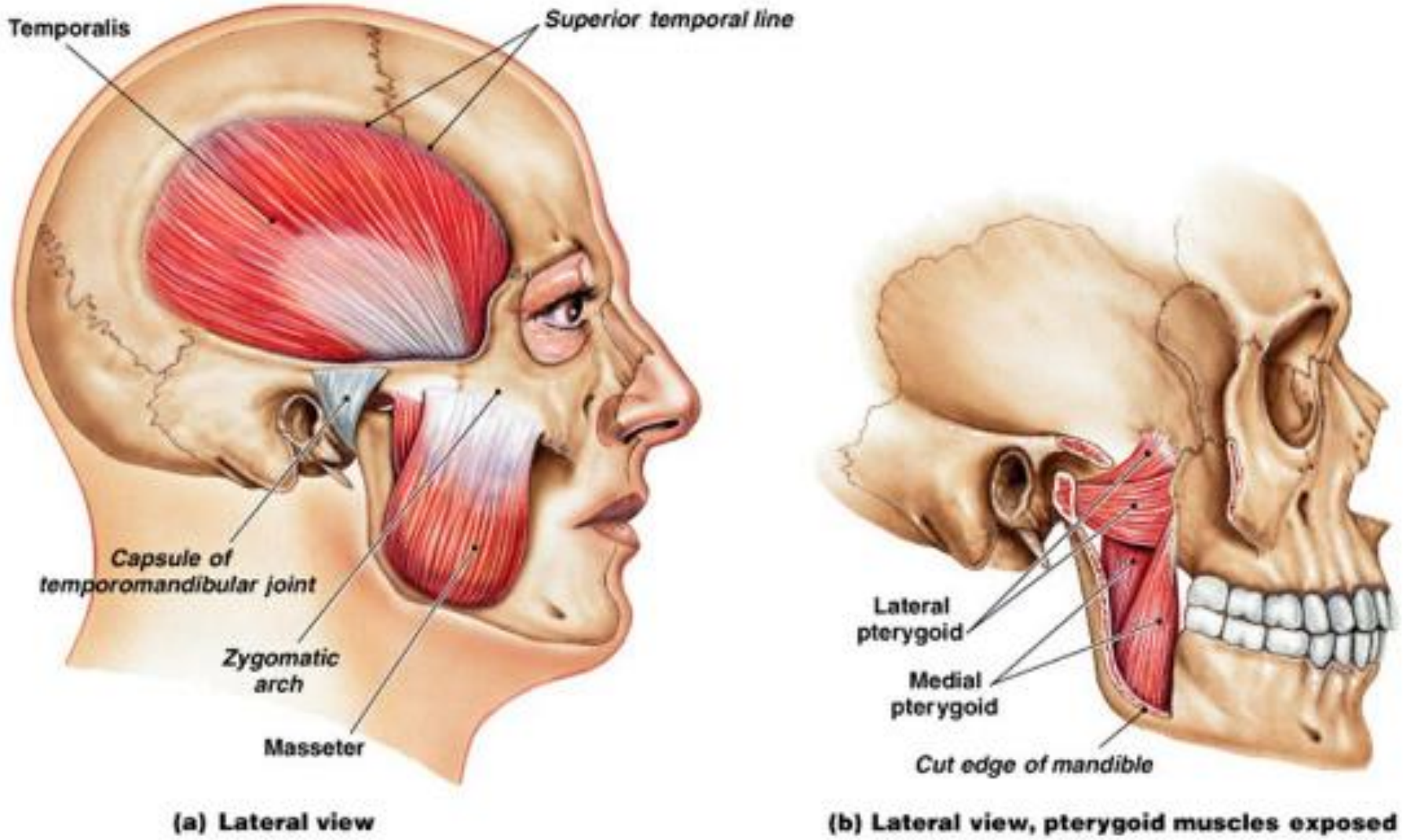
- Masseter: Superficial head originates from anterior 2/3 of zygomatic arch and inserts to the mandibular angle and inferior half of the mandibular ramus. Deep head originates from posterior 1/3 of zygomatic arch and inserts to the superior half of mandibular ramus. It elevates and prutrudes the mandible.
- Temporalis: Originates from temporal fossa and inserts to the coronoid process. It elevates and retrudes that mandible.

- Medial pterygoid: Superficial head originates from the medial surface of lateral pterygoid plate. Deep head originates from maxillary tuberosity and pyramid process of palatine bone. Both insert to the medial surface of ramus and angle of the mandible. It elevates and assist on lateral excursion.
- Lateral pterygoid: Superior head originates from infratemporal surface and infratemporal crest of sphenoid bone and inserts to the articular disc and fibrous capsule. Deep head originates from lateral surface of lateral Pterygoid plate and inserts to the neck of the mandibular condyle.

The superior part is essential in pulling the capsule and disc forward during mouth opening, thereby maintaining normal relationship between the condyle of the mandible and the TMJ disc.

The inferior part is responsible for opening of the mouth, protrusion and contralateral jaw movement.

Masticatory Muscles



Arthrokinematics of opening the mouth

- The TMJ functions uniquely in that the condyle both rotates within the fossa and translates anteriorly along the articular eminence. Because of the condyle's ability to translate, the mandible can have a much higher maximal incisal opening than would be possible with rotation alone
- The joint is thus referred to as "gynglimoidarthrodial": a combination of the terms ginglymoid (rotation) and arthroidial (translation)

Early Phase (Rotation)

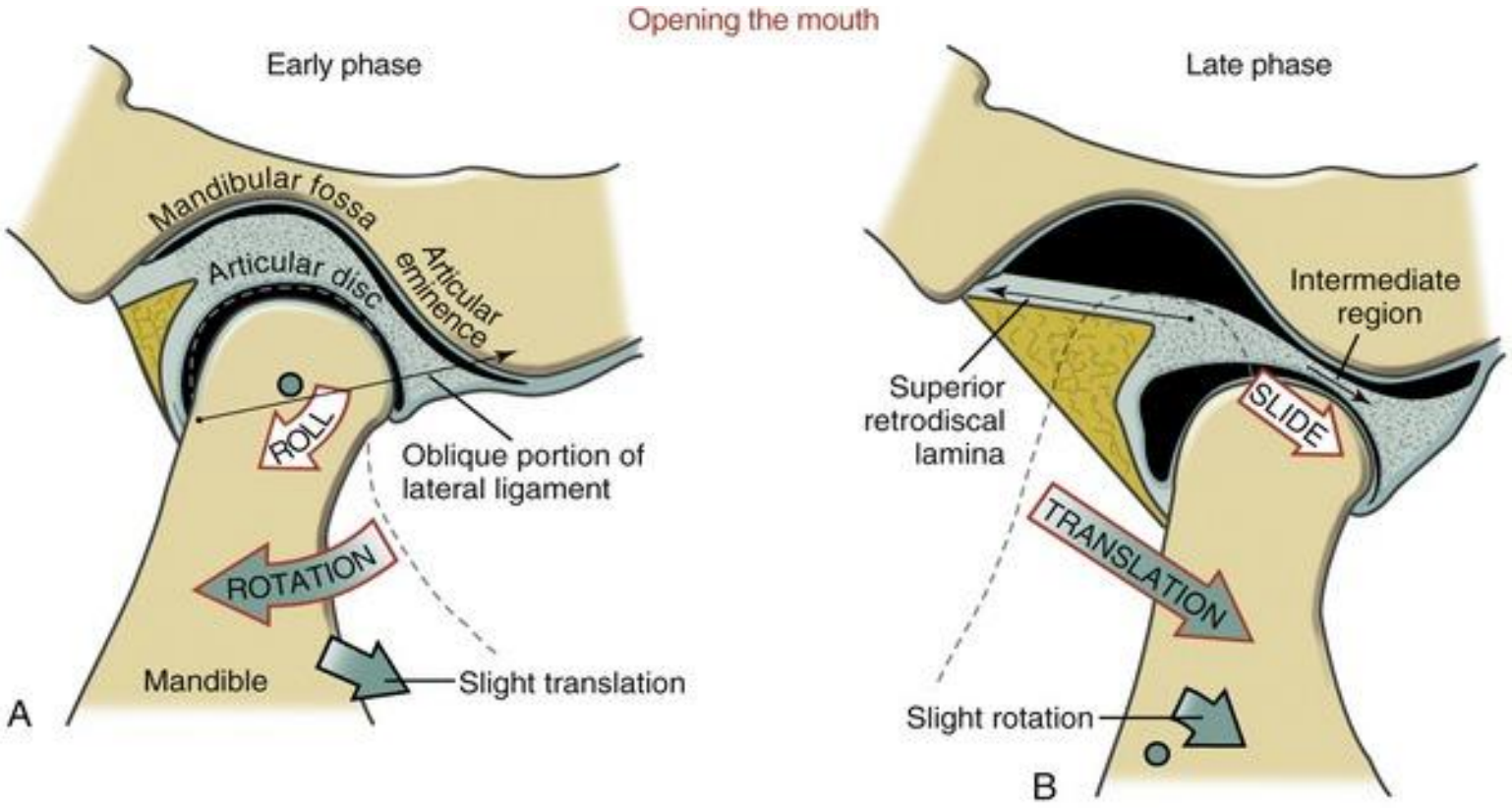
- Early phase, constituting the first 35% to 50% of the range of motion, involves primarily rotation of the mandible relative to the cranium.
- The condyle rolls posteriorly within the concave inferior surface of the disc. (The direction of the roll is described relative to the rotation of a point on the ramus of the mandible.)
- The rolling motion swings the body of the mandible inferiorly and posteriorly.

- The rolling motion of the condyle stretches the oblique portion of the TMJ ligament. The increased tension in the ligament helps to initiate the late phase of the mouth’s opening

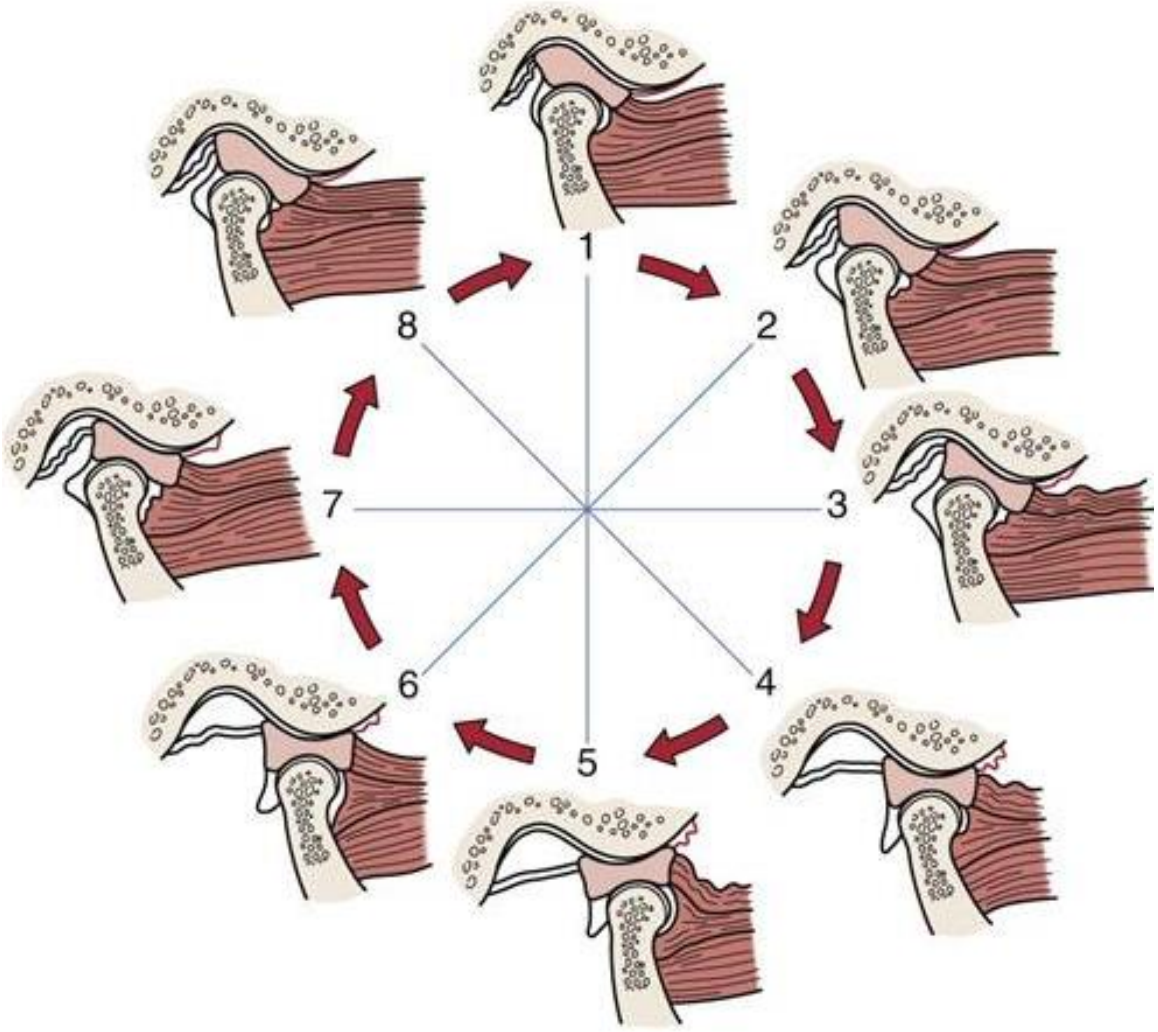
Late Phase (Translation)

- The late phase of opening the mouth consists of the final 50% to 65% of the total range of motion.
- This phase is marked by a gradual transition from primary rotation to primary translation.
- The transition can be readily appreciated by palpating the condyle of the mandible during the full opening of the mouth. During the translation the condyle and disc slide together in a forward and inferior direction against the slope of the articular eminence.

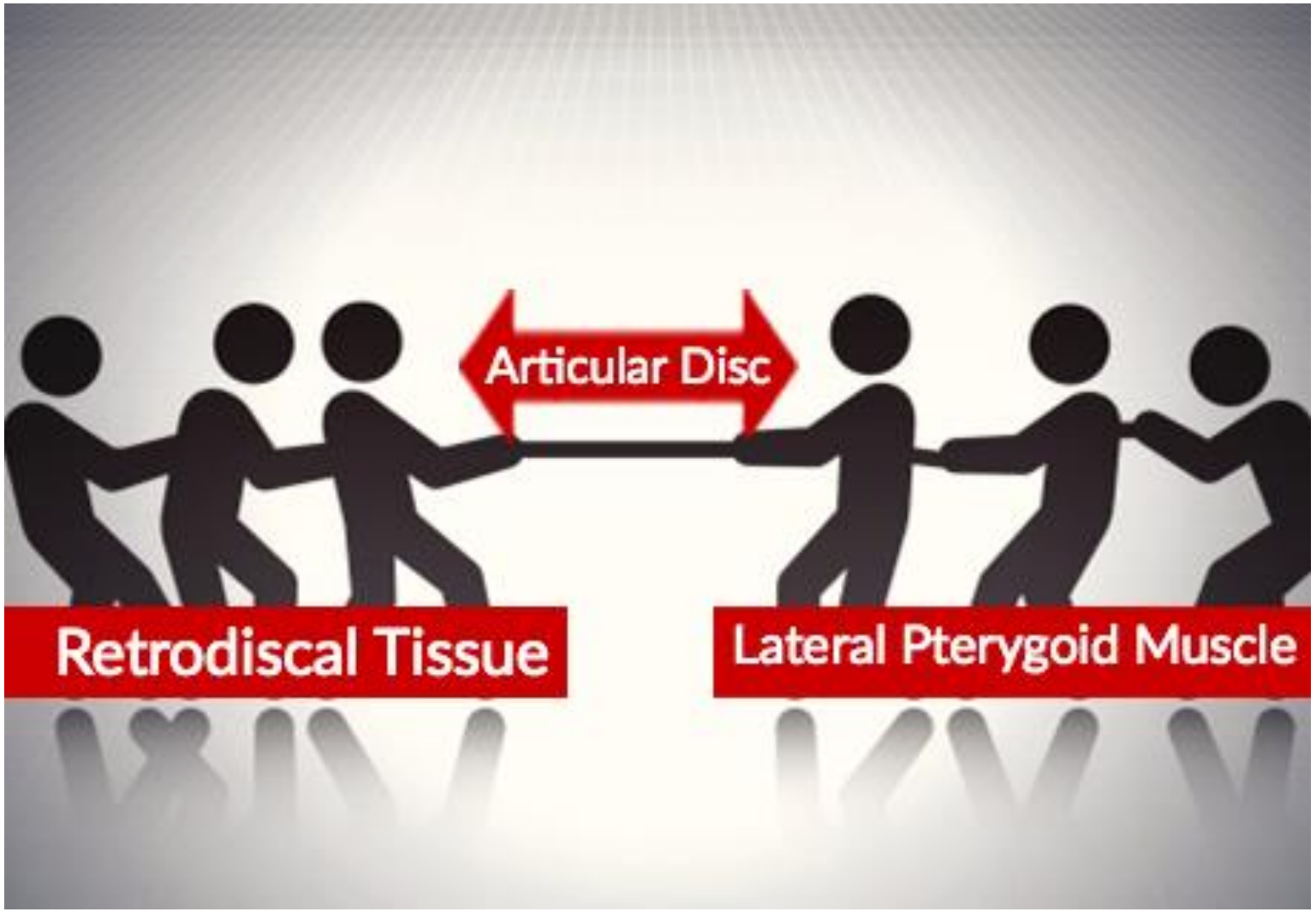
Opening of the mouth: Rotation and translation

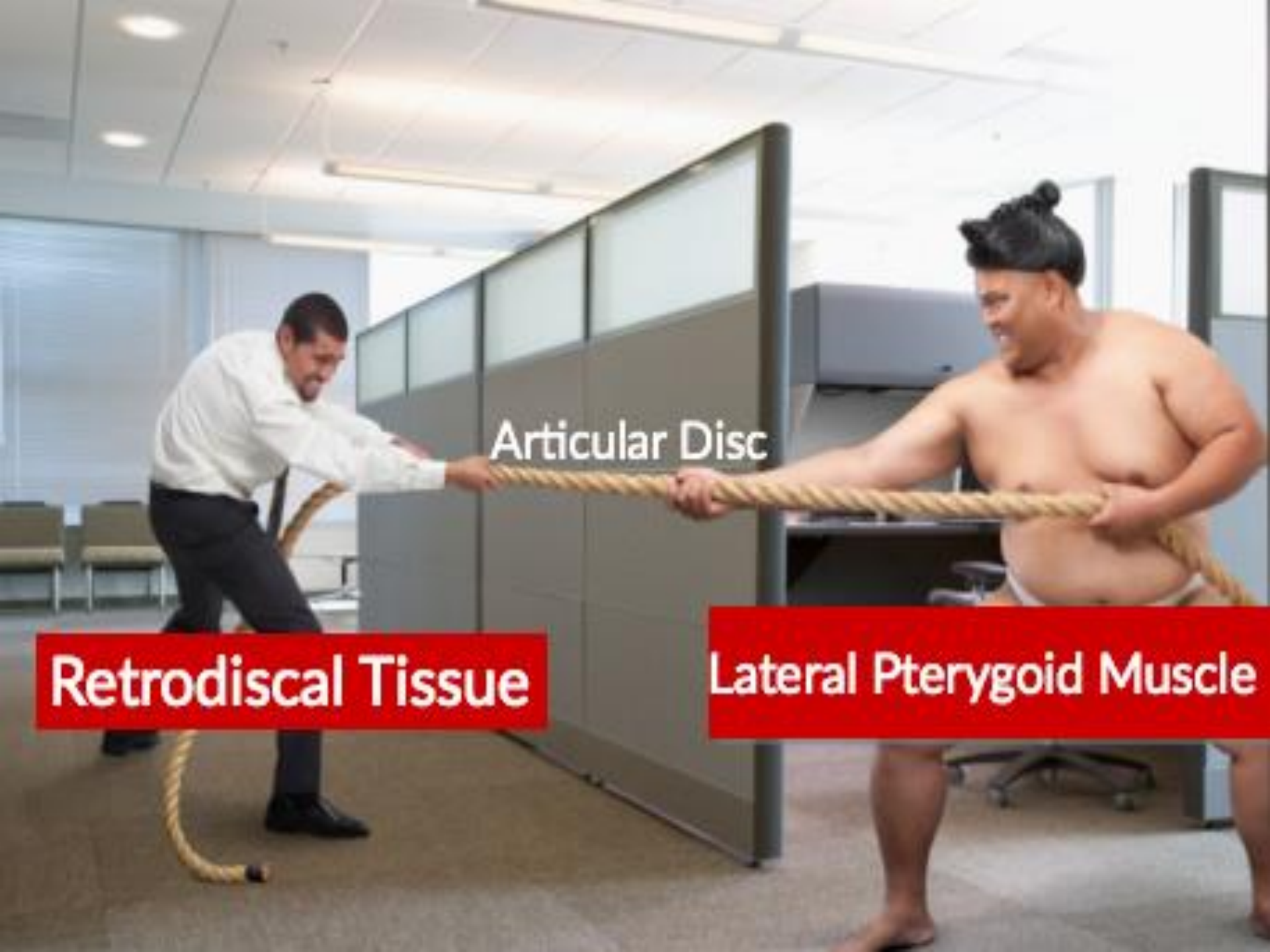


Normal functional movement of the condyle and disc during the full range of opening and closing



The position of the articular disc during the mouth opening and closing is maintained by delicate balance between the retrodiscal tissue and the lateral pterygoid muscle.




