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Temporomandibular Joint Disorders

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Surgery

By

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Certification of the Supervisor

I certify that this project entitled "Temporo Mandibular Joint Disorders " was prepared by the fifth year student Lubna Zuhair under my supervision at the College of Dentistry/University of Baghdad in partial fulfilment of the graduation requirements for the Bachelor Degree in Dentistry.

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Date:

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Dedication

To my home, my family and all my dear people in this life, and last but not least myself for their tolerance and patience for all my mistakes and their endless love and support till I am here in this place writing this project

Acknowledgment

Special thanks to Allah, the most giving and the most forgiving for everything Given to me and for blessing me. I would like to give a grateful thanks for the dean of College of Dentistry. University of Baghdad Prof. Dr. Raghad Al-Hashimi for giving me the opportunity to learn. Deep thanks to Prof. Dr. Ahlam Taha the Head of the Department of Pedodontics and Preventive dentistry. To my supervisor assist. Lec. Shatha A.Abbas for her support and scientific care and also for her clarification of all details and making the work on this project easier and more enjoyable. To all my colleagues for their help all the past five years and being my second family.

And last but not least to my dear parents for backup and engorgement, my sister and my brothers

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List of abbreviation

Abbreviation	The word
1. TMJ	Temporomandibular Joint
2. TMD	Temporomandibular Disorders
3. MPDS	Myofascial Pain Dysfunction Syndrome
4. MRI	Magnetic Resonance Imaging
5. OPG	Orthopantomography
6. CT	Computed Tomography
7. CBCT	Cone beam computed tomography
8. RDC / TMD	Research Diagnostic Criteria for Temporomandibular Disorders
9. DJD	Degenerative joint disease
10. OA	Osteoarthritis
11. RA	Rheumatoid arthritis
12. MRSA	Methicillin-Resistant Staphylococcus Aureus (MRSA)
13. HH	Hemimandibular hyperplasia
14. HE	Hemimandibular Elongation
15. NSAIDs	Non-Steroidal Anti Inflammatory Drugs
16.MCV	Maximum Voluntary Contraction

Introduction

The temporomandibular joints (TMJ) are the two joints connecting the jawbone to the skull. It is a bilateral synovial articulation between the temporal bone of the skull above and the mandible below; it is from these bones that its name is derived. This joint is unique in that it is a bilateral joint that functions as one unit. Since the TMJ is connected to the mandible, the right and left joints must function together and therefore are not independent of each other.

Temporomandibular disorders (TMDs) constitute a group of disorders that cause pain or dysfunction in the jaw joint and muscles that control its movement **(Bumann & Lotzmann ,2003)**

Aim of the study

During the last few decades, an increase in musculoskeletal pain conditions and stress-related health problems have been observed worldwide. The overall aim of this review was to acquire knowledge. Relating to temporomandibular disorders (TMD) as well as to study factors that cause them and their treatment.

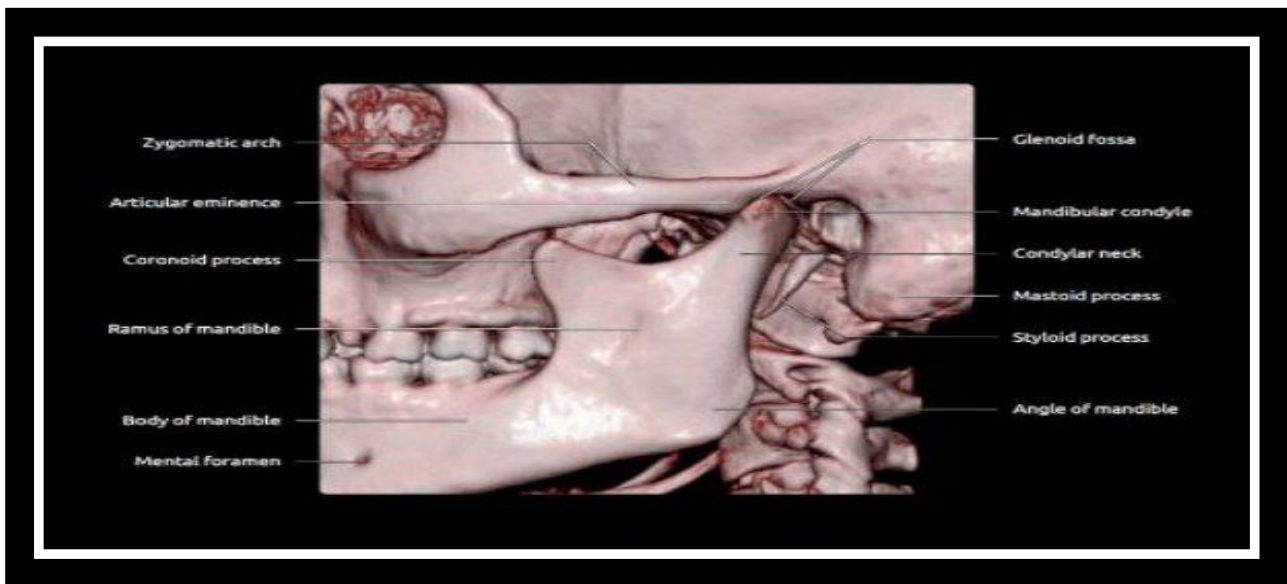
Review of Literature

1.The temporomandibular joint (TMJ):- is a hinge joint that connects the jaw bone to the skull. The main component of TMJ is bilateral mandibular condyle, meniscus, glenoid fossa, articular ligaments, and the associated musculature . It is a bilateral synovial articulation between the temporal bone of the skull above and the mandible below; it is from these bones that its name is derived. This joint is unique in that it is a bilateral joint that functions as one unit. Prevalence of temporomandibular joint disorder in Iraqi population had been studied by many Iraqi researchers, some of those studies are: (**Fehrenbach & Herring ,2012; List &Jensen ,2017**)

*(**Gaphor & Hameed,2010**) stated that out of 500 university students (250 females, 250 males), ages ranged between 18-26 years, prevalence of one or more symptoms of TMDs was 27%, while the prevalence of one or more signs of the TMDs was 63.8% which was generally mild in severity.