Articular Disc
Retrodiscal Tissue
Lateral Pterygoid Muscle

Normal Jaw opening

Arthrogenic Pathophysiology of TMD

- The etiology is multifactorial
- Disc displacement (Internal Derangement) and degenerative joint disease (arthrosis, arthritis) are common pathologies that affect the TMJ
- The TMJ can also be affected in rheumatoid arthritis, trauma and congenital anomaly
- Constant joint overloading can lead to hypertrophic responses in the subchondral bone and disc that decrease joint space and/or alter the articular surfaces to increase friction between the disc and the fossa (gum chewing, bruxism)

Myogenic Pathophysiology of TMD

- Myalgia associated with TMD are described as an aching pain localized to the masticatory muscles that is worsened upon muscle palpation and increased with function.
- Somewhere between 50%-70% of all patients with TMD report masticatory muscle pain, and in 25% of these patients, pain in the masticatory muscles is the principal source of pain

- Patients with TMD usually presents trigger points in the masticatory muscles.
- The development of tender areas is related to direct muscle trauma for example a blow to the jaw or indirect trauma, such as secondary to a whiplash injury.

- The repetitive strain injury to the muscle, which could result from activities such as teeth clenching or grinding may be an initiating factor for the development of tenderness and pain in masticatory muscles.

Other Pathophysiological Factors

- Stress: Psychosocial stressors plays a significant role in the development of TMD pain, particularly masticatory muscle pain. Stress → Bruxism → TMD
- Sex hormones: the incidence of TMD in women, which appears to peak during the third to fourth decade and then declines to levels comparable with men, and partly on the association of the onset of TMD in many women with menstrual cycle-related variations in sex hormone levels that begin at puberty.

- Rapid increases and decreases in estrogen levels that occur cyclically at ovulation and just prior to and during menstruation, respectively, are associated with exacerbations of muscle and joint pain in many female patients with TMD.

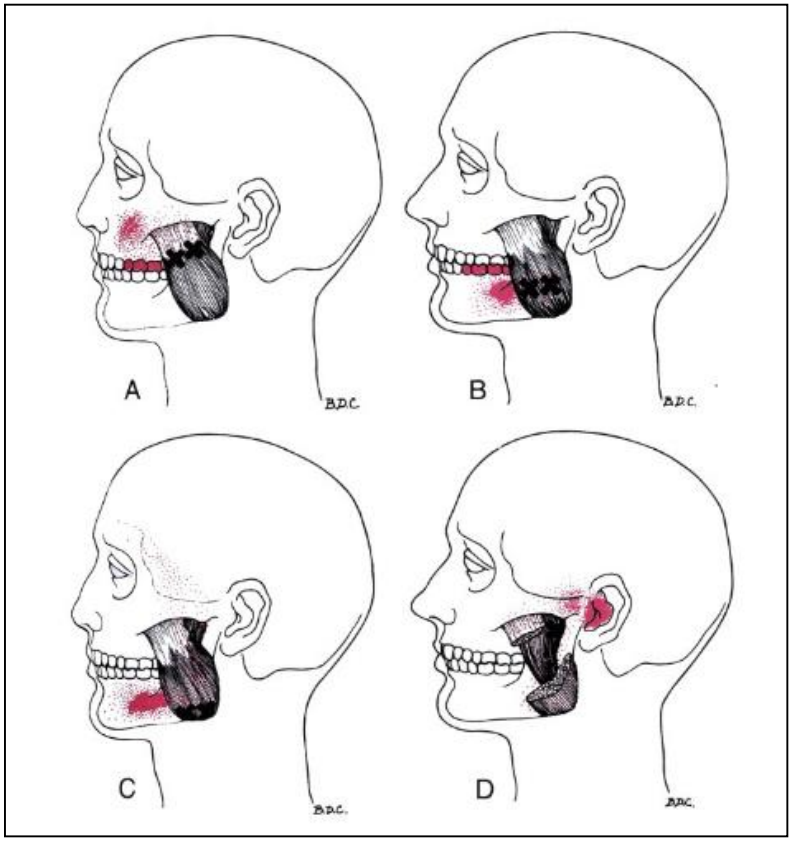
Differential Diagnosis and Common Disorders of TMJ

Differential Diagnosis of TMD

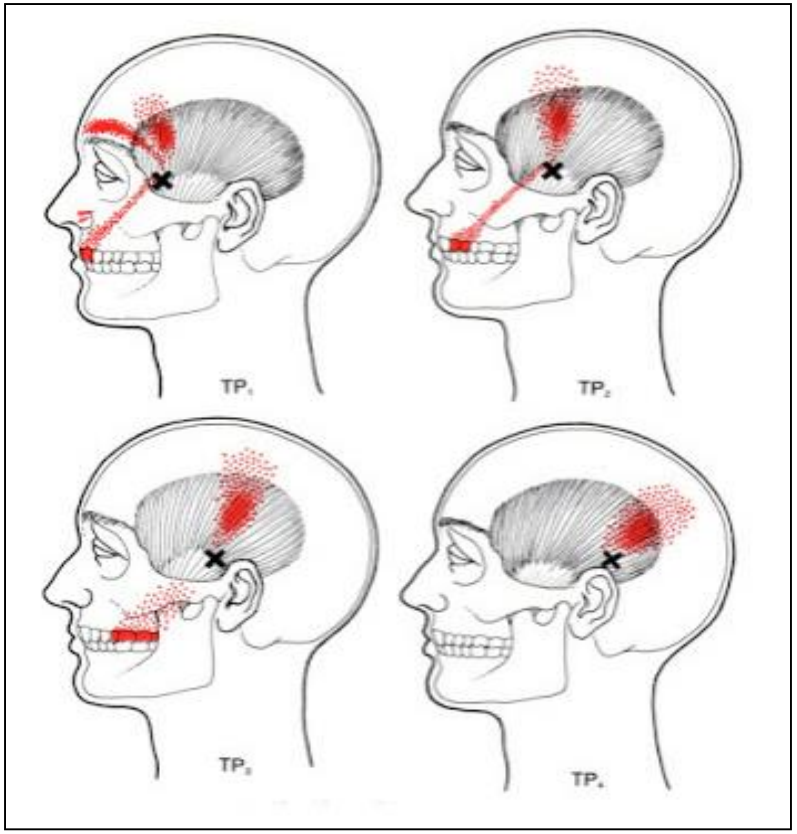
- TMJ disorders can cause referred pain, particularly undifferentiated headache.
- Some studies have shown that as many as 55 percent of patients with chronic headache who were referred to a neurologist were found to have significant signs or symptoms of TMJ disorders.

Masticatory muscles trigger points

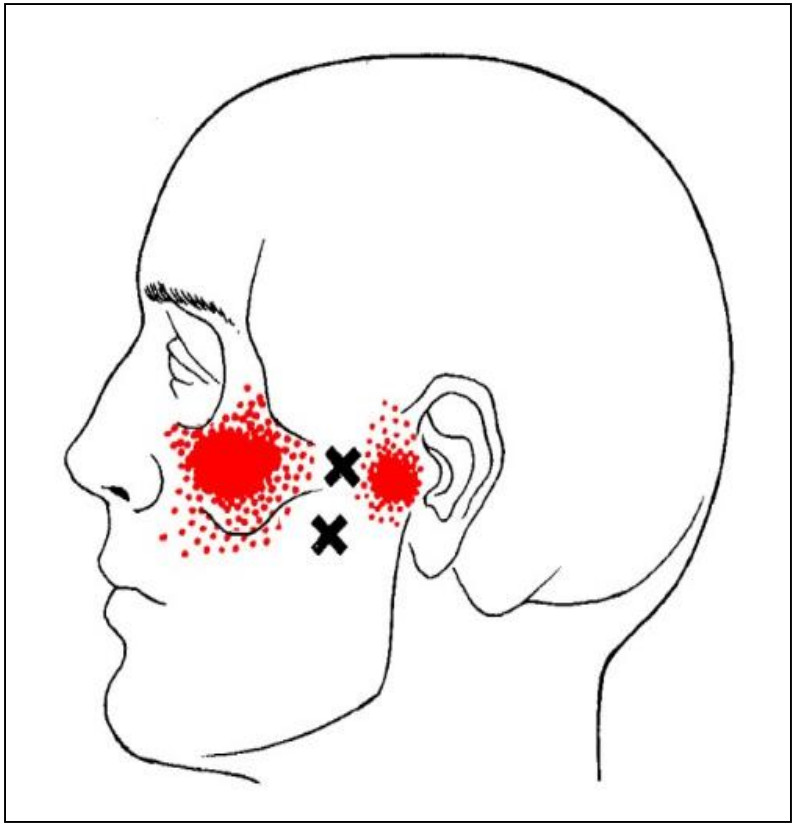
Masseter



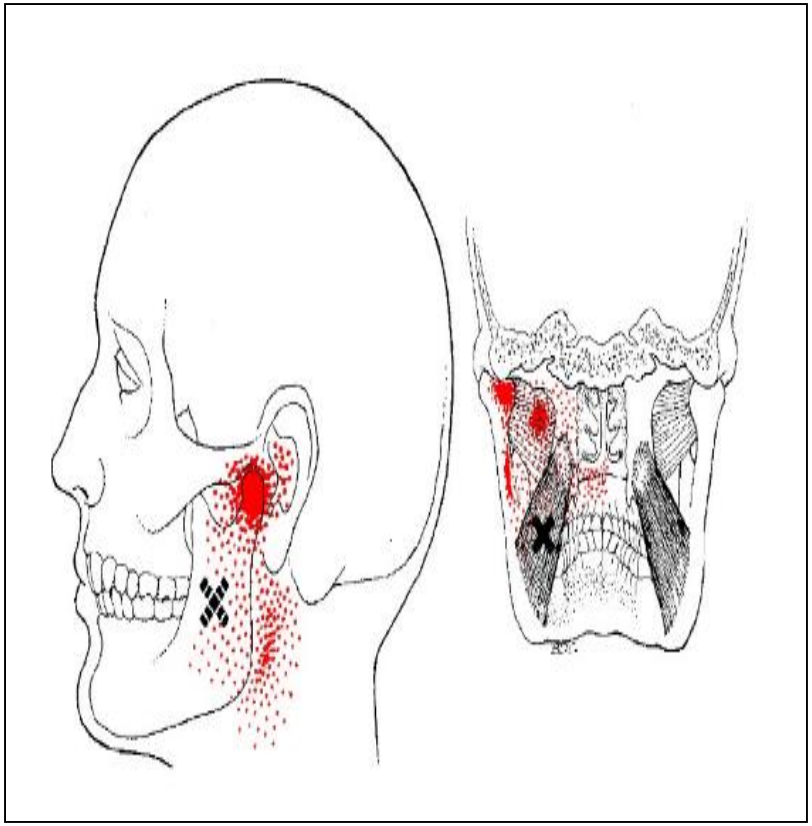
Temporalis



Lateral Pterygoid



Medial Pterygoid



Condition	*Symptoms*	*Signs*
Dental pathology		
Tooth abscess	Pain with chewing over affected tooth	Visible tooth decay; fluctuance along gum line; pain with palpation over the tooth
Wisdom tooth eruption	Dull ache behind posterior molars	Tenderness to palpation over emerging tooth
Infection or inflammation		
Herpes zoster and postherpetic neuralgia	Prodrome of pain followed by vesicular rash	Vesicular rash in dermatomal distribution, not crossing midline
Mastoiditis	Fever; otalgia	Postauricular erythema and swelling; tenderness over mastoid process
Otitis externa	Pruritus, pain, and tenderness of the external ear	Erythema and edema of external auditory canal
Otitis media	Fever; malaise; otalgia	Tympanic membrane dull, bulging, erythematous; loss of landmarks on tympanic membrane
Parotitis	Fever; malaise; myalgia; pain over parotid gland	Tenderness and induration over parotid gland
Sialadenitis	Pain and swelling of involved salivary gland	Tenderness, induration, and/or erythema of salivary gland; usually unilateral
Trigeminal neuralgia	Paroxysmal, unilateral lancinating pains in trigeminal nerve distribution	Examination generally normal

Common Disorders of TMJ

Myogenic Disorders:

- Local myalgia (unclassified)
- Myofascial pain
- Myofibrotic contracture
- Myositis
- Myospasm
- Neoplasia

Articular Disorders:

- Ankylosis
- Congenital or developmental disorders
- Disk derangement disorders
- Fracture of the condylar process
- Inflammatory disorders
- Osteoarthritis
- TMJ dislocation

Myogenic Disorders

- structural abnormalities (i.e., dental malocclusion, condylar malposition) led to muscular dysfunction and pain.
- It has been reported that approximately 50% of all TMDs are masticatory myalgias or painful masticatory muscle disorders

- TMJ pain from an articular disorder may conversely lead to MFP. This is thought to occur due to reflex muscle contractions in the muscles of mastication. This is considered as a self-protective reflex and is referred to as muscle “guarding” or “splinting.”
- Patients will present with tenderness and hyperalgesia at sites distant to the joint that mimic MFP.

Articular Disorders

The etiology of articular disorders may be degenerative, traumatic, infectious, immunologic, metabolic, neoplastic, congenital, or developmental.

Articular disc displacement (internal derangement)

Anterior disc displacement (ADD) is the most frequently encountered articular disorder. Disc displacement (also known as internal derangement) is defined as *"a disturbance in the normal anatomic relationship between the disc and condyle that interferes with smooth movement of the joint and causes momentary catching, clicking, popping, or locking".* Therapy is indicated if pain and significant limitation in range of motion are present.

Anterior disc displacement with reduction

- When the articular disc becomes displaced anteriorly, there is excessive stretching of the retrodiscal tissue, which then bears repeated loading force from the mandibular condyle. This tissue has been shown to have some capacity to adapt to these forces and may transform into a “pseudodisc.” In many patients the disc is recaptured and is known as “disc displacement with reduction,” resulting in TMJ noise (clicking or popping) and full translational movement of the condyle.
- With mandibular closure, a reciprocal (closing) click represents the condyle returning to the retrodiscal tissue and the disc returning to an anterior position.

Anterior disc displacement with reduction

Anterior disc displacement without reduction

- ADD without reduction, also known as closed lock, will have a much different clinical presentation because the condyle's forward translation is limited by the disc's anterior position and is unable to reduce onto the disc, allowing only for rotational and not translational movement.
- Patients with acute or subacute closed lock typically report a sudden onset of pain and inability to open more than 20 to 30 mm. There is a hard end feel.

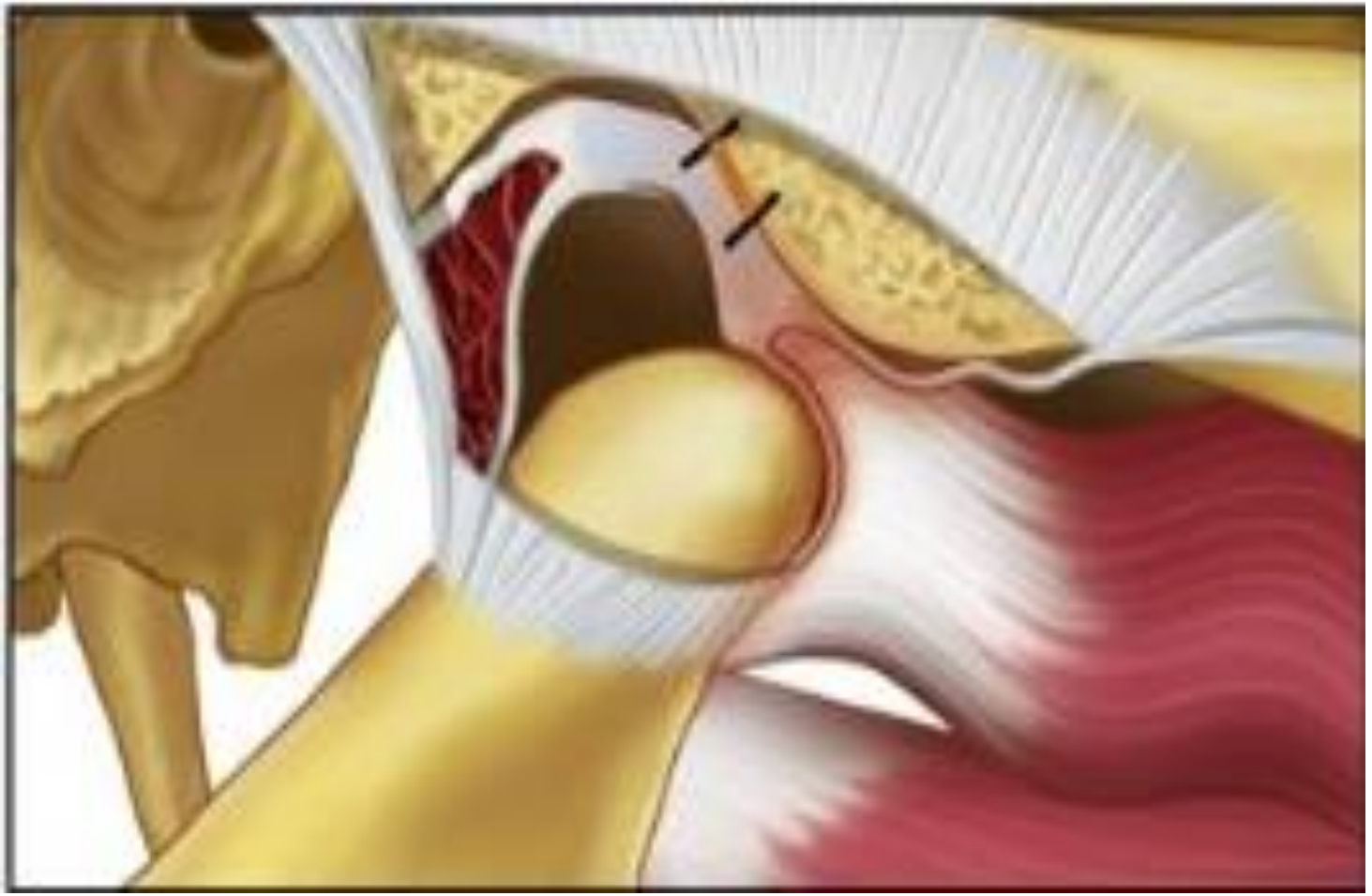
- Clinically, the mandible deviates on opening to the affected side due to the ability of the unaffected joint to translate. Additionally, excursive mandibular movements to the contralateral side are limited.
- In the case of trismus or severe muscle spasm, a downward pressure to the jaw will produce at least a few mm of additional opening. There is a soft end feel.

Anterior disc displacement without reduction (Closed Lock)

Posterior disc displacement (open lock)

- Open-lock is the condition where the condyle is entrapped in front of the articular disc and cannot slide back under the fossa.

Posterior disc displacement



Capsulitis

- Inflammation of the capsular ligament may manifest with swelling and continuous pain localized to the joint.
- Movements that stretch the capsular ligament cause pain with resultant limitation of such movement.
- Significant inflammation may increase joint fluid volume. When this occurs, one may see an ipsilateral posterior open bite (lack of contact between maxillary and mandibular teeth) secondary to inferior displacement of the condyle.
- Inflammation due to trauma or abnormal function may affect the retrodiscal tissue. Edema in this area may cause anterior displacement of the condyle and an acute malocclusion with painful limitation of mandibular movements.

Synovitis

- The highly innervated and vascularized synovial membrane digests debris and pain mediators released from cartilage degradation. When this ability is overwhelmed, inflammation (acute synovitis) results.
- Inflammation of the synovial membrane is an early sign of DJD

Arthritis

- Arthritis of the TMJ has many etiologies: frequently OA and rheumatoid arthritis (RA) and less often infectious, metabolic (gout), or immunologic (ankylosing spondylitis, lupus).
- Excessive and repetitive mechanical stress has been implicated.
- Joints are tender and will exhibit decreased range of motion.

- Crepitus may indicate loss of articular cartilage.
- Patients may have referred pain to head and neck regions.
- Radiography may reveal joint space narrowing, osteophyte formation, condylar head flattening, and subchondral bone cysts.


Degenerative Joint
Disease
with Large Perforation

Chondromalacia

- In the osteoarthritic joint, there is progressive softening and loss of cartilage, which leads to chondromalacia (softening of the articular cartilage) of the TMJ.
- It is thought that repeated stress-related micro trauma (i.e., bruxism) eventually overloads the joint's articular cartilages leading to compression and shearing of cartilage.

Neoplasm

- Pain and/or changes in occlusion may be presenting signs and symptoms of a pathologic joint lesion.
- The most common TMJ neoplasms are the osteoma and osteochondroma. These can be distinguished from condylar hyperplasia by the presence of a normal condylar neck length.
- Pathologic lesions may be first noted on screening panoramic radiographs. Further evaluation of bony tumors is best performed with CT.

Case study

- 38 year-old female, constant jaw pain for the last 6 months after a motor vehicle accident. At examination, the patient shows no dental misalignment or malocclusion, pain in the TMJ w/ palpation, decreased mouth opening by 20% with clicking at mouth opening. X-ray reveals no changes on bony structures or anomalies. The patient was treated with night guard but no improvements.

TMJ Examination and making Diagnosis

Signs and Symptoms

Signs and symptoms of temporomandibular disorders (TMDs) may include: pain, impaired jaw function, malocclusion, deviation with/without correction, limited range of motion, joint noise, and locking.

Headache, tinnitus, visual changes, and other neurologic complaints may also accompany TMDs.

TMD Screening Questionnaire

- Screening Questionnaire can help to identify patients who require further clinical evaluation
- A team of U.S. researchers has developed a screening questionnaire designed to enable dental practitioners and other healthcare professionals to quickly and cost-effectively identify patients with pain-related temporomandibular disorders (Development of a brief and effective temporomandibular disorder pain screening questionnaire: Reliability and validity; *Journal of the American Dental Association*, October 2011, Vol. 142:10, pp. 1183-1191).

TMD-PAIN SCREENER

1. In the last 30 days, how long did any pain last in your jaw or temple area on either side?
    a. No pain
    b. Pain comes and goes
    c. Pain is always present

2. In the last 30 days, have you had pain or stiffness in your jaw on awakening?
    a. No
    b. Yes

3. In the last 30 days, did the following activities change any pain (that is, make it better or make it worse) in your jaw or temple area on either side?

    A. Chewing hard or tough food
        a. No
        b. Yes

    B. Opening your mouth or moving your jaw forward or to the side
        a. No
        b. Yes

    C. Jaw habits such as holding teeth together, clenching, grinding, or chewing gum
        a. No
        b. Yes

    D. Other jaw activities such as talking, kissing, or yawning
        a. No
        b. Yes

- The questionnaire queried patients about how long any pain in their jaw or temple area lasted in the last 30 days, or if they had any pain or stiffness in their jaw on awakening in the same time period. It also included queries about whether various activities, such as chewing hard, affected the pain.
- Threshold values for a positive score as 2 for the short version and 3 for the long version
- Both versions had a sensitivity of 99% and a specificity of 97%

Diagnostic Criteria for Temporomandibular Disorders
Symptom Questionnaire

Patient name _____ Date _____

PAIN

1. Have you ever had pain in your jaw, temple, in the ear, or in front of the ear on either side? **No** ☐ **Yes** ☐

If you answered NO, then skip to Question 5.

2. How many years or months ago did your pain in the jaw, temple, in the ear, or in front of the ear first begin? _____years _____months

3. In the last 30 days, which of the following best describes any pain in your jaw, temple, in the ear, or in front of the ear on either side?

Select ONE response.

- ☐ No pain
- ☐ Pain comes and goes
- ☐ Pain is always present

If you answered NO to Question 3, then skip to Question 5.

4. In the last 30 days, did the following activities change any pain (that is, make it better or make it worse) in your jaw, temple, in the ear, or in front of the ear on either side?

		No	Yes
A.	Chewing hard or tough food	☐	☐
B.	Opening your mouth, or moving your jaw forward or to the side	☐	☐
C.	Jaw habits such as holding teeth together, clenching/grinding teeth, or chewing gum	☐	☐
D.	Other jaw activities such as talking, kissing, or yawning	☐	☐

HEADACHE

		No	Yes
5.	In the last 30 days, have you had any headaches that included the temple areas of your head?	☐	☐

If you answered NO to Question 5, then skip to Question 8.

6. How many years or months ago did your temple headache first begin?

_____years _____months

7. In the last 30 days, did the following activities change any headache (that is, make it better or make it worse) in your temple area on either side?

		No	Yes
A.	Chewing hard or tough food	☐	☐
B.	Opening your mouth, or moving your jaw forward or to the side	☐	☐
C.	Jaw habits such as holding teeth together, clenching/grinding, or chewing gum	☐	☐
D.	Other jaw activities such as talking, kissing, or yawning	☐	☐

JAW JOINT NOISES

				Office use		
		No	Yes	R	L	DNK
8.	In the last 30 days, have you had any jaw joint noise(s) when you moved or used your jaw?	☐	☐	☐	☐	☐

CLOSED LOCKING OF THE JAW

9.	Have you ever had your jaw lock or catch, even for a moment, so that it would not open ALL THE WAY?	☐	☐	☐	☐	☐
	If you answered NO to Question 9 then skip to Question 13.					
10.	Was your jaw lock or catch severe enough to limit your jaw opening and interfere with your ability to eat?	☐	☐	☐	☐	☐
11.	In the last 30 days, did your jaw lock so you could not open ALL THE WAY, even for a moment, and then unlock so you could open ALL THE WAY?	☐	☐	☐	☐	☐
	If you answered NO to Question 11 then skip to Question 13.					
12.	Is your jaw currently locked or limited so that your jaw will not open ALL THE WAY?	☐	☐	☐	☐	☐

OPEN LOCKING OF THE JAW

13.	In the last 30 days, when you opened your mouth wide, did your jaw lock or catch even for a moment such that you could not close it from this wide open position?	☐	☐	☐	☐	☐
	If you answered NO to Question 13 then you are finished.					
14.	In the last 30 days, when you jaw locked or caught wide open, did you have to do something to get it to close including resting, moving, pushing, or maneuvering it?	☐	☐	☐	☐	☐

Inspection

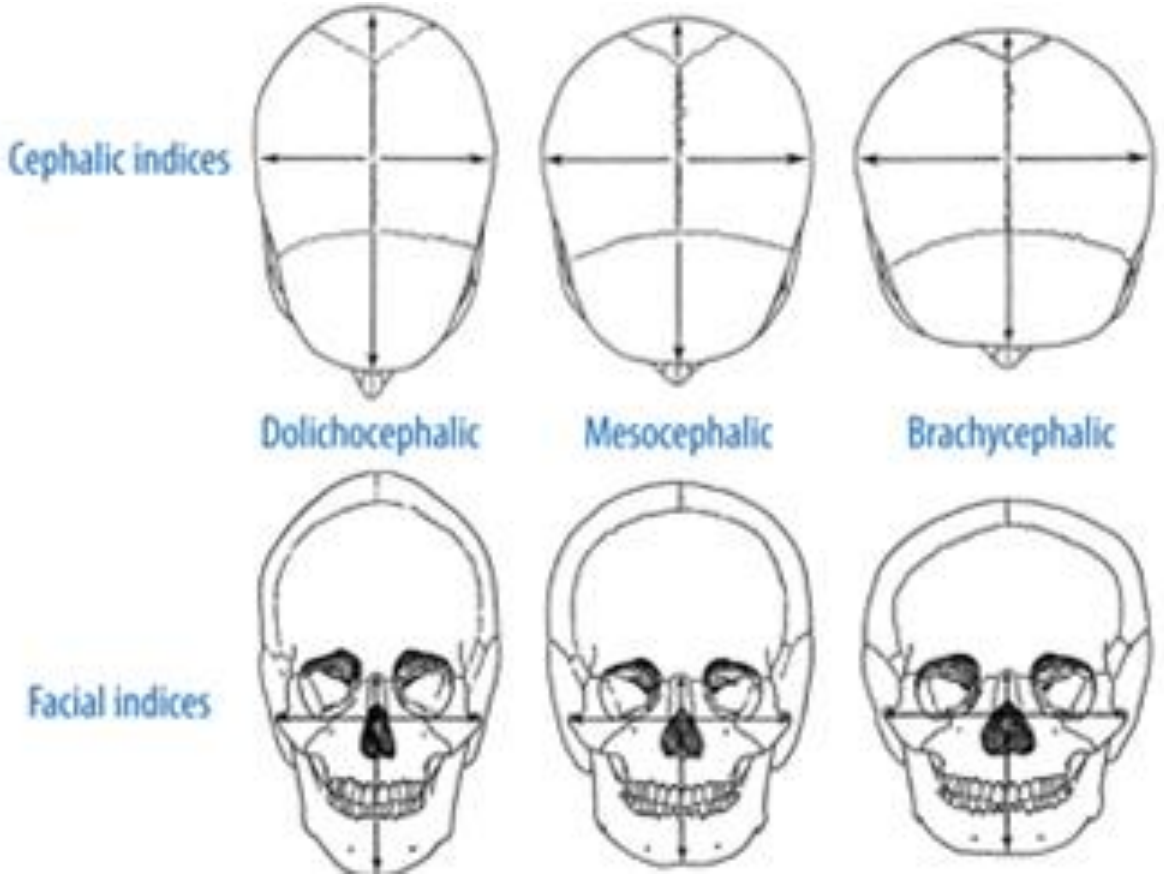
Head and Face (3 types)

- BRACHYCEPHALIC describes an individual with a larger than average cranial width and usually presents with a broad, square head shape and low mandibular plane angle.
- BRACHYFACIAL is an individual characterized by a broad square face with a strong chin, flat lip posture, low mandibular plane angle and a straight profile.

- DOLICOCEPHALIC describes an individual that has a narrower cranial width and usually presents with a long, narrow shape and high mandibular plane angle.
- DOLICOFACIAL is an individual that has a long, narrow face with a high mandibular plane angle, convex profile, poor chin development and an anterior-posterior face height imbalance.

- MESOCEPHALIC describes an individual that falls between the brachycephalic and dolichocephalic types and has an average cranial width.
- MESOFACIAL is an individual who has well balanced facial features.

Cephalic Index: (Maximum Width x 100) / Maximum Lenght

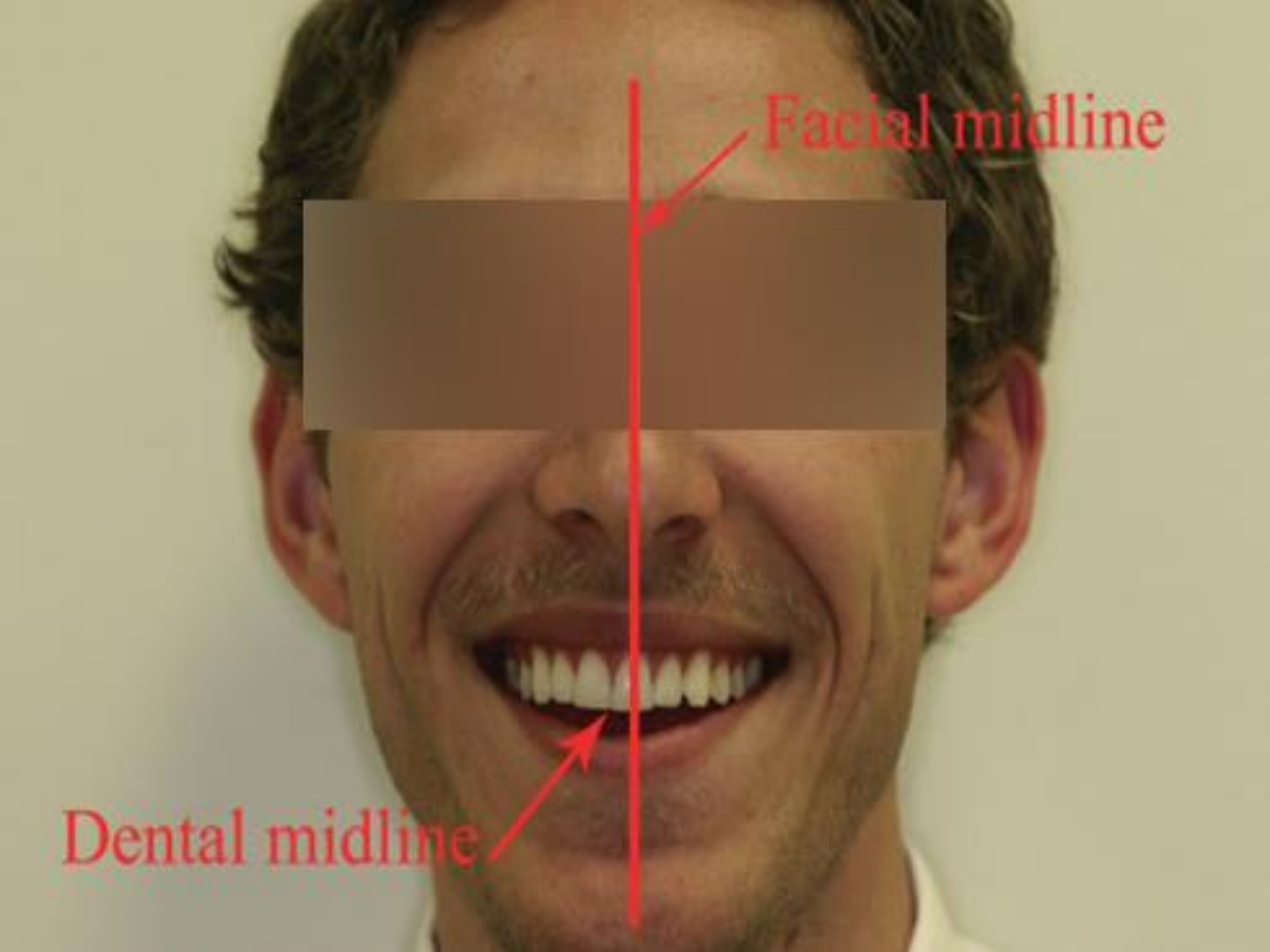


Females	Males	Scientific term
< 75	< 75.9	*dolichocephalic*
75 to 83	76 to 81	*mesaticephalic*
> 83	> 81.1	*brachycephalic*

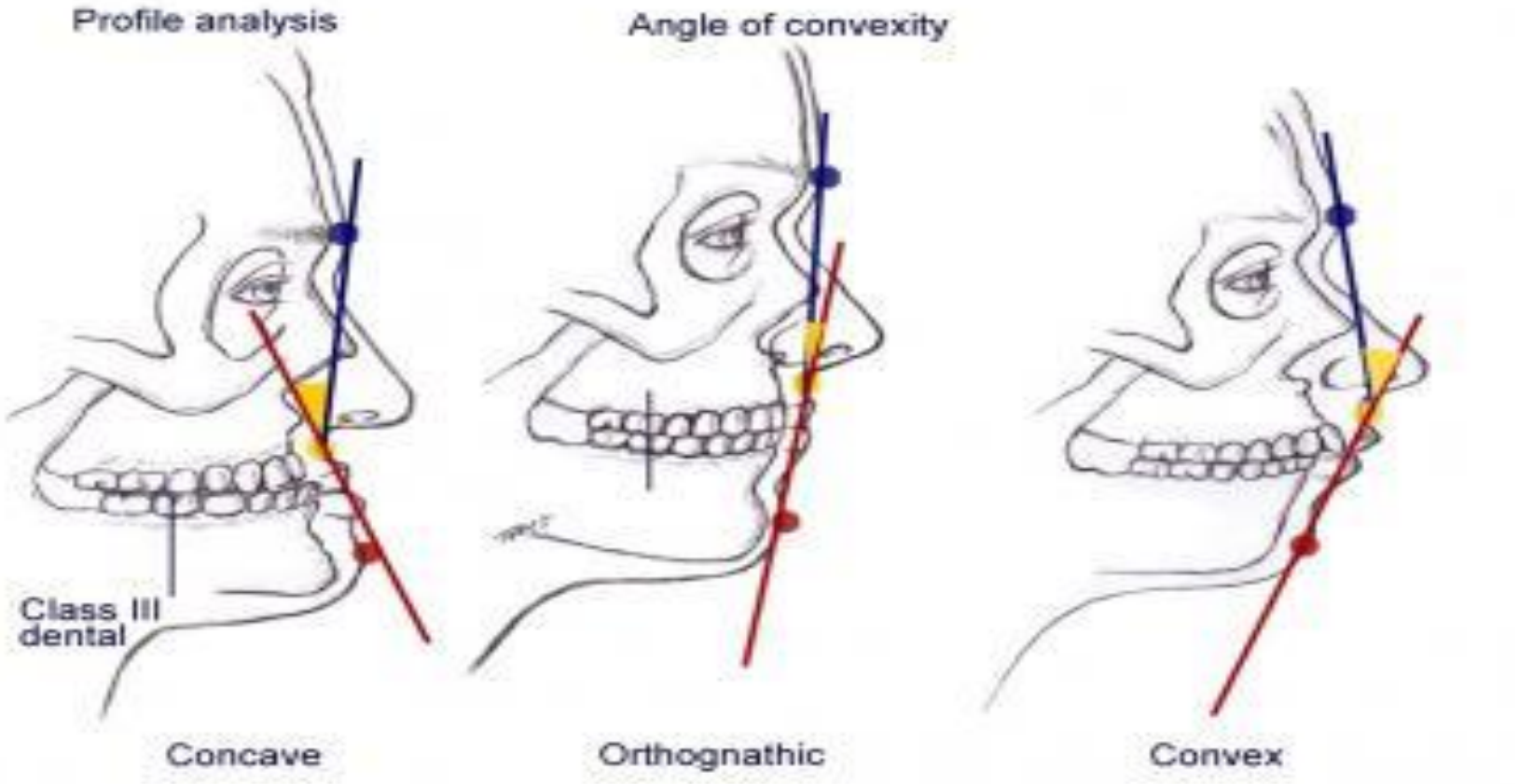
Facial Symmetry and Dental Alignment

- Facial Midline: A line drawn perpendicular to the interpupillary line from glabella to the tip of the nose, passing through the philtrum of the upper lip, and the midline of the chin.

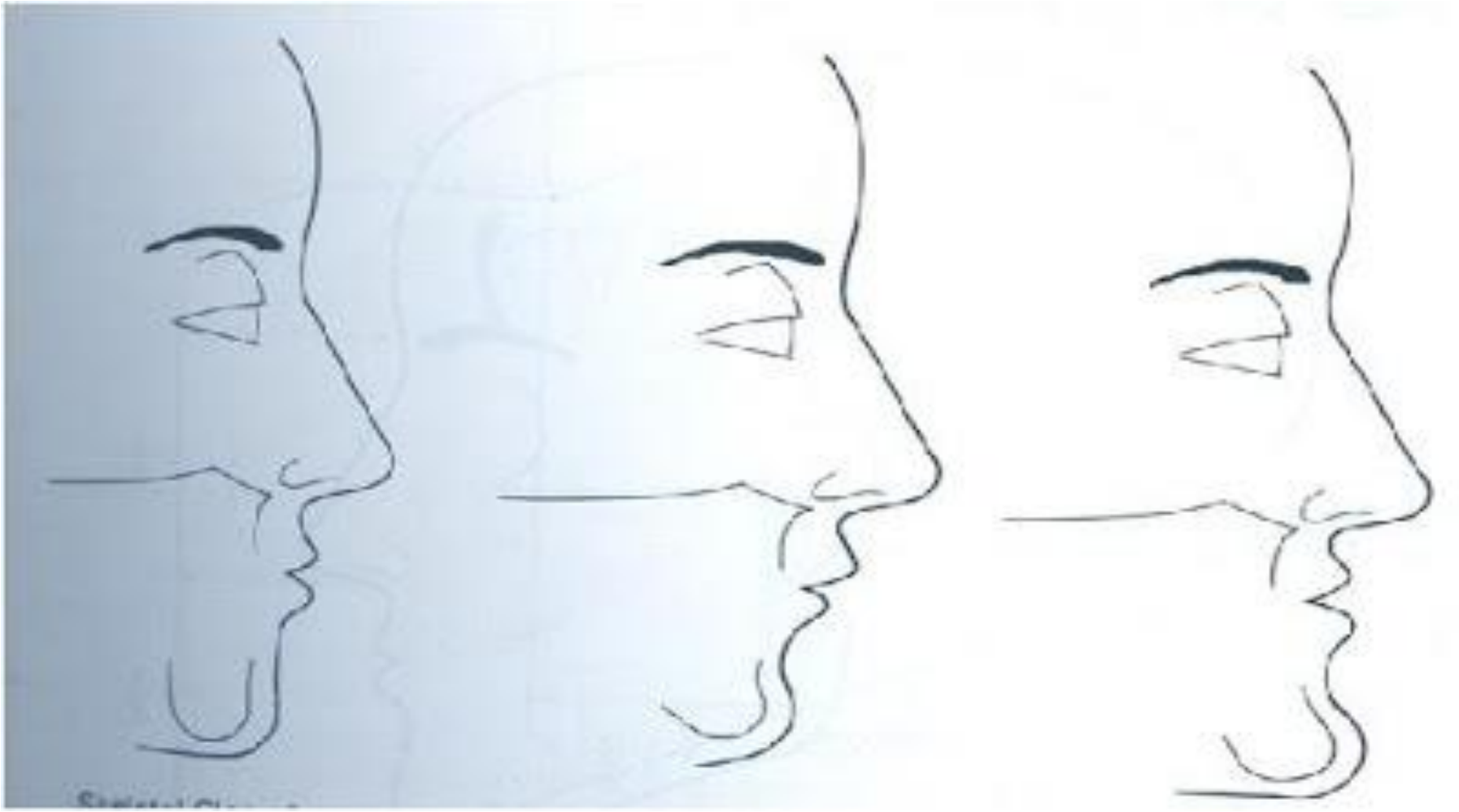
- Dental Midline: Maxillary Dental Midline: A line drawn perpendicular to the maxillary occlusal plane through the proximal contacts of the central incisors.
  Mandibular Dental Midline: A line drawn perpendicular to the mandibular occlusal plane through the proximal contacts of the central incisors.