* An Iraqi study by (**Hussein et al.,2015**) that examined reports of 1325 patients aged from 10-79 years; 650 males (49.05%) and 675 females (50.94%) concluded that out of 53 (0.04%) patients who complained of TMJ problems, 30 patients were males (56.6%) and 23 patients were females (43.4%). The highest numbers of patients were from the younger age groups (20-30 years; n= 37, 69.8%). The pain was the most prevalent reported symptom followed by clicking in the joints and more than half of patients reported emotional stress as a causative factor

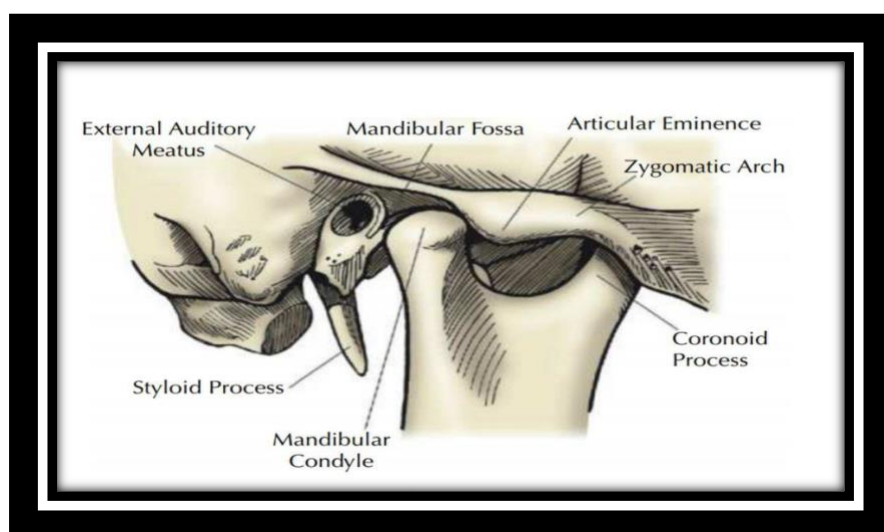
* A recent Iraqi study examined 230 students with the age of 18-25 years reported that most encountered symptoms were joint sounds (27.4%) and joint fatigue (27.4%). (50%) of the students had some grade of temporomandibular disorder (**Yousif& Omer ,2021**).



Figure(1):Temporomandibular Joint(Koeing et al.,2017).

2.Anatomy of TMJ:-

TMJ is a bi-condylar, synovial, diarthrodial joint which functions synchronously. It is classified as ginglymus or ginglymoarthrodial joint as it performs both hinge and sliding movements. This joint forms an articulation between the mandibular condyle inferiorly and the fossa in the temporal bone superiorly. Unlike most joints of the body which are lined by hyaline cartilage. The articular surface of TMJ is lined by fibrocartilage/white fibrous tissue, (Detamore&Athanasίου,2003;Granstrom&Linde,2003;Griffin&Sharpe,2003;Kondoh,2003;Mills et al.,2003)



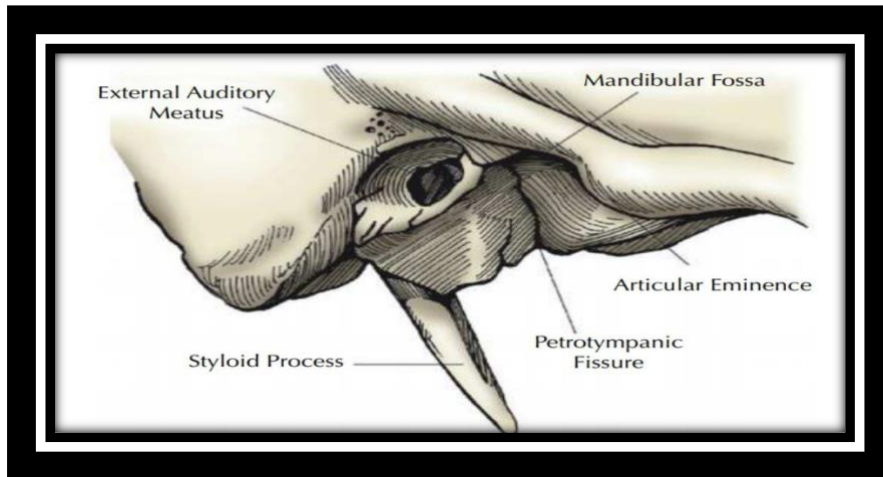


Figure2:Anatomy of TMJ(Bordoni et al.,2020).

2.1.Capsule

The capsule is a dense fibrous membrane that surrounds the joint and incorporates the articular eminence. It attaches to the articular eminence, the articular disc and the neck of the mandibular condyle ,(Evelin,2019)

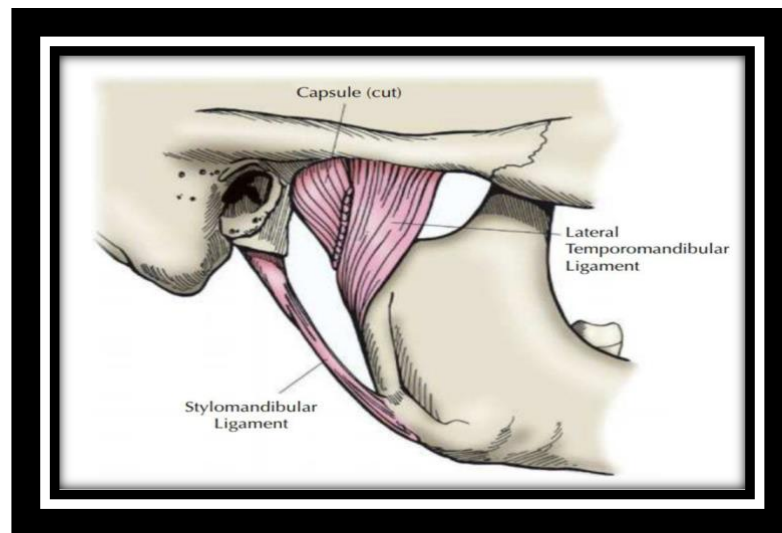


Figure3:capsular Ligament (Lipton et al.,2003;Terrin et al.,2020).

2.2. Articular Disc (Meniscus) :-

Dense fibrous connective tissue primarily consists of dense collagen fibers of variable thickness is referred to as a disc and occupies the space between the fibrocartilage coverings of each condyle and mandibular fossa . The disc consists of collagen fibers, cartilage-like proteoglycans and elastic fibers. It contains a variable number of cells that resemble fibrocytes and fibrochondrocytes. Collagen fibers in the center of the disc (often referred to as the intermediate zone) are oriented perpendicular to its transverse axis , functionally aligned with loading on that zone. The collagen fibers become interlaced as they approach the anterior and posterior bands, and many fibers are oriented parallel to the mediolateral aspect of the disc. Cartilage-like proteoglycans contribute to the compressive stiffness of articular cartilage. The disc is primarily avascular and has little sensory innervation. It is thinnest in the intermediate zone and thickens to form anterior and posterior bands represented as a “bow tie” in sagittal sections. This arrangement is considered to help stabilize the condyle in the glenoid fossa. Over time, discs may exhibit changes in this conformation; the central intermediate zone may become elongated or nonexistent, the anterior band may become thinner, or the posterior band may become either thinner or thicker. These conformation changes, while presumably affecting the ideal function of the disc in stabilizing the condyle during loading, are currently regarded as a variation on normal in the absence of any clinical manifestation of disordered function ,(**Lipton et al.,2003;Rinchuse et al.,2010;Gorenflo et al.,2020**)

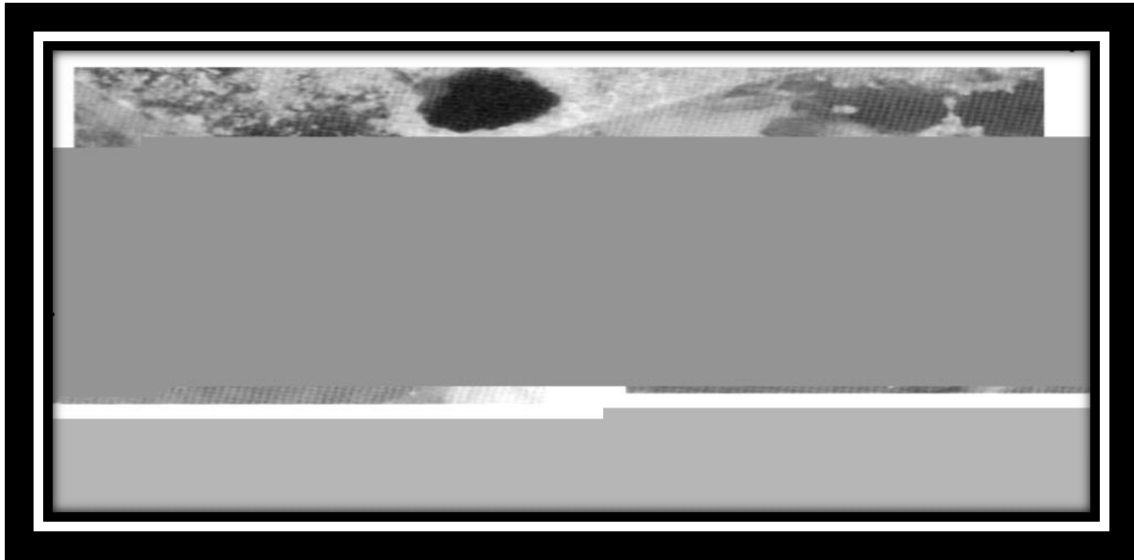


Figure4: A cadaver section through the temporomandibular joint shows the relationship of the condyle, fossa, and articular disc (Dworikin et al.,2008).

2.3.Ligaments:

Ligaments associated with the TMJ are composed of collagen fibres and act predominantly as restraints to motion of the condyle and the disk. There are two groups of ligaments(functional ligaments and accessory ligaments) associated with the temporomandibular joints: one major and two minor ligaments. These ligaments are important in that they define the border movements(**Chandra ,2010; Bordoni&Varacallo,2020**).

2.3.1.Functional ligaments (major ligaments) :

Are lateral temporomandibular ligament , capsular ligament and collateral ligaments. The temporomandibular ligament, is actually the thickened lateral portion of the capsule, and it has two parts: an outer oblique portion (OOP) and an inner horizontal portion (IHP). These ligament prevents the excessive

retraction or moving backward of the mandible, a situation that might lead to problems with the joint ,(Manfredini et al.,2011).

2.3.1.1.Capsular Ligament :

The capsular ligament is a thin inelastic fibrous connective tissue envelope that attaches to the margins of the articular surfaces encompasses each joint, attaching superiorly to the temporal bone along the border of the mandibular fossa and eminence and inferiorly to the neck of the condyle along the edge of the articular facet. It surrounds the joint spaces and the disk, attaching anteriorly and posteriorly as well as medially and laterally, where it blends with the collateral ligament, (Sanders et al.,2013).