Facial midline
Dental midline

Profile Facial types: Concave, Straight and Convex

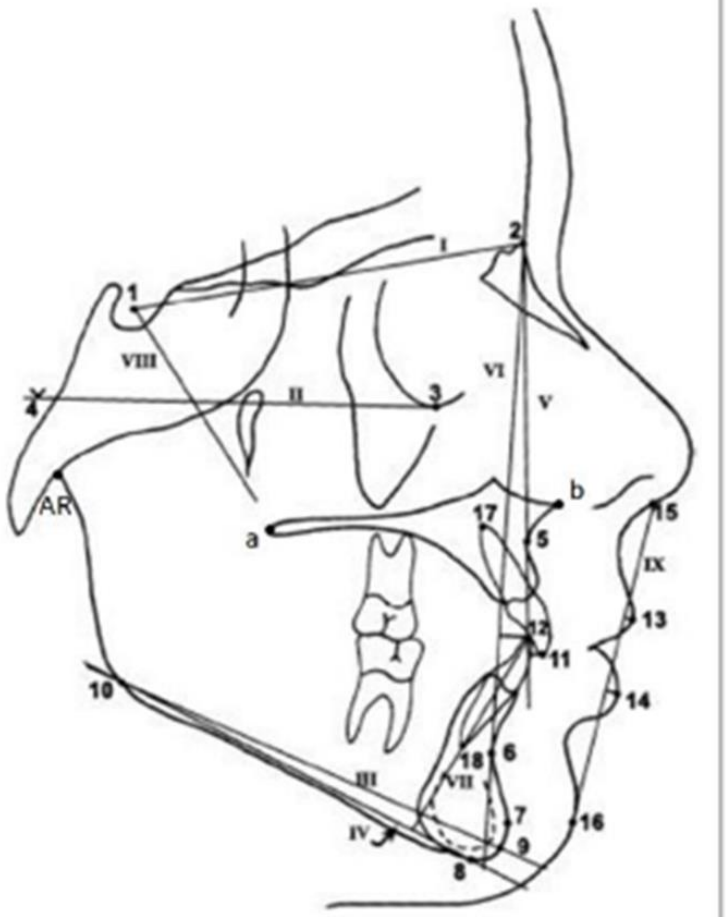


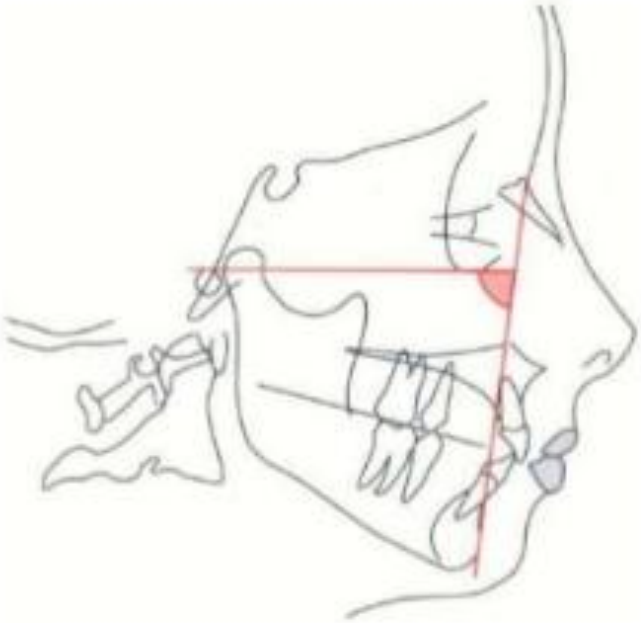
Skeletal patterns: Class I, Class II and Class III



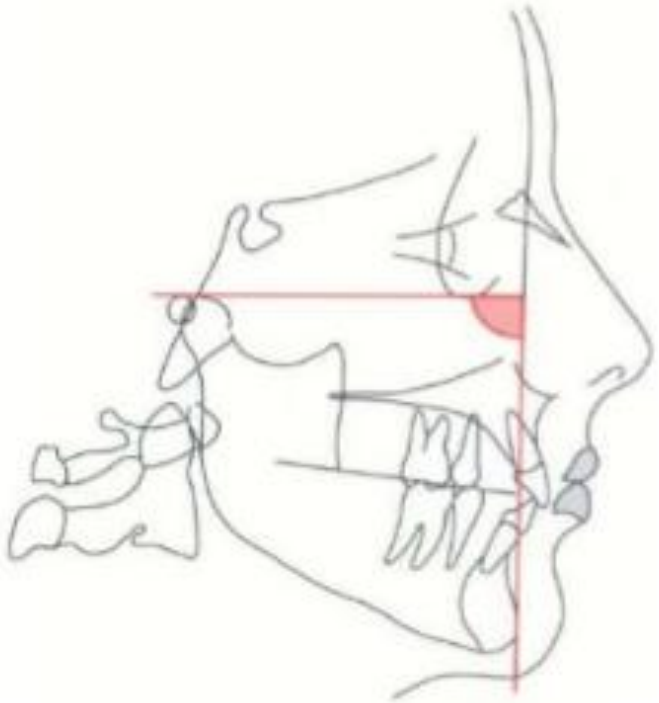
Cephalometric Analysis

No.	Anatomical Landmarks
1	sella turcica
2	nasion
3	orbitale
4	porion
5	subspinale
6	supramentale
7	Pogonion
8	menton
9	gnathion
10	gonion
11	lower incisal incision
12	upper incisal incision
13	upper lip
14	lower lip
15	point Pm or MN
16	soft tissue pogonion
a	posterior nasal spine
b	anterior nasal spine
AR	articulate





Retrognathic facial type
(recessive chin)



Orthognathic facial type
(staight profile normal chin)

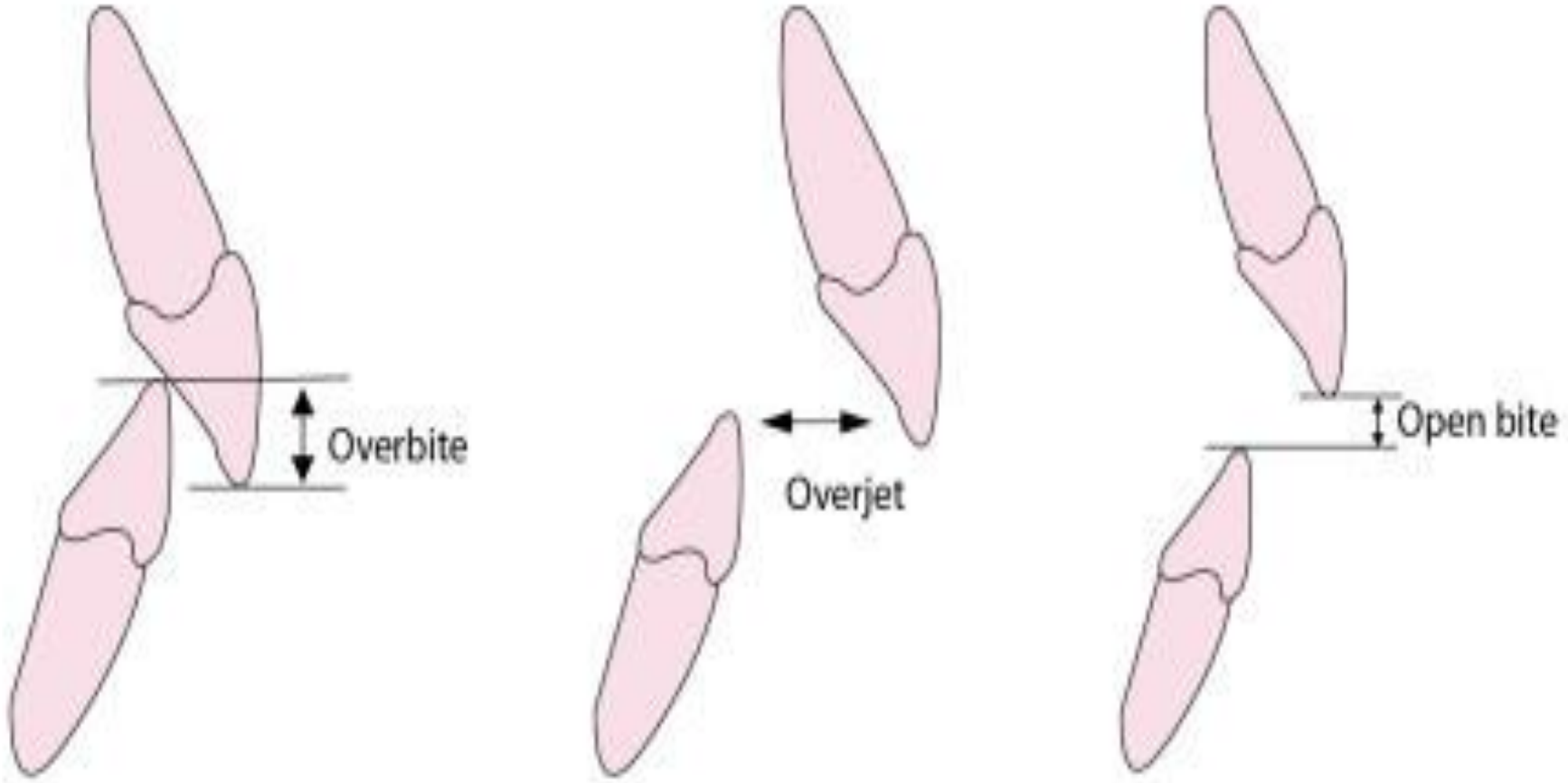
Skeletal patterns: Class I

Skeletal patterns: Class II

Skeletal patterns: Class III

Dental Occlusion

- Overjet is a term used to describe the distance between the labial surfaces of the mandibular incisors and the incisal edge of the maxillary incisors.
- Overbite is the amount of overlap of the mandibular anterior teeth by the maxillary anterior teeth measured perpendicular to the occlusal plane.
- Open Bite is an open bite is present when there is no vertical overlap of the maxillary and mandibular anterior teeth or no contact between the maxillary and mandibular posterior teeth.


Overbite
Overjet
Open bite

- Anterior Cross bite is a malrelation between the maxillary and mandibular teeth when they occlude with the antagonistic tooth in the opposite relation to normal.
- Posterior Cross bite is present when posterior teeth occlude in an abnormal buccolingual relation with the antagonistic teeth. Posterior Cross bites can be the result of either malposition of a tooth or teeth, and/or the skeleton.

Anterior and Posterior Cross bite.

Abnormal wear and tear of the teeth may be a sign of bruxism or grinding.

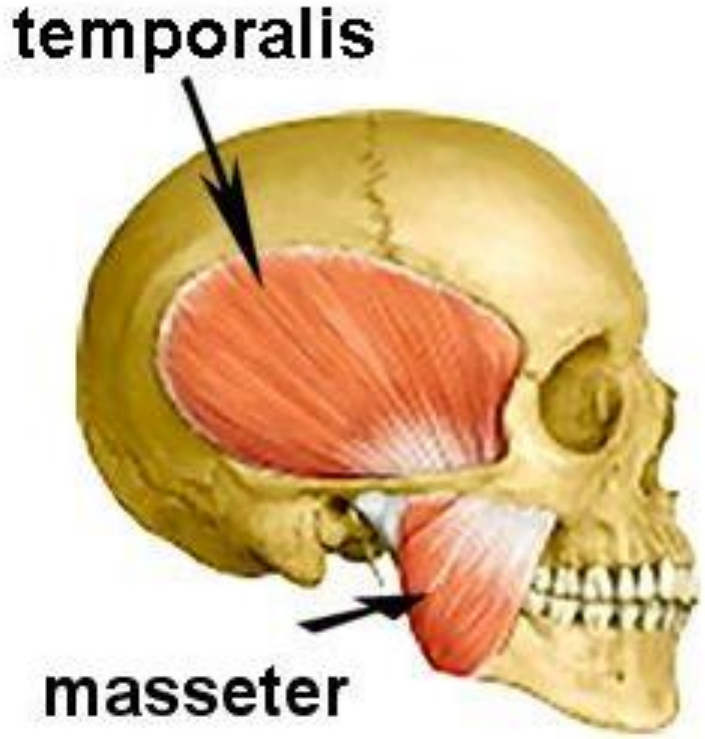
Hypertrophic temporalis and masseter muscles are commonly seen in anxious individuals with "bruxism" and in chronic gum chewing.

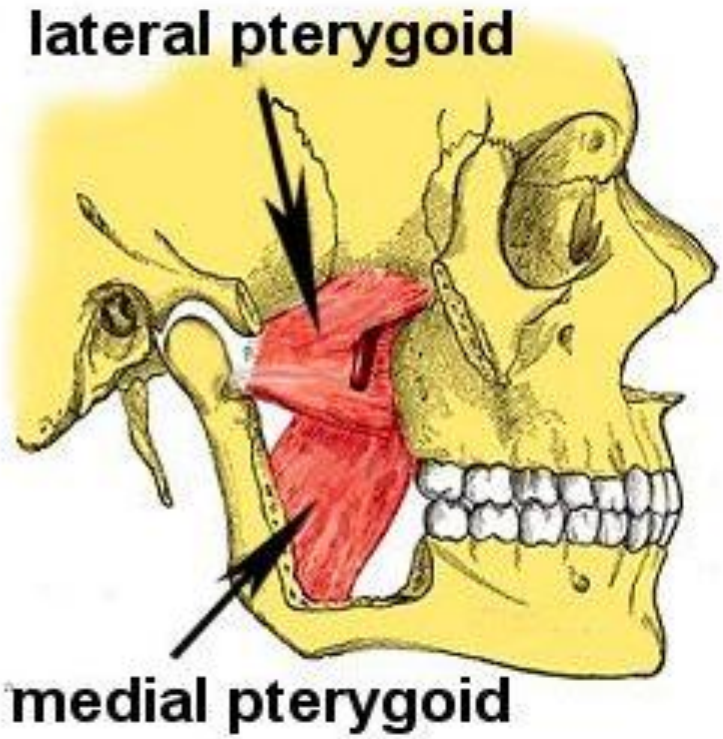
Palpation (static)

- Masticatory muscles: Masseter, temporalis, medial pterygoid, lateral pterygoid.
- TMJ lateral (ant to tragus)
- TMJ post (little finger tip in ear)

TMJ lateral and posterior palpation

Masticatory Muscles





Active Osteokinematic Motion Palpation, Passive Osteokinematic Motion Palpation + End Play)

AOMP:

- Depression (Open)
- Elevation (Close)
- Anterior translation (Protrusion)
- Posterior translation (Retrusion)
- Medial and Lateral translation (Lateral deviation/excursion)

Assess for range of motion, abnormal deviation in movement, clicking or popping

POMP + End Play:

Assess for joint crepitus

Range of motion

Active:

- Assess for pain, range of movement, deviation, abnormal sounds and crepitus
- May need stethoscope for subtle crepitus

Passive:

- Assess for joint capsule and ligaments damage

Resisted:

- Assess for pathological conditions that may exists in the muscles

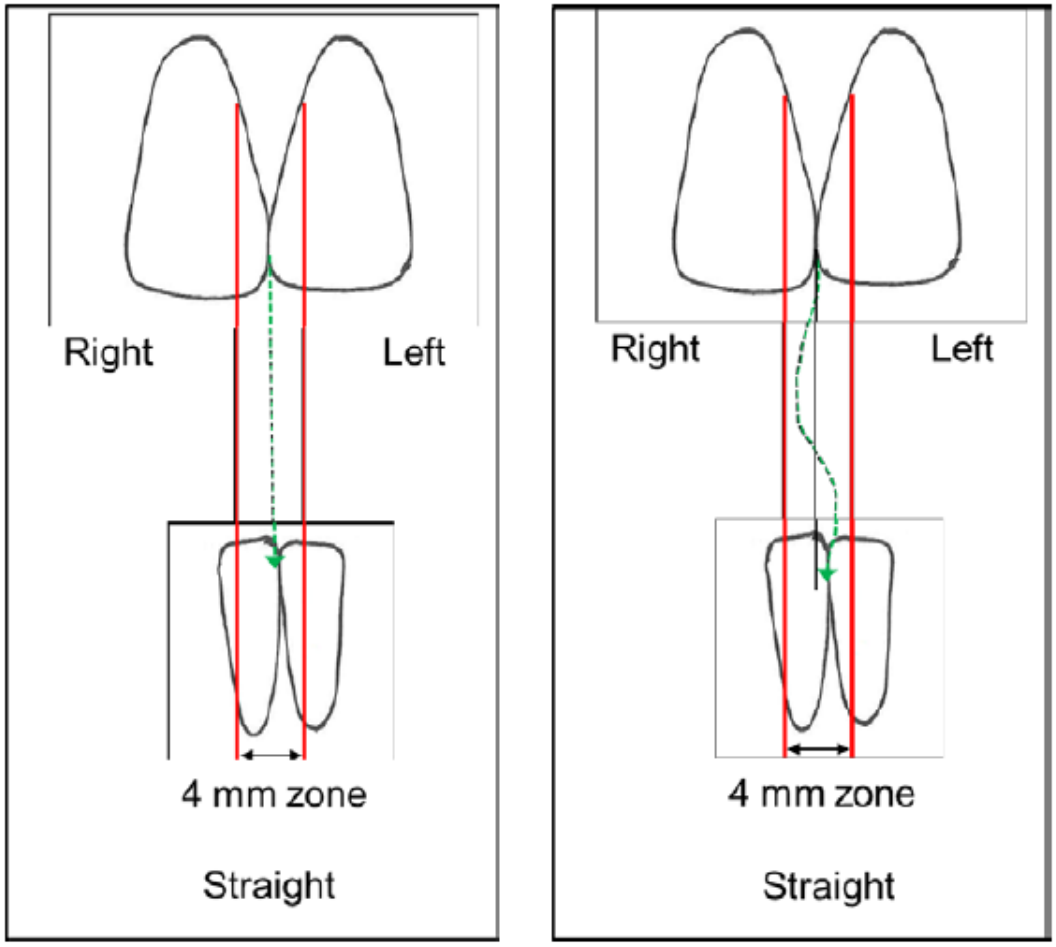
Opening (Depression)

- The mandibular elevators (masseter, temporalis, and medial pterygoid muscles) relax and allow gravity to assist.
- From jaw opening to midrange, rotation of the condyles occurs in the lower compartment. At midrange, further jaw opening is achieved by the lateral pterygoid. This muscle is divided into an upper and lower head.

- The upper head is responsible for a forward translation of the disk and condyle along the articular eminence of the temporal bone while the lower head accomplishes protrusion and lateral deviation at the opposite TMJ
- Opening is also assisted by the digastric, mylohyoid and geniohyoid muscles
- Normal amount of opening is about 3 patient's knuckles or 40 mm (+/- 10) approx.