2.3.1.2.The temporomandibular (lateral) ligaments:

Are located on the lateral aspect of each TMJ. Unlike the capsular and collateral ligaments, which have medial and lateral components within each joint,the temporomandibular ligaments are single structures that function in paired fashion with the corresponding ligament on the opposite TMJ(Mehrotra et al.,2011).

2.3.1.3.The collateral (or diskal) ligaments:

Are short paired structures attaching the disk to the lateral and medial poles of each condyle. Their function is to restrict movement of the disk away from the condyle, thus allowing smooth synchronous motion of the disk-condyle complex. Although the collateral ligaments permit rotation of the condyle with relation to the disk, their tight attachment forces the disk to accompany the condyle through its translatory range of motion(Detamore et al.,2003).

2.3.2. Accessory ligaments:

Sphenomandibular and stylomandibular are considered accessory ligaments because, although they are attached to osseous structures at some distance from the joints, they serve to some degree as passive restraints on mandibular motion, **(Bender et al., 2018)**

2.3.2.1. The sphenomandibular ligament:

Arises from the spine of the sphenoid bone and descends into the fan-like insertion on the mandibular lingula, as well as on the lower portion of the medial side of the condylar neck. The sphenomandibular ligament serves to some degree as a point of rotation during activation of the lateral pterygoid muscle, thereby contributing to translation of the mandible, **(Wolpert et al., 2017)**

2.3.2.2. The stylomandibular ligament:

Descends from the styloid process to the posterior border of the angle of the mandible and also blends with the fascia of the medial pterygoid muscle. It functions similarly to the sphenomandibular ligament as a point of rotation and also limits excessive protrusion of the mandible, **(Rinchuse et al., 2010)**

3. TMJ Musculature:-

TMJ is associated with different muscles which aid in joint function. The muscles involved to elevate/close the jaw are masseter, temporalis, medial pterygoid muscle. The muscles that depress/open the jaw are lateral pterygoid, geniohyoid, mylohyoid and digastric muscle ; however, a total of 12 muscles actually influence mandibular motion, all of which are bilateral. Muscle pairs may

function together for symmetric movements or unilaterally for asymmetric movement(Chandra et al., 2010 ; Devi , 2019).

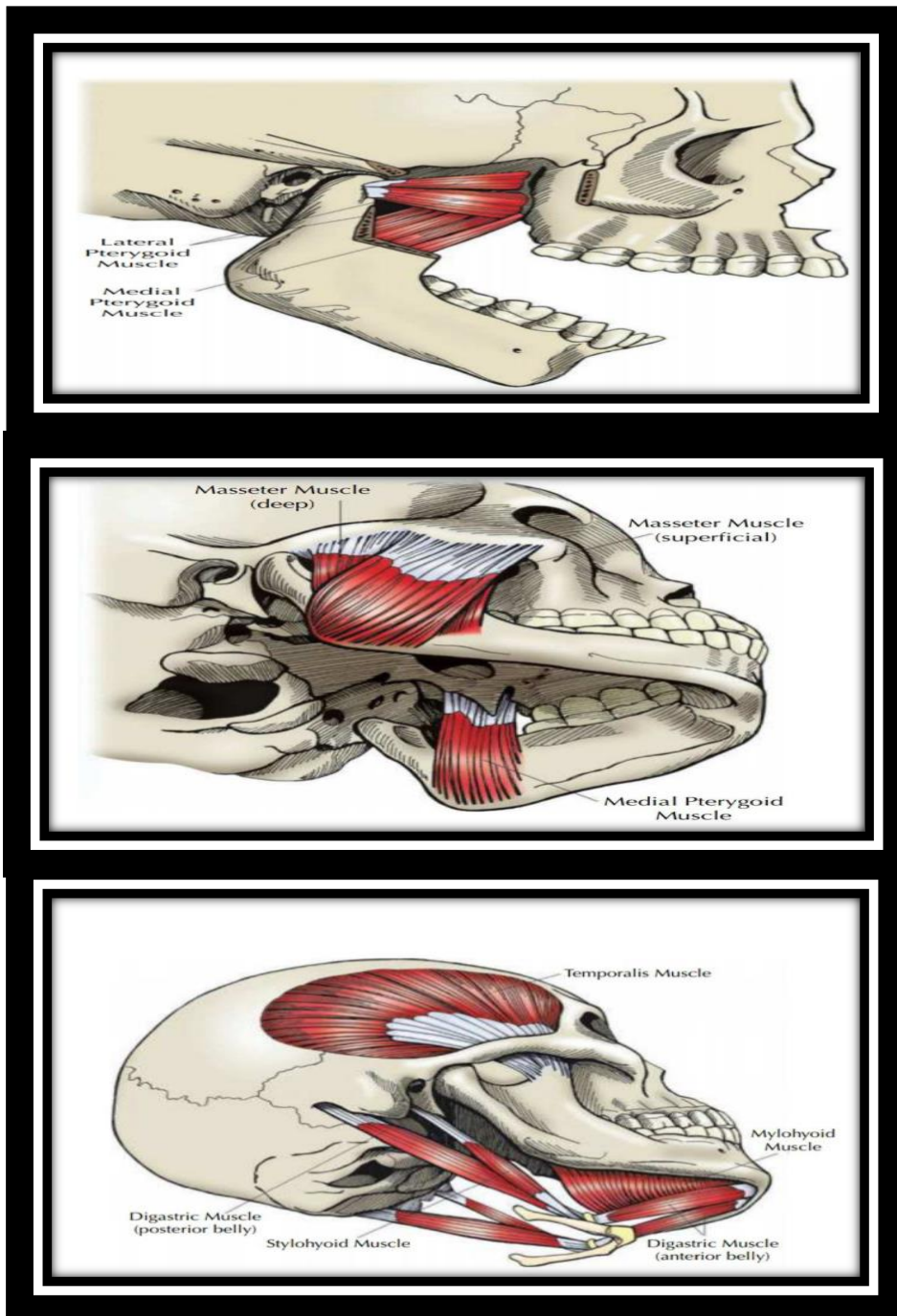


Figure5:Muscles of mastication,(Schmader et al.,2001).