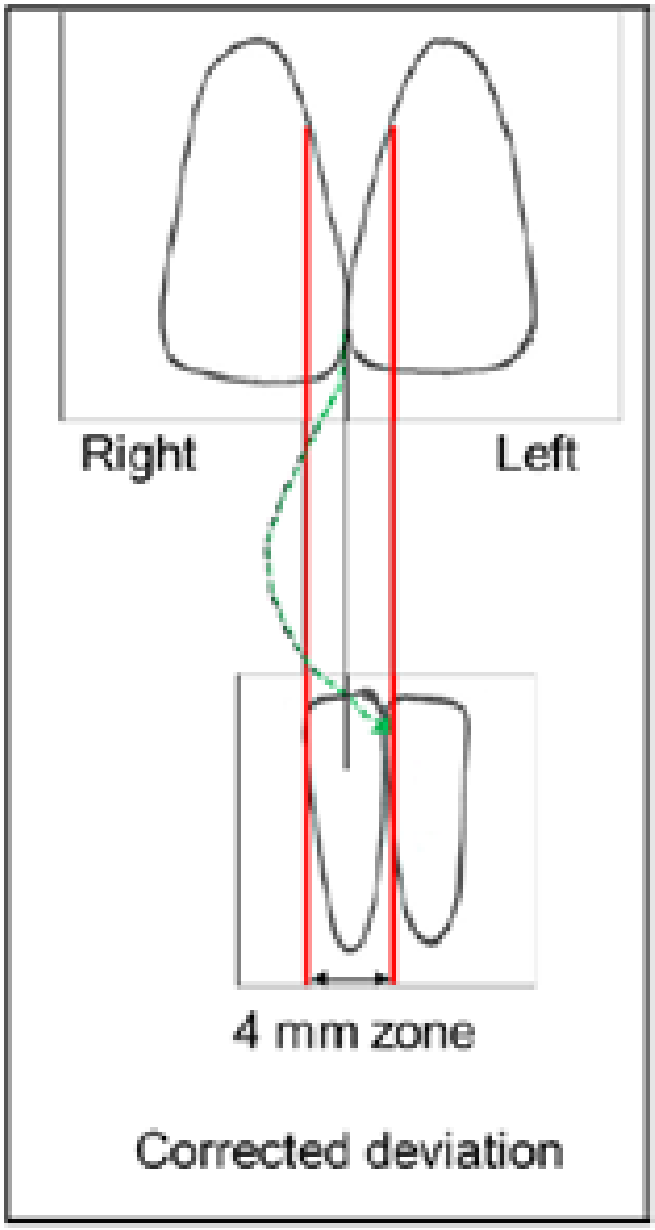
Straight:

This is defined as no or minimally perceptible deviation (< 2mm) upon opening.



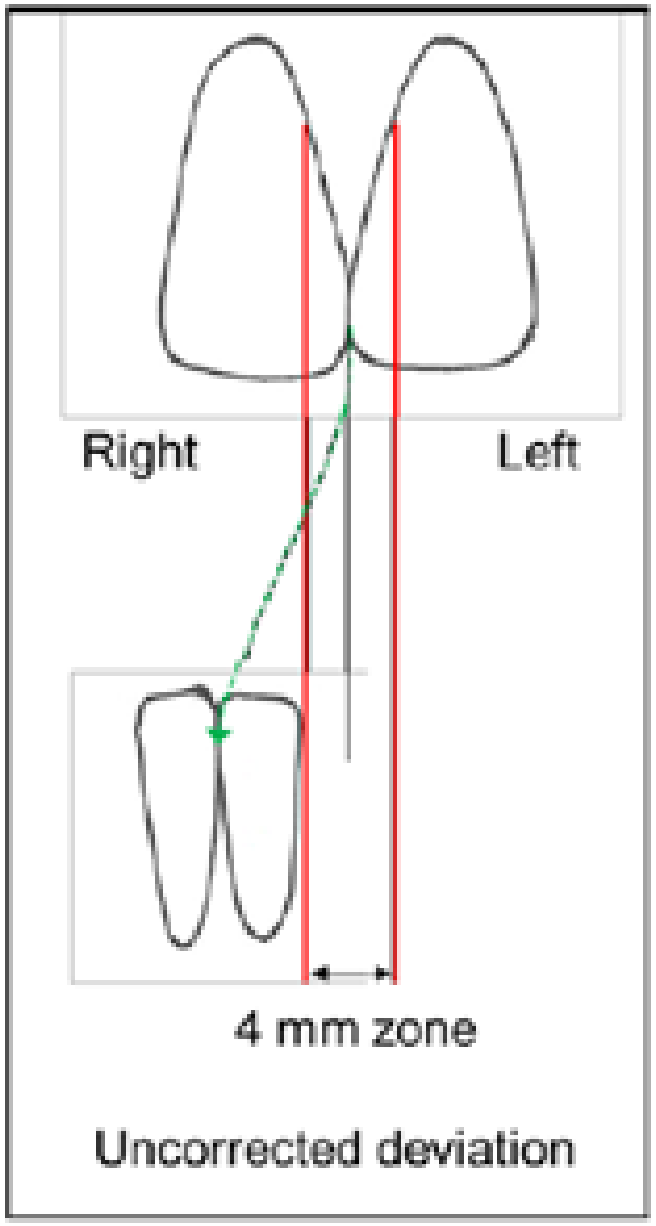
Corrected deviation:

The mandible exhibits perceptible deviation (> 2mm) right and/or left but returns to the midline before or upon reaching the maximum unassisted opening.



Uncorrected deviation:

This is defined as deviation of the mandible of 2 ≥ to the right or left from the midline with maximum unassisted opening.



Closure (Elevation)

- Accomplished through contraction of the mandibular elevators (masseter, temporalis and medial pterygoid) and retraction of the disc by the elastic fibers of the posterior capsule (retrodiscal tissue).
- Both translation and rotation are essential for full opening and closing of the mouth

Protrusion (Protraction)

- Two heads of the lateral pterygoid contract and cause the disks and condyles to slide anteriorly and inferiorly. This takes place in the upper compartment
- Normal amount of protrusion is 7 mm (+/- 3) approx.
- Protrusion is also assisted by superficial fibers of masseter

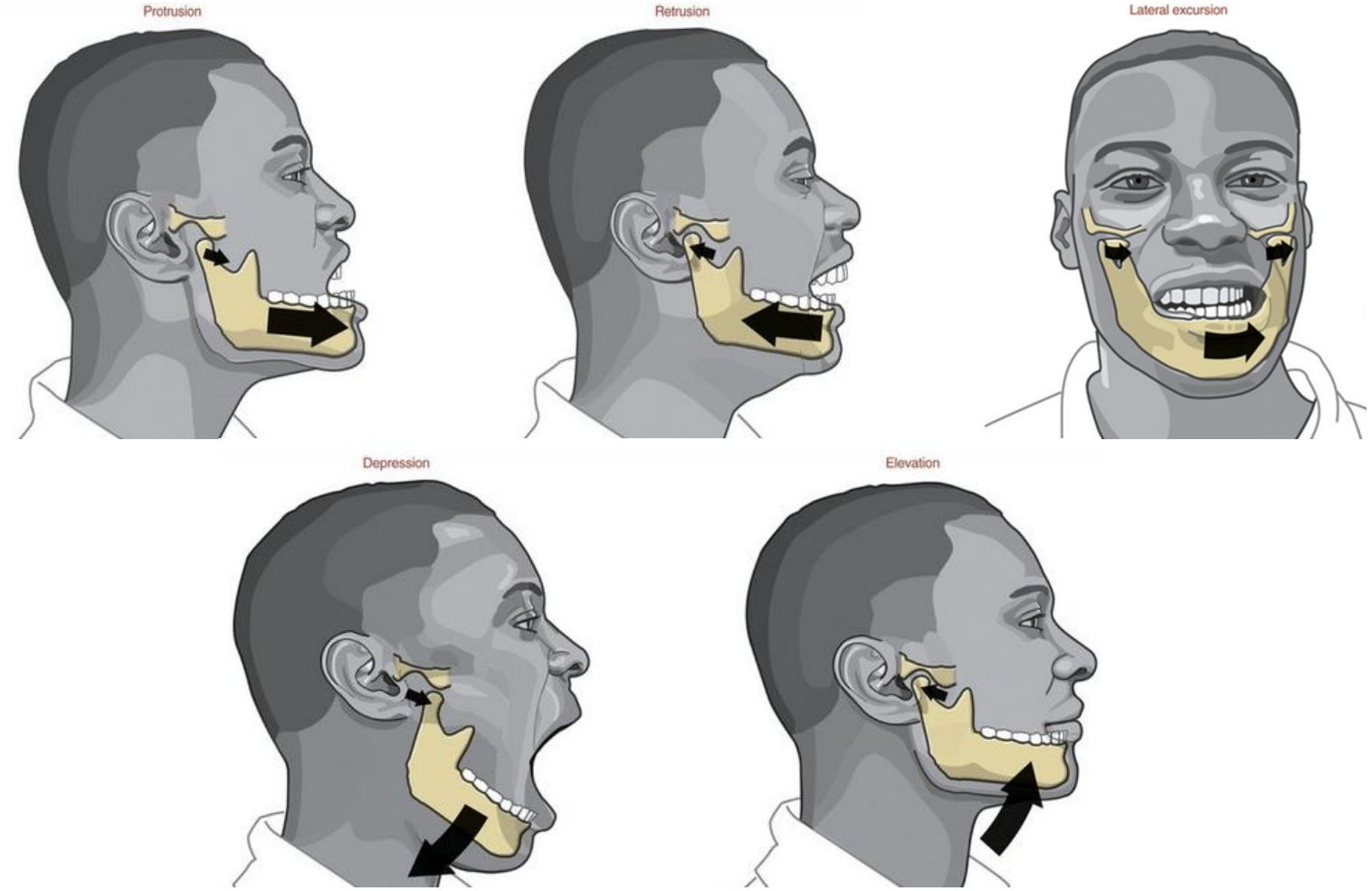
Retrusion (Retraction)

- The disks and condyles slide posteriorly and superiorly while still in the superior cavity. This is accomplished by the temporalis.
- Normal amount of retrusion is 3-4 mm

Lateral Excursion (Translation)

- During lateral deviation, the opposite condyle moves forward, down, and toward the motion side. The condyle on the motion side remains relatively stationary and becomes more prominent
- unilateral action of a lateral pterygoid produces contralateral excursion, usually performed in concert with the medial pterygoids.
- The normal amount of lateral deviation is 10-15 mm.

Osteokinematics of the Mandible



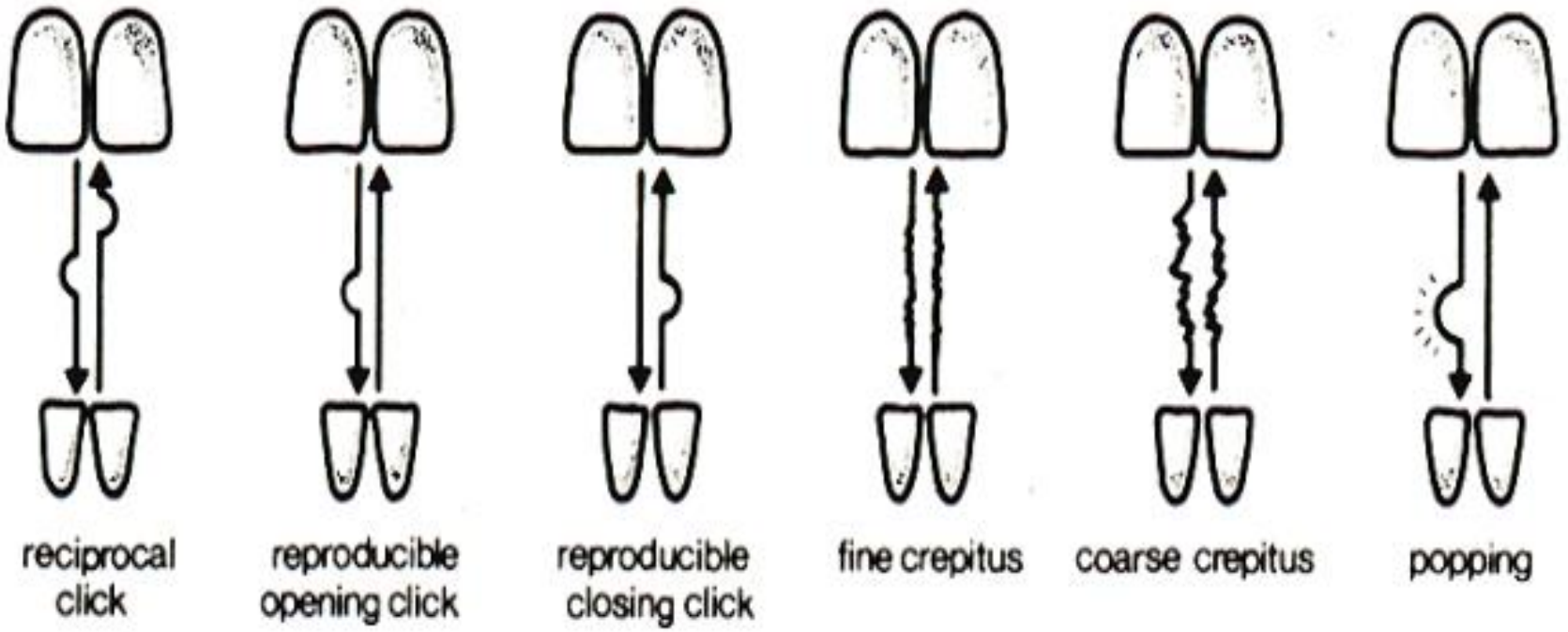
Definition of Noises

Click. *A* distinct noise, of brief and very limited duration, with a clear beginning and end, which usually sounds like a "click". Also referred to as a snap or pop.

Crepitus. *A* noise that is continuous, over a longer period of jaw movement than a click or pop and can occur during part or the whole of the opening and/or closing movement. The noise is not muffled, and it may be comprised of multiple overlapping grating sounds such that it becomes "continuous"; distinguish this from the discrete sound characteristics associated with a click. Such joint noise is also often referred to as crunching, grating, or grinding sounds.

Eminence click. The eminence click has to include at least an opening click and is detected when the condyle-disk complex translates around the eminence accompanied by a bodily shift of the mandible. The examiner observes for noise near the end-range of normal range of movement (i.e., at the end of normal-range opening or beginning of closing from a normal-range maximal opening). Noise detected at the end-range of vertical jaw movement that is limited is not likely representative of an eminence click. An eminence click is not reported on the examination form; it is identified only to distinguish it from the "click" that is reported.

TMJ Abnormal Sounds



Provocative Tests

- The tongue blade test can be utilized to rule out mandibular fractures. The patient bites down to stabilize the tongue depressor between their teeth while the examiner attempts to break it with a twisting movement. If the examiner is able to break the blade while the patient stabilizes it with their teeth, the test is negative and the patient does not undergo radiographic examination. 95% sensitivity and 65% specificity.

- The joint compression test involves manually loading the intraarticular structures. TMJ Synovitis is more susceptible to compression.
- The joint distraction test can evaluate the joint capsule and ligaments.
- Resisted isometric muscle testing: Pain or weakness may be elicited in the presence of muscle problems.

TMJ Imaging

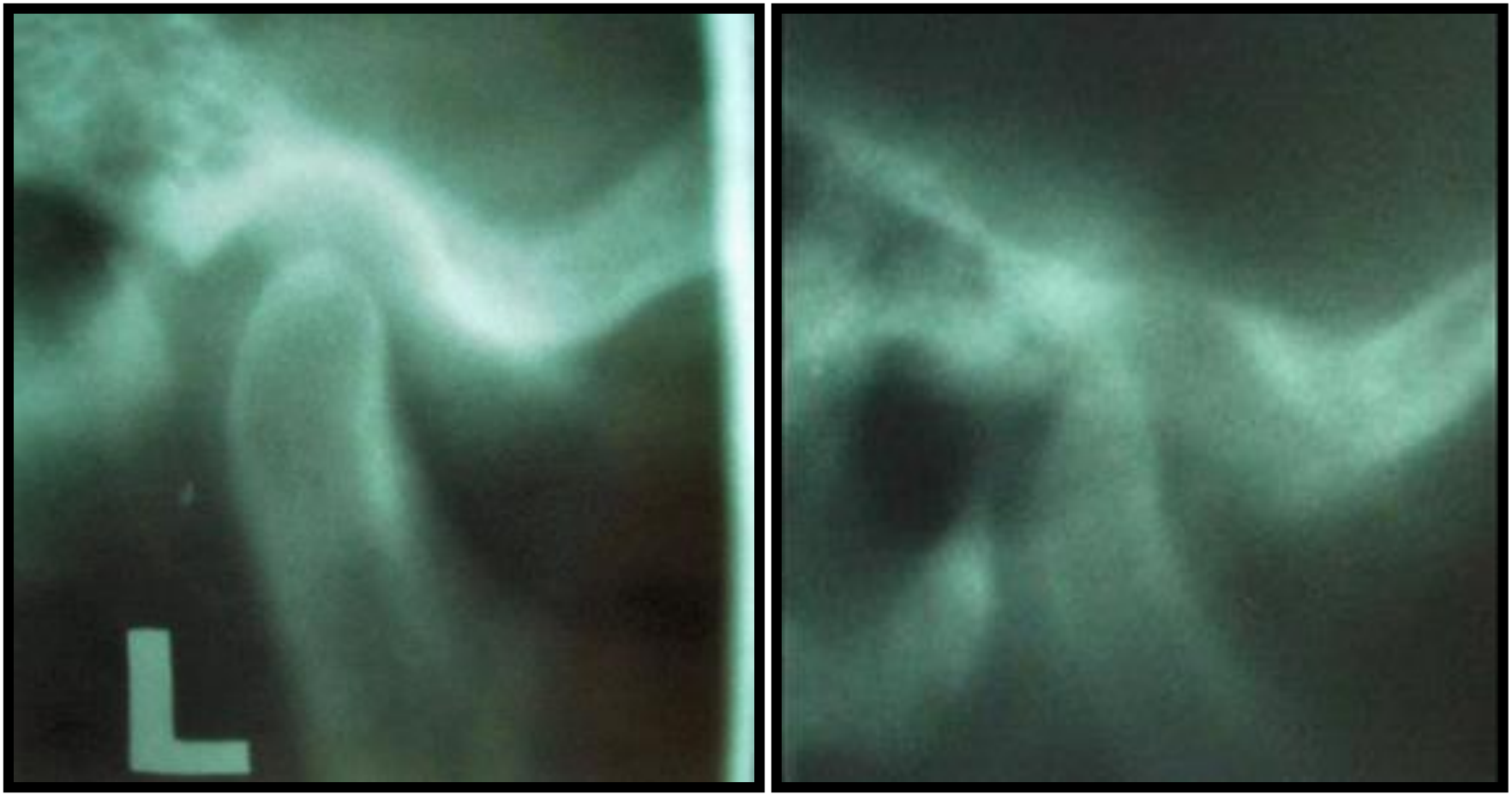
- A variety of modalities can be used to image the TMJ. This includes conventional radiographs, ultrasound, Computed tomography (CT) and MRI
- Magnetic resonance imaging is commonly used for evaluation of the TMJ due to its superior contrast resolution and its ability to acquire dynamic imaging for demonstration of the functionality of the joint.

- Computed tomography and ultrasound imaging have specific indication in imaging of the TMJ.
- The clinician will commonly order diagnostic imaging if progressive pathology and injury are suspected.

Conventional X-Ray

- Conventional radiographs have a limited role in evaluation of the TMJ.
- They can be used to evaluate only the bony elements of the TMJ. They do not give useful information when it comes to the non-bony elements such as cartilage or adjacent soft tissues. They also do not give useful information concerning joint effusions, which are commonly associated with pain and disc displacements.
- Another disadvantage concerning conventional radiographs is the problem of superimposition of adjacent structures.

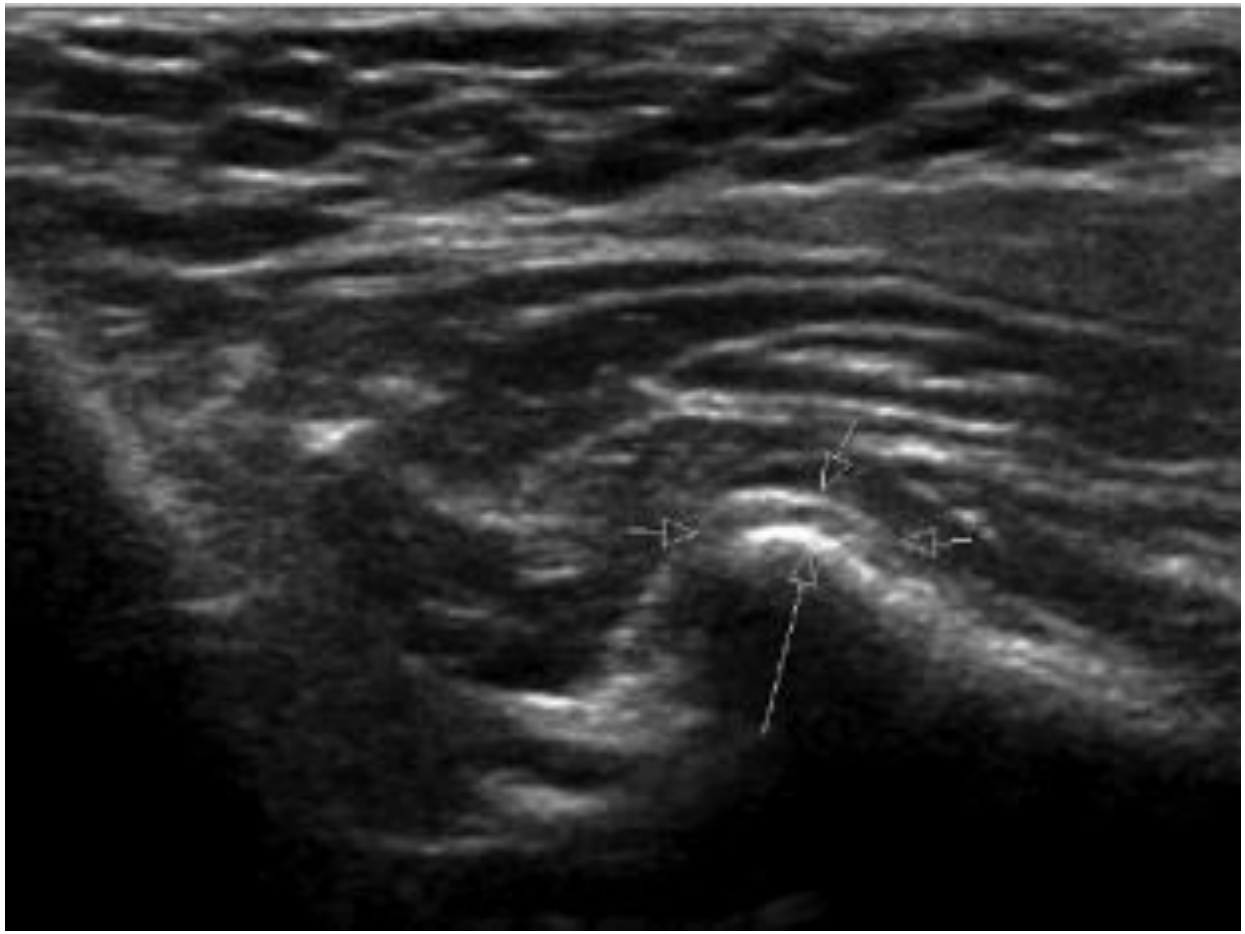
Conventional X-Ray



Panoramic X-Ray

Ultrasound

- Ultrasound is a less expensive and easily performed imaging modality that can be used to evaluate the TMJ.
- This is simple way to look for the presence of a joint effusion.
- Ultrasound is also used to evaluate cartilage as well as disk displacement with both open and closed mouth imaging. It is used for image-guided injections for both diagnostic and therapeutic purposes.



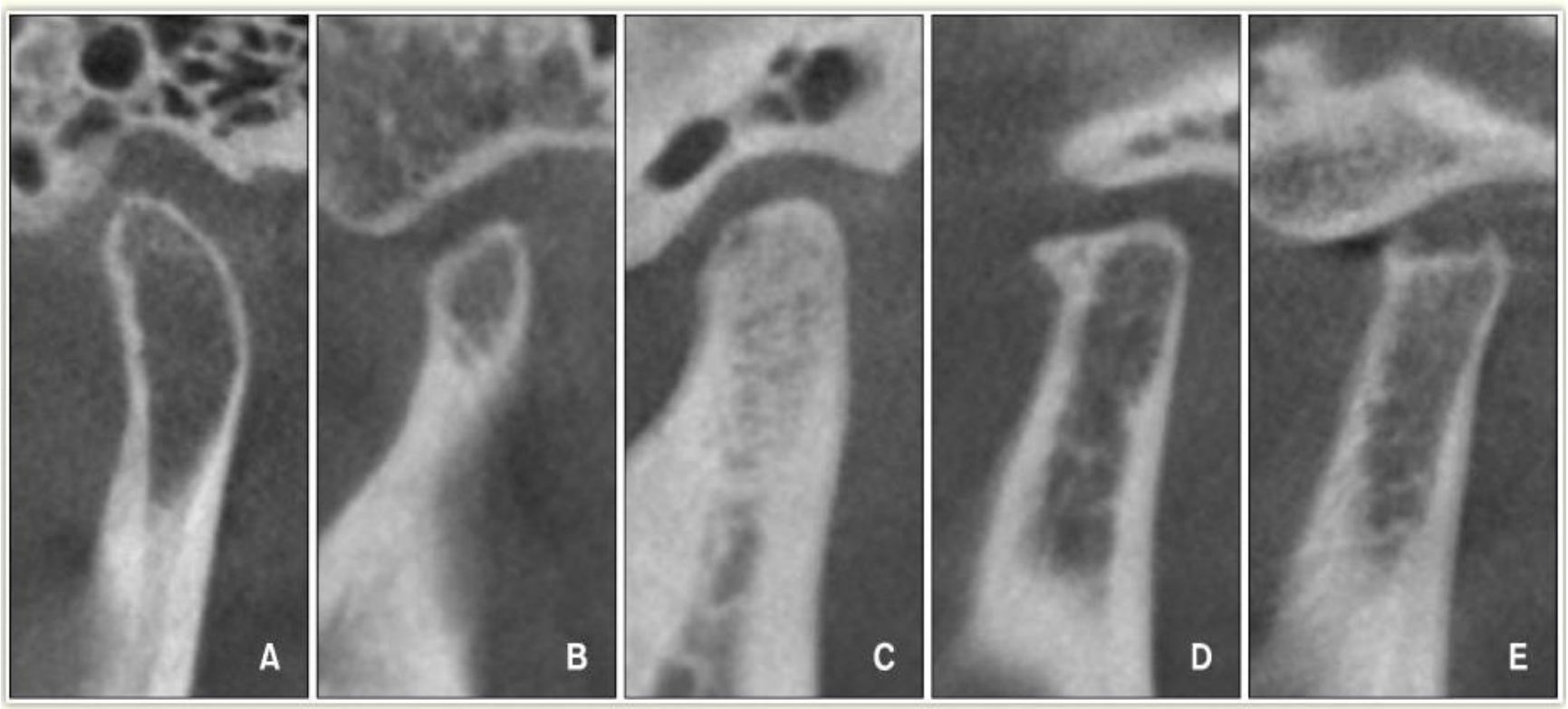
Ultrasound of Normal TMJ

Large Arrow: Condylar head
Upper short arrow.: Glenoid fossa
Opposed short arrows: The disc

Computed tomography (CT)

- CT is useful to evaluate the bony elements of the TMJ as well as the adjacent soft tissues.
- CT is ideal for the evaluation of fractures, degenerative changes, erosions, infection, invasion by tumor, as well as congenital anomalies

Computed tomography (CT)

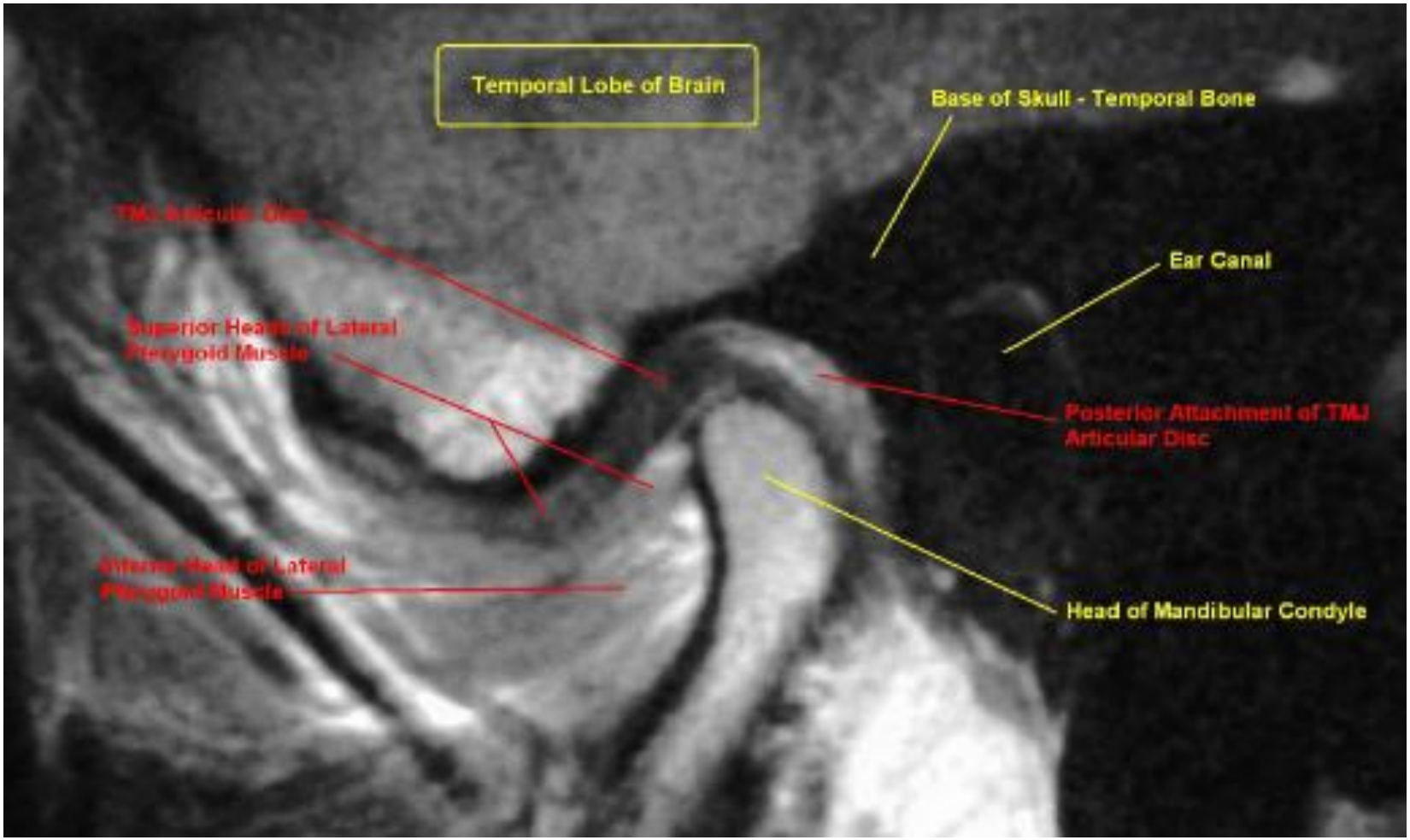


Different type of condylar shapes in cone beam computed tomography sagittal imaging (**A**, Normal; **B**, flattening; **C**, sclerosis; **D**, osteophyte; **E**, erosion).

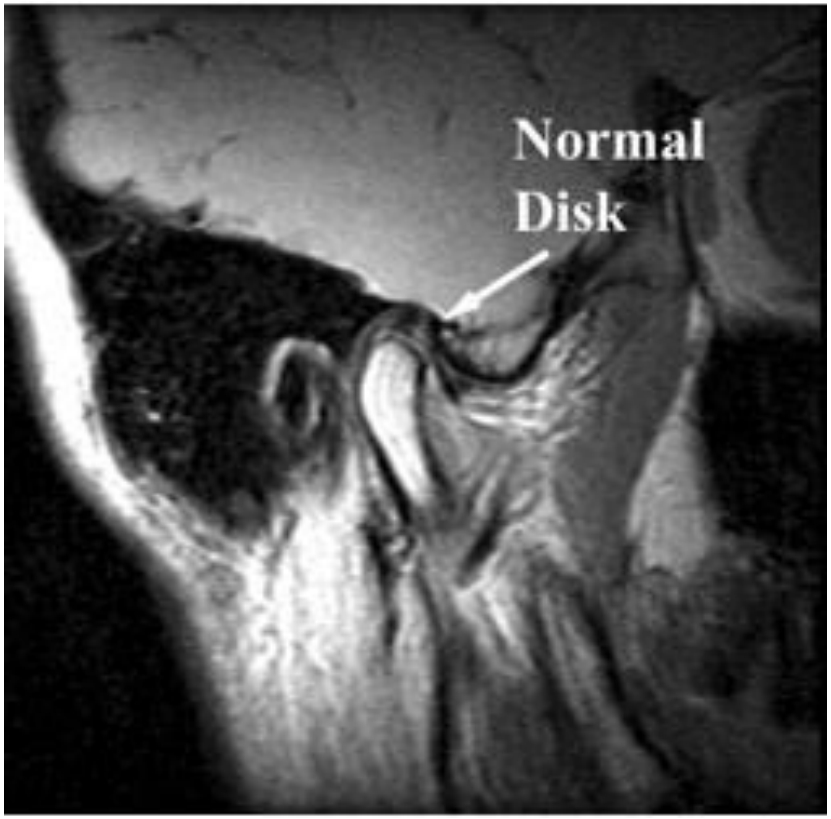
MRI

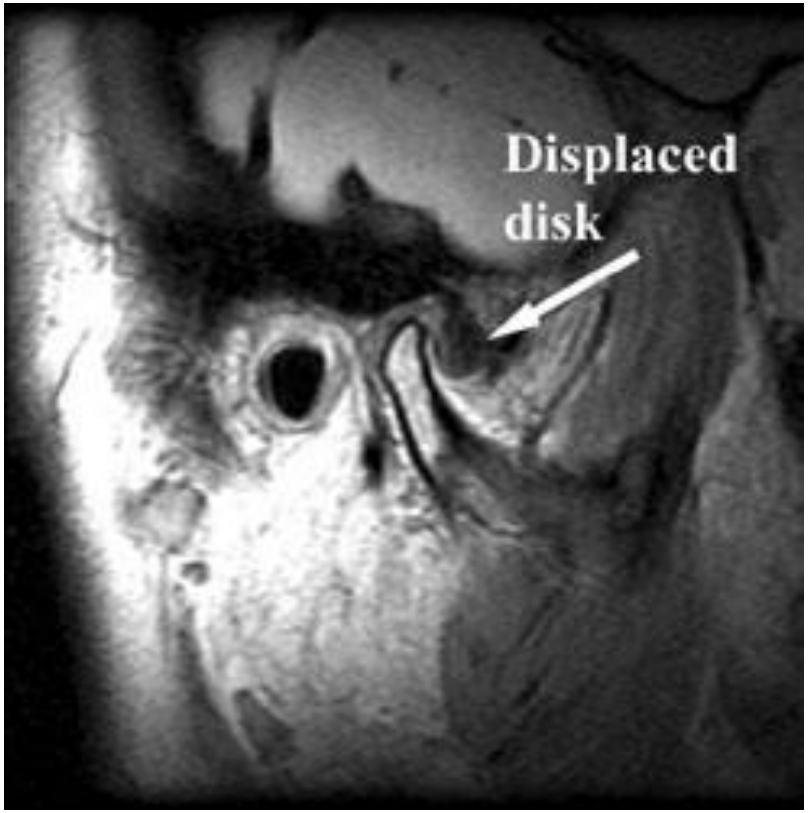
- MRI provides high resolution and great tissue contrast. This allows for a detailed evaluation of the anatomy was well as biomechanics of the joint through open and closed mouth imaging.

MRI


Temporal Lobe of Brain
Base of Skull - Temporal Bone
Ear Canal
Posterior Attachment of TMJ Articular Disc
Head of Mandibular Condyle

MRI of TMJ





Treatment of TMD

- Conservative management strategies should always be considered the first line of management of TMDs.
- American Association of Dental Research has issued a new scientific statement indicating reversible conservative therapy, for instance basic intra-oral appliances, bio-behavioral therapy, physiotherapy, simple analgesia, as the initial management of TMDs.

- Surgical procedures for the TMJ include arthrocentesis, arthroscopy, open joint procedures, and total joint replacement.
- Arthrocentesis is the most minimally invasive of the four options but has the disadvantage of being a “blind” procedure only allowing lysis and lavage. Arthroscopy has the added benefit of being able to visualize the interior of the joint capsule, usually the upper joint space.

Arthrocentesis

b. Second needle attached to syringe removes excess fluids

a. First needle injects fluid to wash out joint

Noninvasive Therapies for TMJ Disorders

Alternative therapies

- Acupressure
- Acupuncture

Dental procedures

- Temporary occlusal therapy

Medical interventions

- Intra-articular corticosteroid or anesthetic injection
- Myofascial trigger-point injection
- Pharmacologic treatment

Physical therapy modalities

- Biofeedback
- Superficial or deep heat/cold
- Therapeutic exercise
- Transcutaneous electrical nerve stimulation

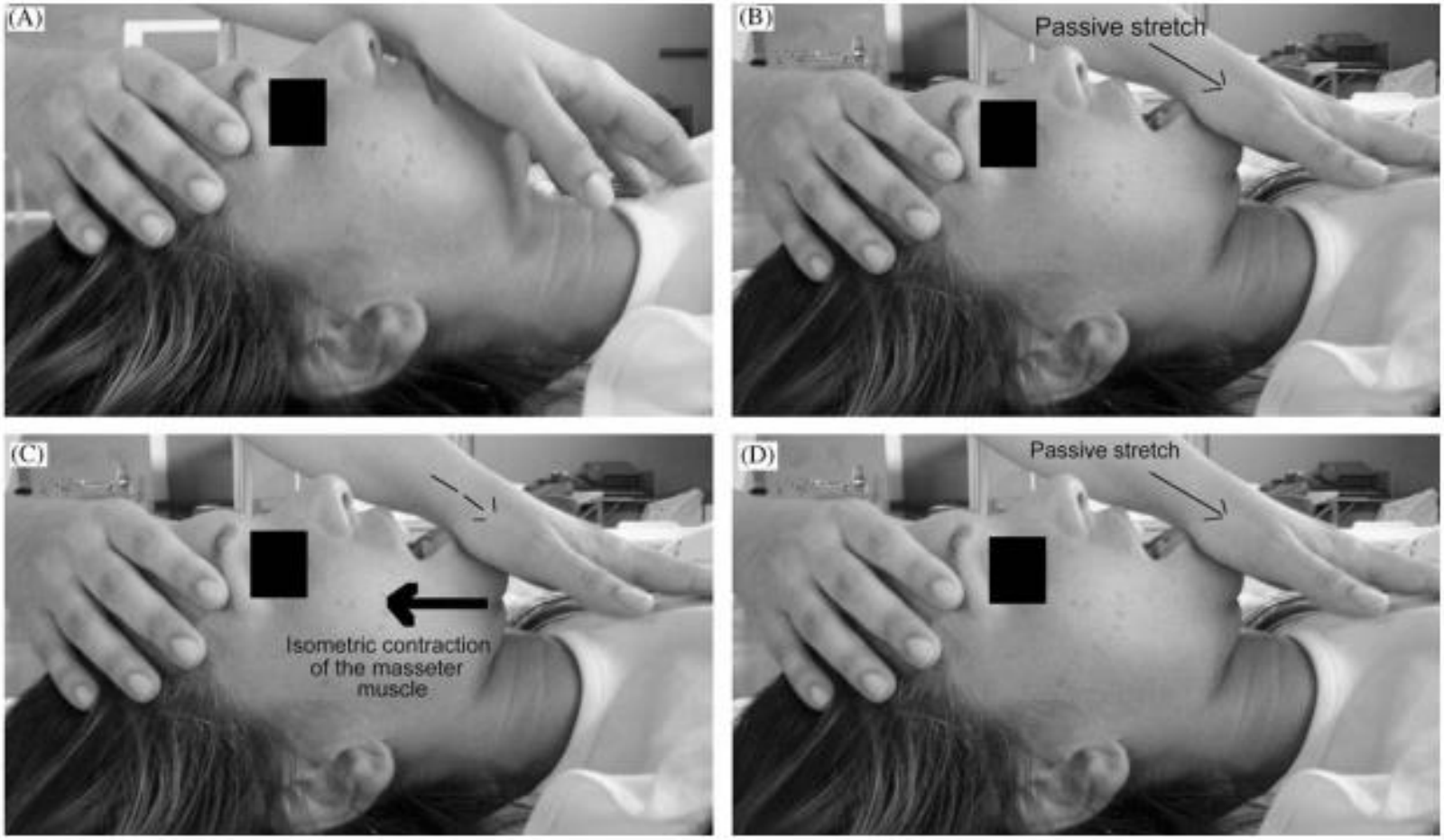
Psychological interventions

- Cognitive behavior therapy
- Relaxation techniques
- Stress management

Post Isometric Relaxation

- Post-isometric relaxation, are commonly recommended in the management of MTrPs
- With this technique, the therapist can restore the decreased range of motion that is usually found with TMD disorders through a systematic process of stretching and providing resistance.