4.Vascular Supply of Masticatory System Structures :

The external carotid artery (ECA) is the main blood supply for the structures of the masticatory system. The ECA leaves the neck and courses superiorly and posteriorly, embedded in the substance of the parotid gland, sending two important branches, the lingual and facial arteries, to the region. At the level of the mandibular condylar neck, the external carotid bifurcates into the superficial temporal artery and the internal maxillary artery. These two arteries supply the muscles of mastication and the TMJ. Arteries within the temporal bone and mandible also send branches to the capsule, **(Bordoni & Varacallo , 2020)**

5.The nerve supply to the TMJ :-

Is predominantly from branches of the auriculotemporal nerve with anterior contributions from the masseteric nerve and the posterior deep temporal nerve, (**Johansson & Isberg , 1990**)

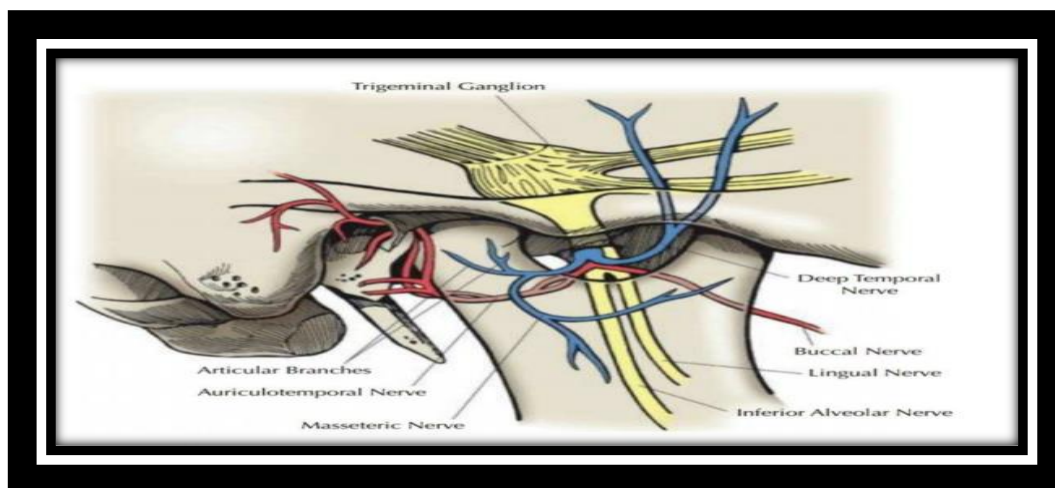


Figure6: Nerve supply of TMJ(Branches of the auriculotemporal nerve supply sensory innervation of the TMJ. This nerve arises from the mandibular division in the infratemporal fossa and sends branches to the capsule of the joint) (Ivers et al.,2012).

6.The movement of the TMJ:

Two types of movement are possible in TMJ: rotation and translation ,(Bender et al., 2018)

I.Rotational movement:

This is the initial movement of the jaw when the mouth opens. The upper joint compartment formed by the articular disc and the temporal bone is involved in this movement.

II. Transtional movement

Is the secondary gliding motion of the jaw as it is opened widely. The part of the mandible which mates to the under-surface of the disc is the condyle and the part of the temporal bone which mates to the upper surface of the disk is the articular fossa or glenoid fossa or mandibular fossa.

7.Etiological factors of the TMJ disorder

The causes of temporomandibular disorders are complex and multifactorial. There are numerous factors that can contribute to temporomandibular disorders .It can be divided in to :- **Predisposing factors** , **Initiating factors** and **Perpetuating factors**, (Bhat et al., 2010).

7.1.Predisposing factors:

Factors that increase the risk of temporomandibular disorders. Predisposing factors are pathophysiologic, psychological or structural processes that alter the masticatory system sufficiently to increase the risk of development of temporomandibular disorders .While the main occlusion problems that predispose to TMJ disorders are ,(Lipton et al.,2003) :-

*Open bite

*Overjet greater than 6-7 mm

*Retruded contact position/intercuspal position with sliding greater than 4 mm.

*Unilateral lingual cross-bite

*Five or more missing posterior teeth

*Faulty restorations and ill-fitting prosthesis.

7.2. Initiating factors :

Those causing the onset of temporomandibular disorders. Initiating factors lead to the onset of the symptoms and are related primarily to trauma or adverse loading of the masticatory system, (Zhi et al., 2009)

7.3. Perpetuating factors:

Factors that interfere with healing or enhance the progression of temporomandibular disorder. The following may be included as perpetuating factors, (Mehrotra et al., 2011) :-

* **Behavioral factors** (grinding, clenching and abnormal head posture)

* **Social factors** (could affect perception and influence the learned response to pain)

* **Emotional factors** (depression and anxiety)

* **Cognitive factors** (negative thoughts and attitudes which can make resolution of the illness more difficult).

8. Sign and symptoms of TMJ disorders:

Signs and symptoms of TMJ disorders may include:

*Pain or tenderness of the jaw

*Pain in one or both of the temporomandibular joints

*Aching pain in and around the ear

*Difficulty in chewing or pain while chewing

*Aching facial pain

*Locking of the joint, making it difficult to open or close the mouth.