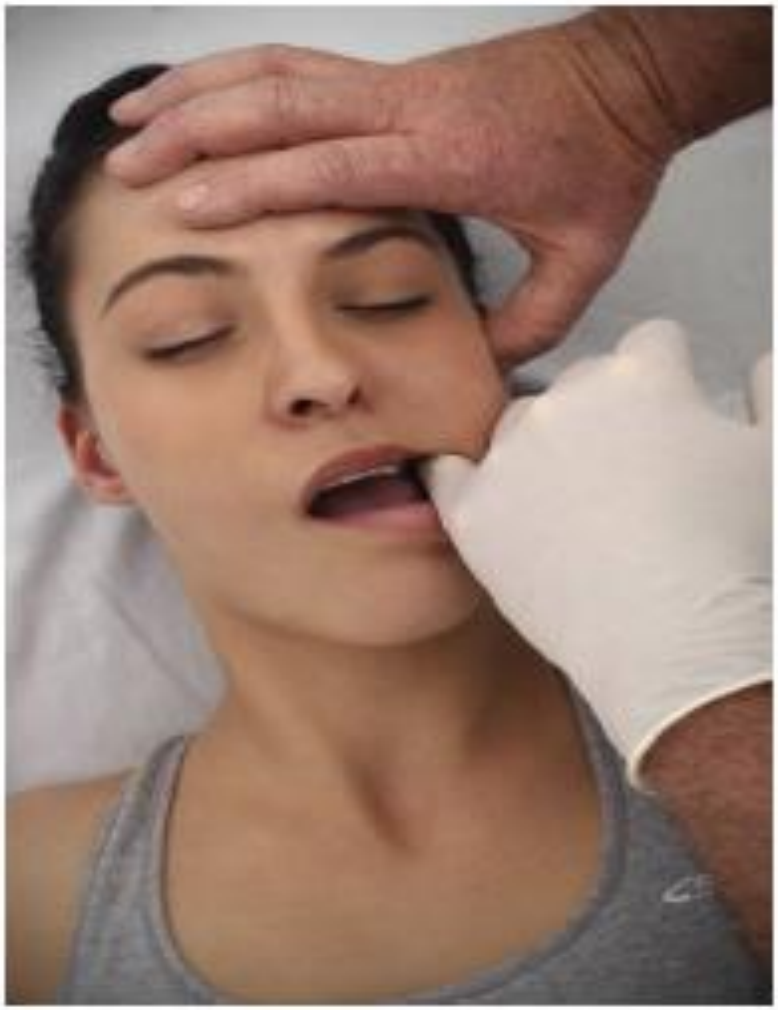
PIR in the masseter muscle



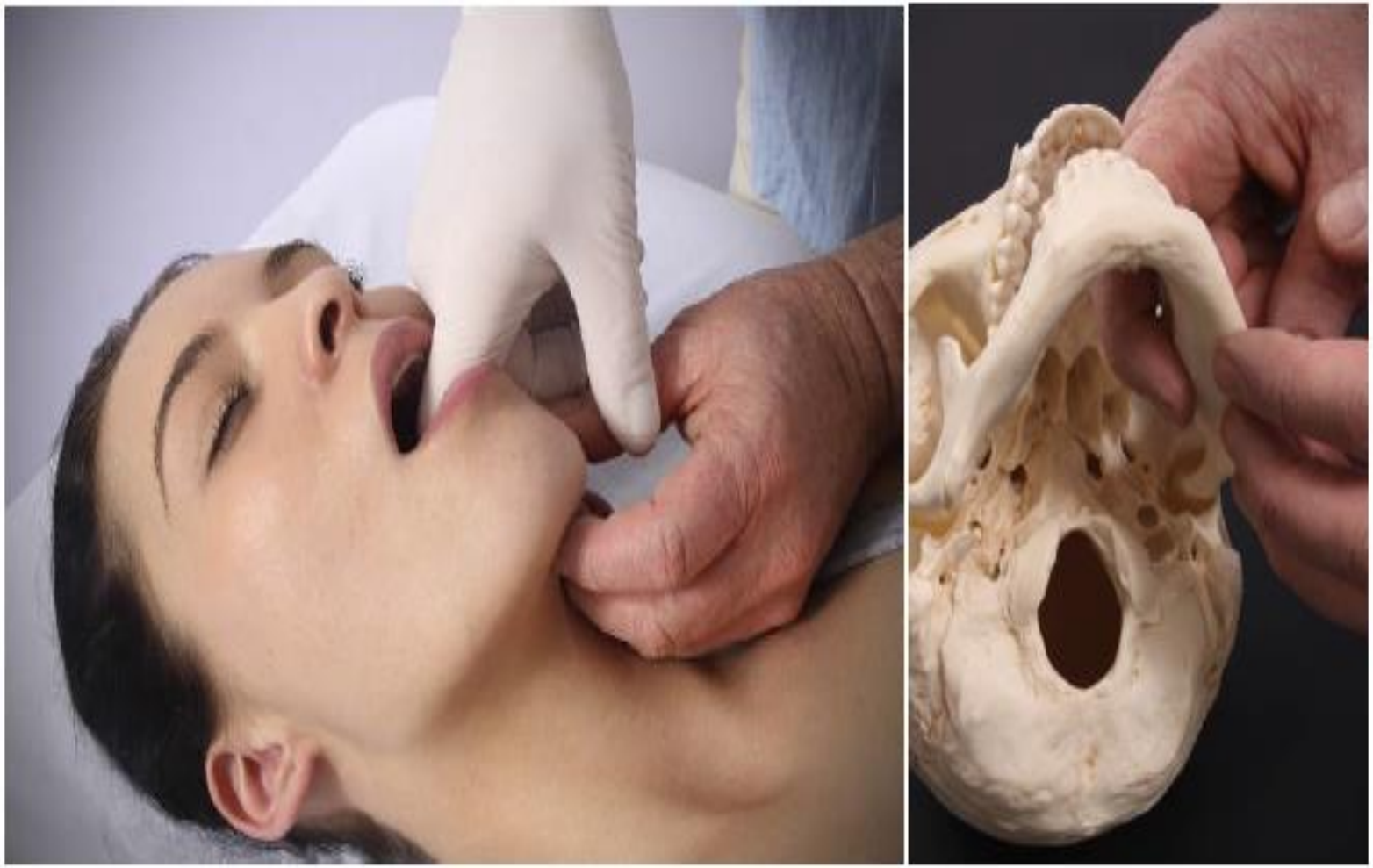
Trigger Point Pressure Release

- Trigger Point Pressure Release (David Simons, MD and Janet Travell, MD) involves applying pressure with a finger or other instrument to the trigger point and increasing the pressure as the trigger point "releases" and softens.
- Other techniques often used include Spray and Stretch which is a technique that uses a vapo-coolant spray to distract the muscle into allowing a more complete stretch thereby helping to release the trigger point.

Lateral Pterygoid Release Technique

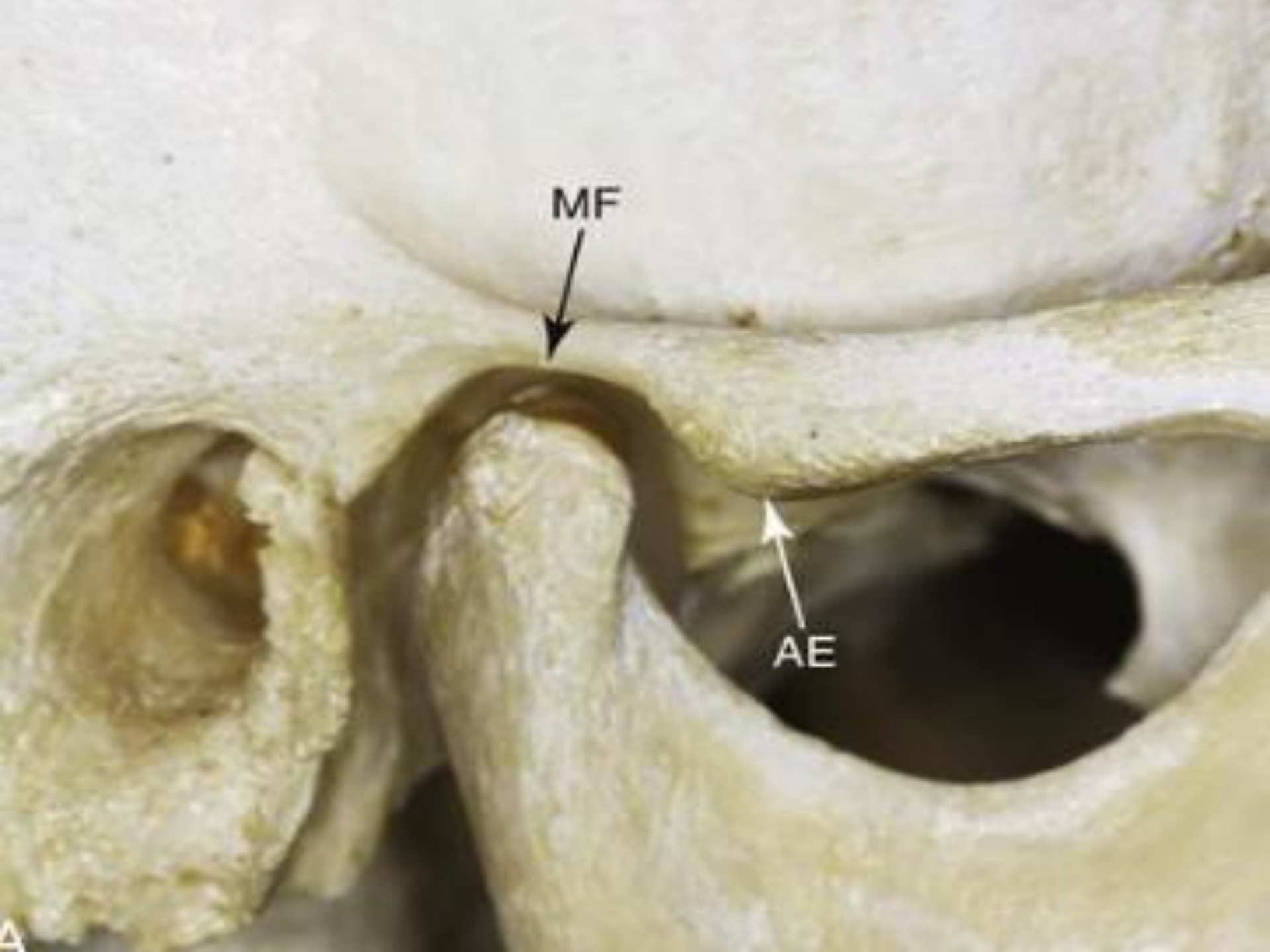


Medial Pterygoid Release Technique

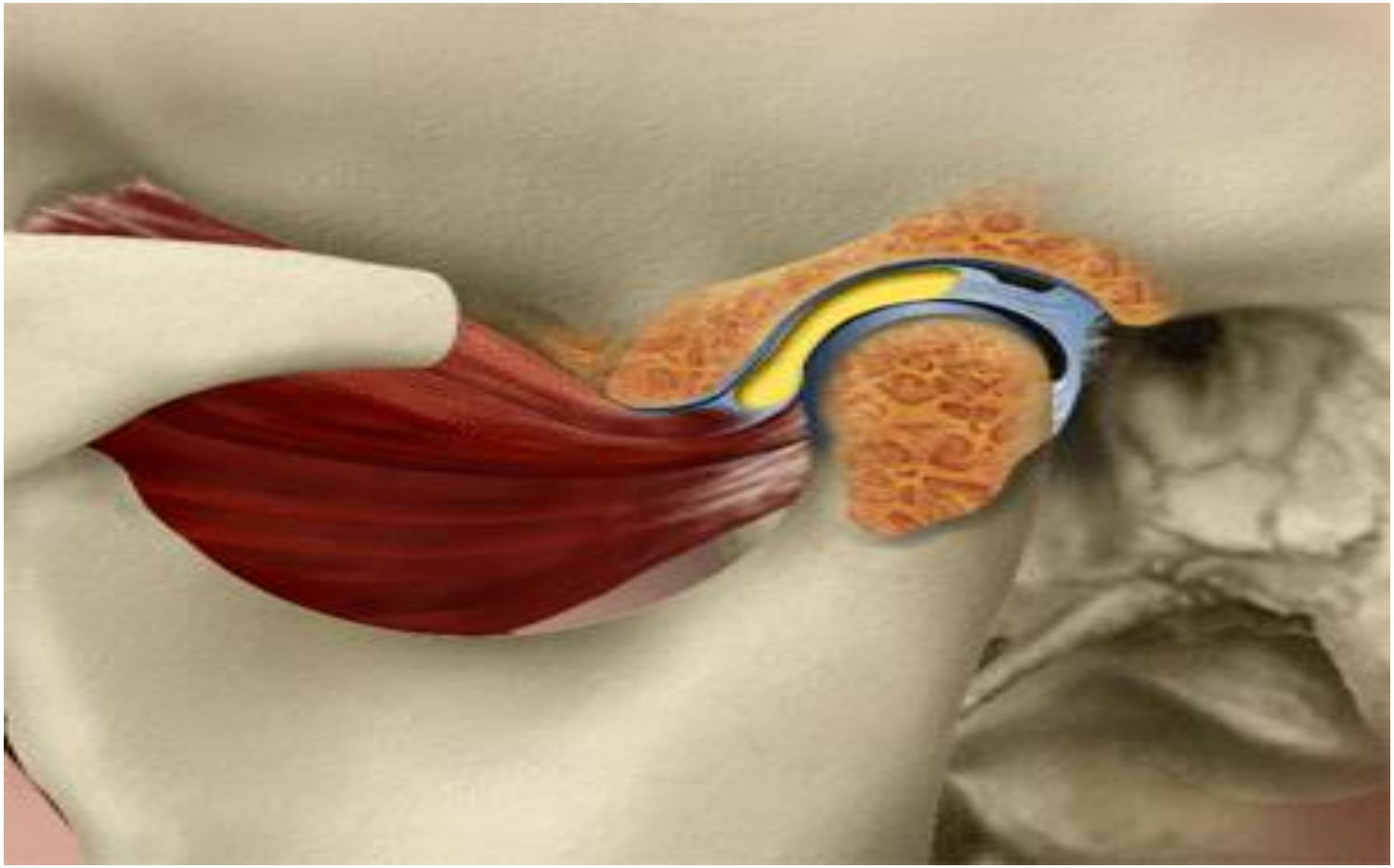


Manipulation - Mobilization

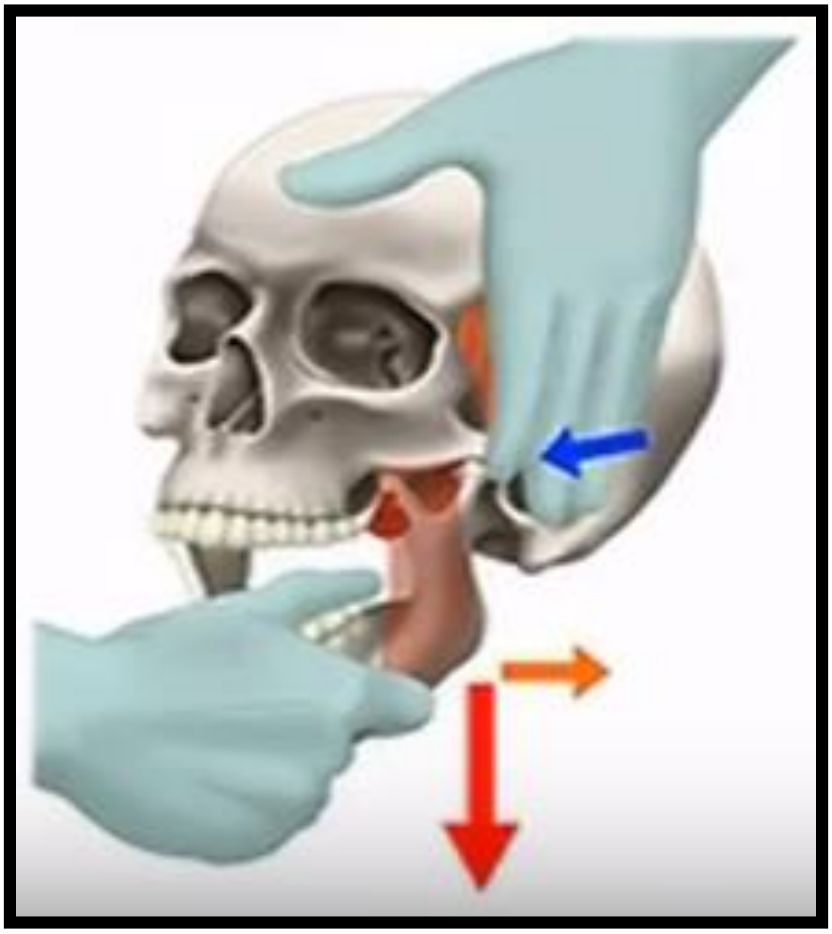
- Treating unilateral anterior displacement of the articular disc with adhesion to the articular eminence requires a very low-amplitude high velocity thrust parallel to the slope of the articular eminence.
- TMJ mobilization is performed to tear joint capsule adhesions and to realign collagen fibers.


MF
AE

Open lock




Myrtle Beach



Closed lock

Temporary Occlusal Therapy

- Splints prevent the upper and lower teeth from coming together. This makes it difficult for you to grind or clench your teeth. These devices take pressure off the jaw joints and muscles so they can relax and heal.
- Indicated for patients with pain and stiffness in the TMJ on awakening.

Maxillary Occlusal Appliance

Self home Exercises

Oral Behaviors

- Patients should avoid opening their mouth wide and moving excessively from one side to another, instead use passive range of motion exercises to gently stretch tight jaw muscles.
- Intentionally popping or clicking the TMJ should also be avoided.
- The usual jaw position should be where the jaw muscles are relaxed so the teeth are slightly apart and the tongue is lightly resting just behind the maxillary or mandibular anterior teeth.

- Frequent self-monitoring and correcting the jaw position and ensuring no clenching and grinding activity is occurring, will help to decrease jaw muscle tension.
- Some simple diet modifications (e.g., smaller bites, soft diet, and avoidance of opening wide and hard/crunchy/chewy foods) can also help to decrease jaw muscle tension and fatigue.

Behavioral Treatments

- For patients who indicate they are stressed, it is helpful for them to identify the stressors and make a plan to reduce and manage them.
- Clinicians can recommend patients talk with their physicians about a referral to a psychologist who can assist.

Medications

- The most commonly recommended medications for relief of TMD muscle and joint pain are over-the-counter non-steroidal anti-inflammatory drugs (NSAIDs).
- Muscle relaxants may be prescribed for patients to take at bedtime, for those who awake with muscle pain.
- Co-management with primary care provider may accelerate and improve the outcome.

Case study

- 38 year-old female, constant jaw pain for the last 6 months after a motor vehicle accident. At examination, the patient shows no dental misalignment or malocclusion, pain in the TMJ w/ palpation, decreased mouth opening by 20% with clicking at mouth opening. X-ray reveals no changes on bony structures or anomalies. The patient was treated with night guard but no improvements.

The relationship between cervical joint dysfunction and TMD

Can Cervical Joint Dysfunction cause Temporomandibular Disorders?

European Journal of Orthodontics 23 (2001) 179–192

Temporomandibular disorders in relation to craniofacial dimensions, head posture and bite force in children selected for orthodontic treatment

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SUMMARY The present study examined the associations between craniofacial dimensions, head posture, bite force, and symptoms and signs of temporomandibular disorders (TMD). The sample comprised 96 children (51F, 45M) aged 7–13 years, sequentially admitted for orthodontic treatment of malocclusions entailing health risks. Symptoms and signs of TMD were assessed by 37 variables describing the occurrence of headache and facial pain, clicking, jaw mobility, tenderness of muscles and joints, and the Helkimo Anamnestic and Dysfunction indices. Craniofacial dimensions (33 variables), and head and cervical posture (nine variables) were recorded from lateral cephalometric radiographs taken with the subject standing with the head in a standardized posture (mirror position). Dental arch widths were measured on plaster casts and bite force was measured at the first molars on each side by means of a pressure transducer. Associations were assessed by Spearman correlations and multiple stepwise logistic regression analyses.

The magnitudes of the significant associations were generally low to moderate. On average, temporomandibular joint (TMJ) dysfunction was seen in connection with a marked forward inclination of the upper cervical spine and an increased craniocervical angulation, but no firm conclusion could be made regarding any particular craniofacial morphology in children with symptoms and signs of TMJ dysfunction. Muscle tenderness was associated with a 'long face' type of craniofacial morphology and a lower bite force. Headache was associated with a larger maxillary length and increased maxillary prognathism. A high score on Helkimo's Clinical Dysfunction Index was associated with smaller values of a number of vertical, horizontal, and transversal linear craniofacial dimensions and a lower bite force.