TMJ disorders can also cause a clicking sound or grating sensation when the mouth opened or during chewing . But if there's no pain or limitation of movement associated with the jaw clicking, a treatment for TMJ disorder is not indicated,(**Wolpert et al.,2017**).

9. Clinical significance

9.1.The differentiation of pain

The differentiation of pain originating within the joint from that coming from extraarticular structures is essential to successful treatment. However ,the distinction cannot always be made from the history and both intra- and extraarticular structures may be involved simultaneously. The patient with stress-related MPDS(Myofacial Pain Dysfunction Syndrome) usually complains of constant, dull pain that may or may not be exacerbated by mastication or mandibular movement and relieved by jaw rest. Quite often, this pain is worse in the morning, if related to nighttime parafunctional clenching or bruxism. To be more clarify for example ,the patient with intraarticular TMJ pain due to arthritis has the pain relieved by jaw rest and may be pain free except when moving the mandible or masticating solid food. Unfortunately,intraarticular TMJ disease often involves the masticatory muscles secondarily so that both types of pain (intra- and extraarticular) are experienced simultaneously by the patient(**Bumann &Lotzmann ,2003**).

9.2.Joint noise.

During function is highly suggestive of intraarticular disease. Grinding or crepitus often indicates an arthritic or other degenerative process and is caused by contact of roughened bony surfaces during function. Clicking or popping in the joint is usually associated with displacement of the fibrocartilaginous disk

(meniscus) that separates the joint into upper and lower compartments. The following facts should be understood by the examiner of the TMJ (**Bhargava et al.,2021**).

*Jaw popping without accompanying pain is not typically a cause for concern.

* If certain health conditions underlie the popping, medical intervention may be needed.

* The cause of jaw popping is not completely understood. Jaw popping can often be treated at home, especially if there is no pain or other symptoms. However, anyone of any age or gender can experience jaw popping, which may be linked to behaviors such as:

* grinding the teeth

*chewing gum regularly or excessively

*nail-biting

* clenching the jaw

* biting the inside of the cheek or lip

Also, several medical conditions can lead to jaw popping, including arthritis which is a disease of the joints. Two of the most common forms of arthritis are rheumatoid arthritis and osteoarthritis, both of which can result in cartilage damage in the TMJ. As a result destruction of the TMJ cartilage tissue can make jaw movements difficult and can cause a popping sound and clicking sensation in the joint,(**Bumann & Lotzmann,2003; Demir et al.,2010**).

9.3.Limitation:-

Limitation of mandibular opening may be due to reflex spasm of masticatory muscles secondary to MPDS, other reasons are fibrous or bony ankylosis of the joint, fracture of the mandibular condyle,or total anterior displacement of the

joint meniscus that blocks normal forward movement of the mandibular condyle. In physical examination for temporomandibular disorders, measurement and recording of mandibular movements should be completed for opening, lateral and protrusive movements. The quality and symmetry of jaw movement should be noted and diagrammed. During the clinical examination of a study a significant differences in the amplitude of jaw opening between TMD patients and control subjects. While comparing active maximum mouth opening, and temporomandibular stiffness values of temporomandibular disorder patient subgroups and a control group. The temporomandibular disorder patient subgroups consisted of myogenous pain patients and arthrogeous pain patients with a "closed lock" and arthrogeous pain patients without a "closed lock." Both myogenous patients and the "closed lock" patients showed great differences for all parameters ,(Bumann & Lotzmann,2003; Terrin et al.,2020).

9.4.Hyper mobility:-

Hyper mobility can result in excessive anterior movement of the jaw and the articular disc. This will result in deviation of the jaw away from the affected side. There are usually some clicking sounds in the TMJ and there may or may not be a pain. Hyper mobility may be related to connective tissue disorders such as Marfan syndrome or conditions such as Down's syndrome and cerebral palsy. Long term hyper mobility can cause the articular disc to elongate and degenerate. The disc can then fail to reduce on closing, causing the TMJ to become stuck in an open position (Open Lock). This can often occur after opening the mouth to an extreme position, such as when singing or yawning or after a prolonged dental procedure, (Bumann, Lotzmann,2003;Bader et al.,2010).

10. Diagnosis Of TMD

10.1. History and clinical examination:-

There are different clinical protocols used to establish TMD diagnoses but the Research Diagnostic Criteria for TMD (RDC/TMD) most common used. The diagnosis of TMD is based largely on history and physical examination findings. The symptoms of TMD are often associated with jaw movement (e.g., opening and closing the mouth, chewing) and pain in the preauricular, masseter, or temple region. Another source of orofacial pain should be suspected if pain is not affected by jaw movement. Adventitious sounds of the jaw (e.g., clicking, popping, grating, crepitus) may occur with TMD. Other symptoms may include dizziness or neck, eye, arm, or back pain(**Gorenflo et al.,2020**)

Chronic TMD is defined by pain of more than three months' duration. Physical examination findings that support the diagnosis of TMD may include but are not limited to abnormal mandibular movement, decreased range of motion, tenderness of masticatory muscles, pain with dynamic loading, signs of bruxism, and neck or shoulder muscle tenderness. Clinicians should assess for malocclusion (e.g., acquired edentulism, hemifacial asymmetries, restorative occlusal rehabilitation), which can contribute to the manifestation of TMD. Cranial nerve abnormalities should not be attributed to TMD,(**Tayeb et al.,2017**).

A clicking, crepitus, or locking of the TMJ may accompany joint dysfunction. A single click during opening of the mouth may be associated with an anterior disk displacement. A second click during closure of the mouth results in recapture of the displaced disk; this condition is referred to as disk displacement with reduction. When disk displacement progresses and

the patient is unable to fully open the mouth (i.e., the disk is blocking translation of the condyle), this condition is referred to as closed lock. Crepitus is related to articular surface disruption, which often occurs in patients with osteoarthritis. Reproducible tenderness to palpation of the TMJ is suggestive of intra-articular derangement. Tenderness of the masseter, temporalis, and surrounding neck muscles may distinguish myalgia, myofascial trigger points, or referred pain syndrome. Deviation of the mandible toward the affected side during mouth Opening may indicate anterior articular disk displacement (Gauer & Semidey , 2015)

10.2. Imaging of TMJ:

Imaging can assist in the diagnosis of TMD when history and physical examination findings are equivocal. Although infrequently used, multiple imaging modalities are available to obtain additional information about suspected TMD etiologies. The initial test should be:-

10.2.1.plain radiography (transcranial and transmaxillary views) or panoramic radiography:-

Acute fractures, dislocations, and severe degenerative articular disease are often visible in these views. Panoramic Radiography (OPG) is used to detect if there is any gross osseous abnormalities . 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 radiographs is the problem of superimposition of adjacent structures(many different views such as the submentovertex, transmaxillary,

and the transcranial are used to reduce superimposition.) Limited value for diagnosis of specific conditions causing temporomandibular joint dysfunction because mild degenerative disease is seen equally in symptomatic and asymptomatic people. OPG is not recommended as a routine investigation in all patients who present with TMJ symptoms. Only patients with clinical evidence of significant TMJ disease or a lack of response to conservative type of treatment(**Bhargava ,2021**).

10.2.2.Computed tomography(CT)

Is superior to plain radiography for evaluation of subtle bony morphology. Computed tomography has been used to detect bony abnormalities of the TMJ and in rare conditions such as synovial osteochondromatosis. It has also previously been used for the diagnosis of internal disc derangement, arthritis and other miscellaneous conditions of the TMJ. The followings conditions could be detected by the CT(**Aiyer et al.,2020**) :-

A-Internal disc derangement.

B- Erosive arthritis.

C- Osseous erosions are frequently seen in association with disc displacement.

D- Idiopathic condylar resorption a more severe form of condylar erosion associated with high grade internal derangement is recognized

E- Ankylosis.

F- Osteoarthritis.

G- Condylar fractures.

H- Osteochondroma

10.2.3.Magnetic Resonance Imaging(MRI):-

Is the optimal modality for comprehensive joint evaluation in patients with signs and symptoms of TMD therapy has been ineffective, or in those with suspected internal joint derangement. The first step in MRI imaging of the TMJ is to evaluate the articular disk, or meniscus also morphologic features and location relative to the condyle in both closed and open-mouth positions. Abnormal disk morphologic features, disk displacement, joint effusion, osteoarthritis, as well as new indirect and also rupture of retrodiskal layers. Disk injuries ,the irregular and rounded morphologic features are universally considered to indicate disease in the TMJ, (**Bhargava ,2021**).

10.2.4.Ultrasonography:

Is a noninvasive, dynamic, low-cost technique to diagnose internal derangement of the TMJ when magnetic resonance imaging is not readily available. Common Indications are:-

- Pain in front of the ears
- Jaw clicking / locking
- Reduced / Painful mouth opening (**Bhargava ,2021**).

11.Joint disorders

A. Disc disorders

Internal Derangement OF The TMJ:

Wilkes Classification of Internal Derangements Disc- Condyle disorders can be staged based on the characteristics of the pain, amount of mouth opening, disc Location/condition, and altered joint anatomy, as observed from physical examination, MRI, and arthroscopy(**Gauer et al.,2015**).

I)Disc Displacement with Reduction:

A diagnosis of disc displacement with reduction is made when the patient presents with a history of a click or pop and it can be felt when the patient moves the mandible. As the patient opens the mouth, the condyle translates forward and moves on to an intermediate zone of the disc (reduced position) that may cause the opening click or pop. As the mouth continues to open, the condyle continues to translate forward with the disc and remains in the intermediate zone of the disc. As the patient closes the mouth, the condyle retrudes and moves back under the posterior band onto the retrodiscal tissue, which may again cause the closing click or pop. As the mouth continues to close, the condyle remains on the retrodiscal tissue. If both opening and closing click/pop is present, then the opening click/pop occurs at a wider opening than the closing click/pop. Rather, it should be heard by the patient at least once in the last 30 days and by the examining dentist during at least a third of the mandibular movements. Because the disc reduces during condylar translation, range of motion is not limited. However, movements may not be as smooth as a normal TMJ because of the momentary sliding of the condyle on and off of the disc (De Leeuw & Klasser,2018).

II)Disc Displacement with Reduction with Intermittent Locking

A diagnosis of disc displacement with reduction with intermittent locking is made when the patient has a disc displacement with reduction and reports that occasionally the TMJ structure that normally causes the click blocks the condyle's movement, inhibiting the mouth for obtaining its normal opening. This lock suddenly occurs, may last for seconds to days, and then suddenly releases. When the limited opening occurs, a maneuver may be needed to unlock

the TMJ. History is positive for any noises present with jaw movement or function in the last 30 days or during the examination itself and report of intermittent locking with limited opening in the last 30 days or evidence of intermittent locking during clinical examination(**Rinchuse & Kandasamy ,2010**).

III)Disc Displacement without Reduction with Limited Opening:

A diagnosis of disc displacement without reduction with limited opening (closed lock) is made when a patient has a suddenly occurring continuous marked limited opening (less than 40 mm). The patients themselves are usually aware that the TMJ structure that normally caused the click is now blocking them from obtaining their normal opening. They may also report of their TMJ catching at that location or intermittently having had this problem (lasting seconds to days), which suddenly released and allowed them to regain their normal opening. As the mouth opens, the condyle first rotates and then attempts to translate forward, but the condyle cannot slide under the disc's posterior band to reduce onto the intermediate zone of the disc. The translation is limited by the disc, and typically, the patient is initially able to open only between 20 and 30 mm(**Kalaykova et al., 2011**) .