Associations between TMD and posture

A characteristic pattern of associations with posture was found for three signs of TMJ dysfunction, namely clicking assessed by auscultation with a stethoscope, the occurrence of locking of the jaw, and the occurrence of an asymmetric opening movement of the mandible. All three signs were associated with a marked forward inclination of the cervical column, and locking of the jaw was furthermore characterized by a marked increase in craniocervical angulation. No symptoms or signs were associated with craniovertical angulation.

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Hindawi

Research Article

Correlation between TMD and Cervical Spine Pain and Mobility: Is the Whole Body Balance TMJ Related?

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Abstract

Temporomandibular dysfunction (TMD) is considered to be associated with imbalance of the whole body. This study aimed to evaluate the influence of TMD therapy on cervical spine range of movement (ROM) and reduction of spinal pain. The study group consisted of 60 patients with TMD, cervical spine pain, and limited cervical spine range of movements. Subjects were interviewed by a questionnaire about symptoms of TMD and neck pain and had also masticatory motor system physically examined (according to RDC-TMD) and analyzed by JMA ultrasound device. The cervical spine motion was analyzed using an MCS device. Subjects were randomly admitted to two groups, treated and control. Patients from the treated group were treated with an occlusal splint. Patients from control group were ordered to self-control parafunctional habits. Subsequent examinations were planned in both groups 3 weeks and 3 months after treatment was introduced. The results of tests performed 3 months after the beginning of occlusal splint therapy showed a significant improvement in TMJ function ($P > 0.05$), cervical spine ROM, and a reduction of spinal pain. The conclusion is that there is a significant association between TMD treatment and reduction of cervical spine pain, as far as improvement of cervical spine mobility.

Conclusions from this study

Our studies as well as the clinical follow up suggest that TMD is very frequently present along with pain in the cervical spine. The key aspect of the studies described here is the considerable ROM improvement in the cervical spine and the elimination of cervical spine pain felt there by the subjects in the experimental group. Taking into account the results of our study, it seems obvious that interdisciplinary cooperation between orthopedist, laryngologist, neurologist, and dentist is necessary and essential

Delayed temporomandibular joint pain and dysfunction induced by whiplash trauma

A controlled prospective study

Hanna Salé, DDS; Annika Isberg, DDS, PhD

Abstract

BACKGROUND:

The Quebec Task Force on Whiplash-Associated Disorders urged for controlled, prognostic studies of symptoms after whiplash trauma. The authors conducted a study that met the design requirements to enhance knowledge about short-term and long-term temporomandibular joint (TMJ) pain, dysfunction or both induced by whiplash trauma.

METHODS:

The authors studied 60 consecutive patients who had neck symptoms after whiplash trauma and were seen at a hospital emergency department. They followed up 59 subjects one full year later. At the inceptive examination and at follow-up, each subject completed a self-administered questionnaire, followed by a comprehensive interview. Fifty-three frequency-matched control subjects followed the same protocol concurrently.

RESULTS:

The incidence of new symptoms of TMJ pain, dysfunction or both between the inceptive examination and follow-up was five times higher in subjects (34 percent) than in control subjects (7 percent). The frequency of TMJ pain increased significantly in female subjects, as did the frequency of TMJ symptoms that were reported to be the main complaint. At the follow-up, 20 percent of all subjects reported that TMJ symptoms were their main complaint.

CONCLUSIONS:

Our results suggest that one in three people who are exposed to whiplash trauma is at risk of developing delayed TMJ symptoms that may require clinical management.

CLINICAL IMPLICATIONS:

Awareness of a significant risk for delayed onset of TMJ symptoms after whiplash trauma is crucial for making adequate diagnoses, prognoses and medicolegal decisions.

Coclusions from this study

One in three people who are exposed to whiplash trauma, which induces neck symptoms, is at risk of developing delayed TMJ pain and dysfunction with onset during the year after the accident.

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Neck function in rhythmic jaw activities

Birgitta Häggman Henrikson

ABSTRACT

This investigation tested the hypothesis of a functional integration between the human jaw and neck motor systems in rhythmic jaw activities. By means of a wireless optoelectronic 3-D movement recording system, spatiotemporal characteristics of mandibular and head-neck movements were studied during rhythmic jaw opening-closing and chewing tasks, in healthy and in individuals with pain and dysfunction in the jaw and neck region following neck trauma, Whiplash-associated Disorders (WAD). As a basis, a methodological study evaluated the applicability of skin and teeth attached reflex markers fixed to the lower jaw and to the head in optoelectronic recording of chewing movements.

The results showed concomitant and coordinated mandibular and head movements during rhythmic jaw tasks. The start of the head movement generally preceded the start of the mandibular movement.

For chewing, larger size and harder texture of bolus were associated with larger head extension and larger amplitude of both mandibular and head movements. Immobilization of the head by mechanical fixation deranged jaw motor behavior with regard to speed and amplitude of mandibular movements. Even with head fixation, muscle activity was present in neck muscles during jaw activities. Compared to healthy subjects, WAD individuals showed smaller amplitudes and disturbed coordination of mandibular and head movements. Furthermore, a dynamic load test showed a reduced endurance during chewing in the WAD group.

A new concept for human jaw function is proposed, in which "functional jaw movements" are the result of activation of jaw as well as neck muscles, leading to simultaneous movements in the temporomandibular, atlanto-occipital and cervical spine joints. The finding of an association between neck injury and disturbed jaw behavior suggest that assessment and management of neck injured patients should include jaw function.

Conclusions from this study

This study showed that head-neck fixation can lead to a deranged jaw behavior, as indicated by reduced amplitudes of mandibular movements and shorter duration of jaw opening-closing cycles. This suggests that optimal jaw function requires free unrestricted head-neck movements.

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Upper cervical range of motion is impaired in patients with temporomandibular disorders.

Grondin F, Hall T, Laurentjoye M, Ella B.

Abstract

AIMS:
Clinicians increasingly suggest assessment and treatment of the cervical spine in patients with temporomandibular dysfunction (TMD); however, few studies have investigated upper cervical spine mobility in people who suffer from TMD. The purpose of this study was to investigate whether patients with TMD pain (with or without headache) present with upper cervical spine impairment when compared with asymptomatic subjects.

METHODOLOGY:
A single blind examiner evaluated cervical range of motion (ROM) measures including axial rotation during the flexion-rotation test (FRT) and sagittal plane ROM. Twenty asymptomatic subjects were compared with 37 subjects with pain attributed to TMD, confirmed by the Revised Research Diagnostic Criteria. Subjects with TMD were divided according to the presence of headache (26 without headache TMDNHA, 11 with headache TMDHA). One-way analysis of variance and planned orthogonal comparisons were used to determine differences in cervical mobility between groups. All subjects with TMD were positive on the FRT with restricted ROM, while none were in the control group.

RESULTS:
The analysis of variance revealed significant differences between groups for the FRT $F(2,54) = 57.96$, $P<0.001$) and for sagittal ROM [$F(2,54) = 5.69$, $P = 0.006$]. Findings show that the TMDHA group had less axial rotation than group TMDNHA, and both TMD groups had less ROM than controls. For sagittal ROM, the only difference was between group TMDHA and controls.

CONCLUSIONS:
Subjects with TMD had signs of upper cervical spine movement impairment, greater in those with headache. Only subjects with TMD and headache had impairment of cervical spine sagittal plane mobility. This study provides evidence for the importance of examination of upper cervical mobility determined by the FRT in patients who suffer from TMD

Conclusions from this study

Range recorded during flexion rotation test was significantly less in people with TMD compared to asymptomatic controls with up to 51° difference in mean ROM.

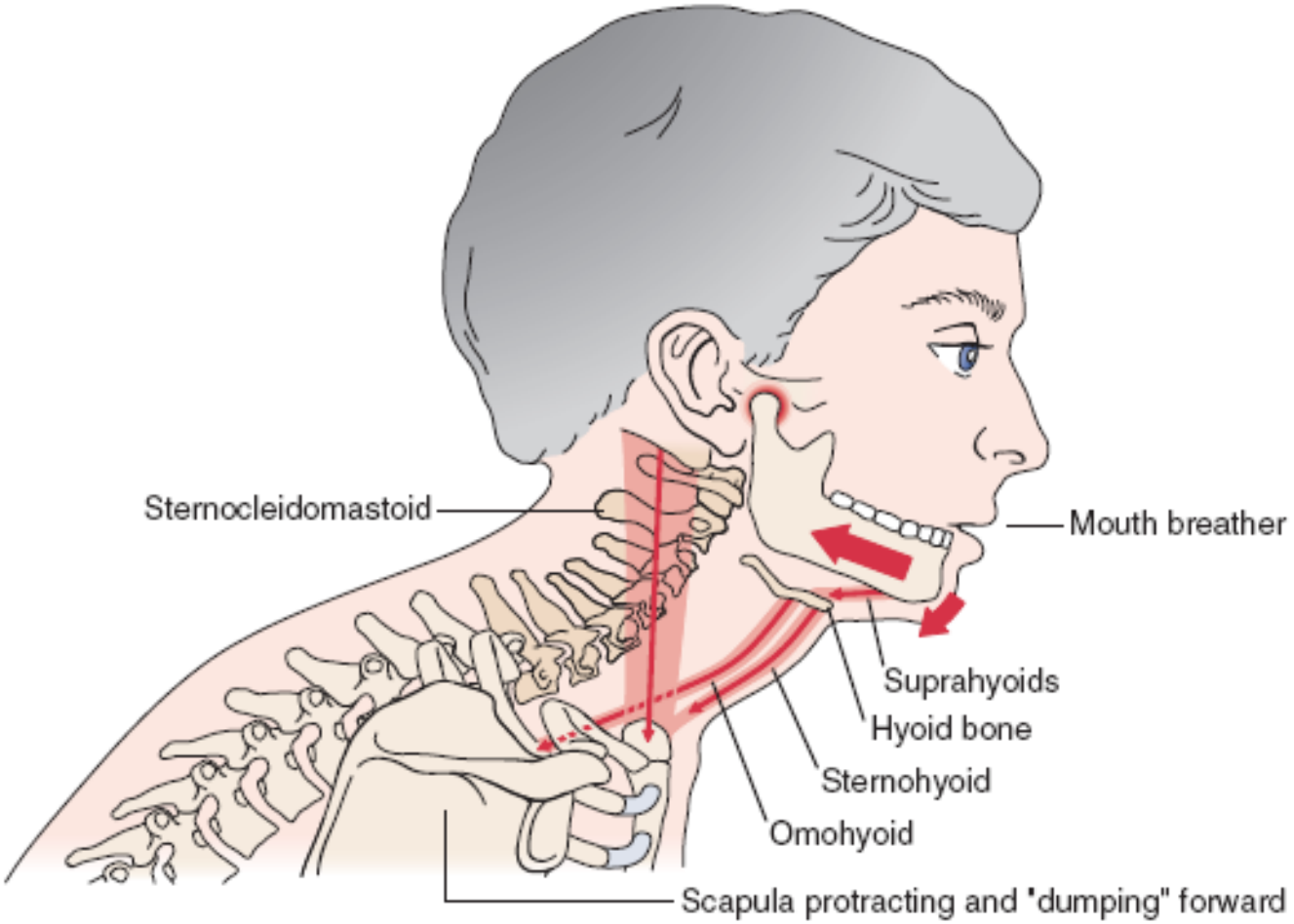
Sagittal plane cervical spine movements was reduced in those subjects with TMD and headache when compared with asymptomatic controls.

Can Cervical Joint Dysfunction cause Temporomandibular Disorders?

- The mandible normally moves backward during cervical extension and forward in cervical flexion, producing poor occlusion during extreme flexion-extension.
- Patient with a cervical spine in a chronic state of fixed flexion or extension in the resting position will exhibit a constant state of malocclusion, which will lead to TMJ dysfunction.

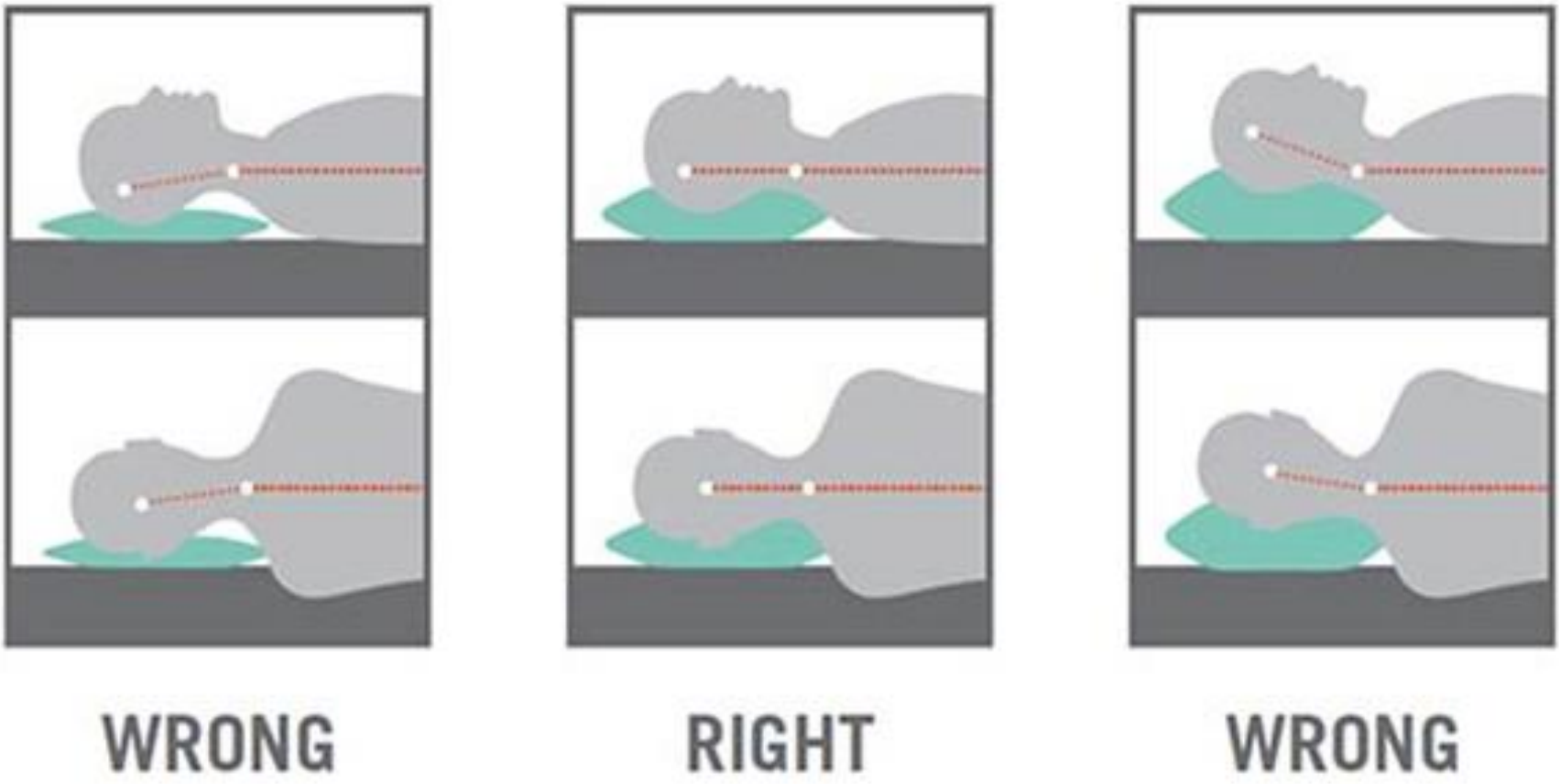
Whiplash Trauma

Forward Head Posture



Sleeping position

Can sleeping position affect the TMJ?



“People in the Middle Ages thought the Earth is flat”

“Many health care providers believe that TMD is usually caused by mal occlusion and bruxism”

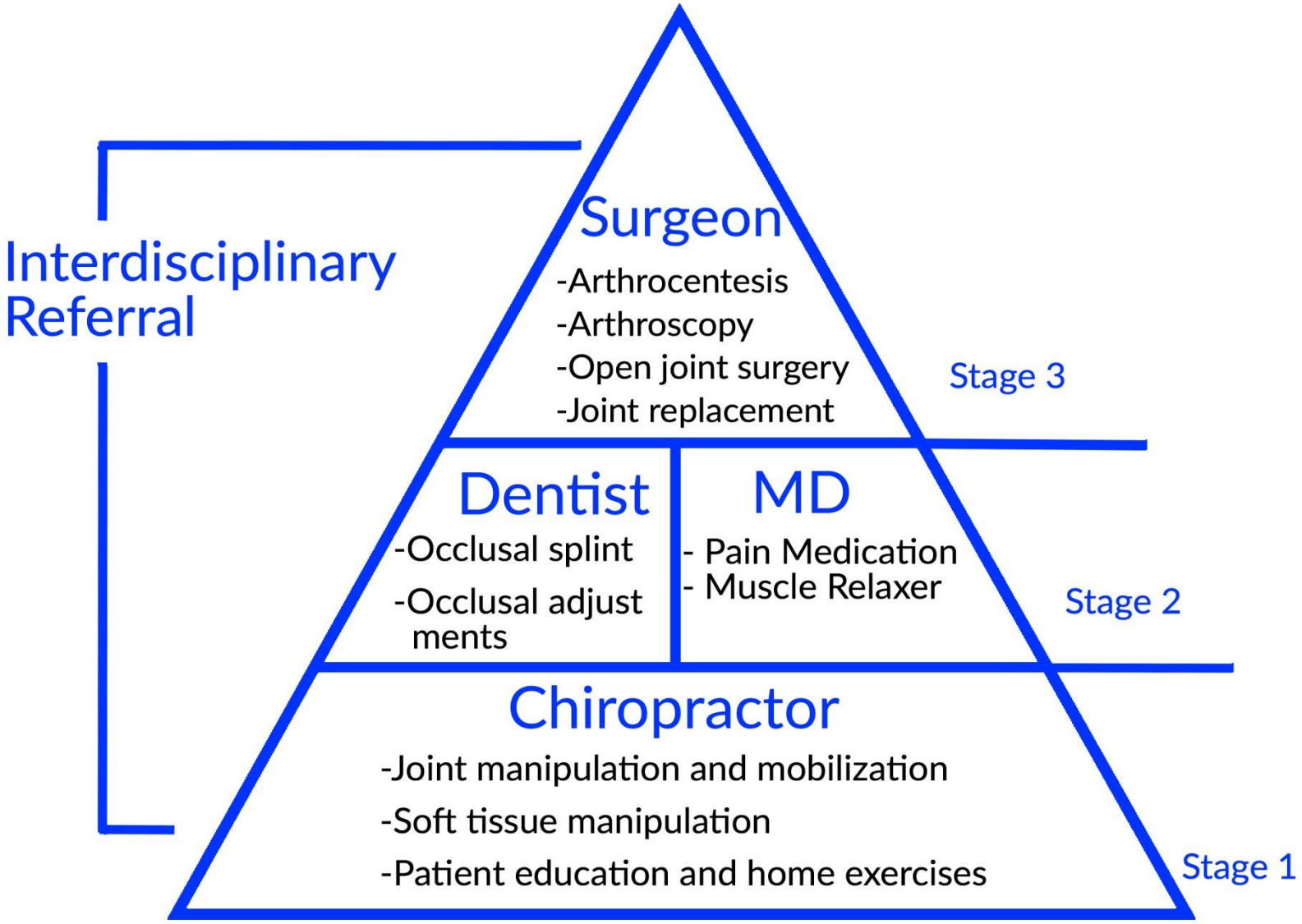
The Earth is round

Cervical joint dysfunction can cause TMD

TMJ Management Protocol

Chiropractic treatments as a first line of treatment for TMD

- The normal muscle balance and joint function should be established before to proceed with any invasive procedure.
- Chiropractors should evaluate each TMD patients thoroughly and give a proper referral.
- Educating our community and working in partnership with other healthcare professionals.


Interdisciplinary Referral
Surgeon
-Arthrocentesis
-Arthroscopy
-Open joint surgery
-Joint replacement
Stage 3
Dentist
-Occlusal splint
-Occlusal adjust ments
MD
- Pain Medication
- Muscle Relaxer
Stage 2
Chiropractor
-Joint manipulation and mobilization
-Soft tissue manipulation
-Patient education and home exercises
Stage 1

Case study

- 38 year-old female, constant jaw pain for the last 6 months after a motor vehicle accident. At examination, the patient shows no dental misalignment or malocclusion, pain in the TMJ w/ palpation, decreased mouth opening by 20% with clicking at mouth opening. X-ray reveals no changes on bony structures or anomalies. The patient was treated with night guard but no improvements.

Group activity

- Please explain to the dentist why his TMD patient is not responding to the treatment and how the patient will benefit from the chiropractic care.

Thank You!