IV)Disc Displacement without Reduction without Limited Opening:

A diagnosis of disc displacement without reduction without limited opening is made when the patient has a history of sudden-onset limited opening that gradually increased to 40 mm or greater. This suggests that the patient had a disc displacement without reduction with limited opening and over time, the retrodiscal tissue stretched and enabled the disc to move forward, thereby allowing the condyle to translate further and permitting the patient to open wider. History is the same as defined for disc displacement without reduction with limited opening, (**Kalaykova et al., 2011**).

V)Posterior Disc Displacement :

Posterior disc displacement has been described as the condyle slipping over the anterior rim of the disc during opening, with the disc being caught and brought backward in an abnormal relationship to the condyle when the mouth is closed. The disc is folded in the dorsal part of the joint space, preventing full mouth closure. The Clinical features are (**Blankestijn & Boering , 1985**).

- (1) a sudden inability to bring the upper and lower teeth together in maximal occlusion.
- (2) pain in the affected joint when trying to bring the teeth firmly together.
- (3) displacement anteriorly of the mandible on the affected side.
- (4) restricted lateral movement to the affected side.
- (5) no restriction of mouth opening.

B. Hypomobility disorders other than disc disorders:-

I)Adherence/Adhesions:

Adherence refers to a transient sticking of the articular surfaces. However, prolonged periods of adherence may result in true adhesions, wherein fibrous bands of connective tissue form between the articulating surfaces of the condyle or mandibular fossa, the disc, or surrounding tissues. Adhesions occur secondary to prolonged static loading of the TMJ's surfaces (for example, jaw-clenching during sleep). The patient presents with history of loss of jaw mobility and no history of TMJ clicking (historically to differentiate from disc displacement without reduction with limited opening)(**Okeson,2011**).

II -Ankylosis

Ankylosis is the firm restriction of the condyle due to fibrous bands or osseous union within the TMJ, most commonly resulting from trauma to the

mandible and/or TMJ. It is a Chronic, painless, limitation jaw motion. The involved condyle may not be able to translate and may have limited rotation, causing the patient to have a very limited opening, depending on the type and extent of the ankylosis. Ankylosis of the temporomandibular joint (TMJ) most often results from trauma or infection, but it may be congenital or a result of rheumatoid arthritis. When ankylosis leads to arrest of condylar growth, facial asymmetry is common. Intra-articular (true) ankylosis must be distinguished from extra-articular (false) ankylosis, which may be caused by enlargement of the coronoid process, depressed fracture of the zygomatic arch, or scarring resulting from surgery, irradiation, or infection.

In most cases of true ankylosis, x-rays of the joint show loss of normal bony architecture. A late and rare finding; in some cases, it affects both. In severe cases, there is a loss of mandibular condylar support with resultant retrognathia. Congenital temporomandibular joint ankylosis is a rare maxillofacial disorder characterized by significant reduction in mouth opening (i.e. from a few millimeters to a few centimeters) in the absence of acquired factors (e.g. trauma, infection) contributing to the ankylosis. It is associated with variable degrees of facial dysmorphism (i.e. lateral deviation of the mandible and chin, lower facial asymmetry, retrognathia, micrognathia, dental malocclusion) and patients typically present with feeding and breathing difficulties, also developmental delay, hypotonia, seizures, and additional dysmorphic feature. Clinical differential diagnosis of ankylosis should include pseudoankylosis of extra-articular pathology occurring in hypomobility of the joint due to coronoid hyperplasia (Jacob disease), fibrous adhesions between coronoid and tuberosity of maxilla or zygoma, depressed zygomatic arch fracture, dislocated zygomatic complex

fracture, temporalis muscle scarring, or myositis ossificans,(**Bumann & Lotzmann,2003; Zhi et al.,2009**).

Ankylosis may be fibrous or osseous.

***Fibrous Ankylosis:-**

Fibrous ankylosis results when fibrotic tissue forms between the articulating surfaces of the condyle or mandibular fossa, the disc, or surrounding tissues. There are no gross bony changes and no radiographic findings other than absence of ipsilateral condylar translation on opening. Patient findings include history of progressive loss of jaw mobility; positive findings for severe limited range of motion on opening, uncorrected jaw deviation to the affected side, marked limited laterotrusion to the contralateral side; and positive CT/CBCT imaging finding of decreased ipsilateral condylar translation on opening and a joint space between ipsilateral condyle and eminence.(**Okeson,2019**).

***Osseous Ankylosis:-**

Bone formation between the condyle and fossa usually results in osseous ankylosis, the patient has a more restricted opening than with fibrous ankylosis or even complete immobility of the joint. The characteristic findings include radiographic evidence of bone proliferation with marked deflection to the affected side and marked limited laterotrusion to the contralateral side. Patient findings include history of progressive loss of jaw mobility, positive examination findings such as absence of or severely limited jaw mobility with all movements and CT/CBCT being positive for imaging-based evidence of bone proliferation, with obliteration of part or all of the joint space (**Okeson,2019**).

C- Hypermobility disorders

I)Subluxation (Partial Dislocation):

This is a condition involving the disc-condyle complex and the articular eminence. A diagnosis of subluxation is made when in the opened mouth , the disc-condyle complex is positioned anterior to the articular eminence and is unable to return to normal closed-mouth position without a manipulative maneuver by the patient. Causes of subluxation include looseness of the joint capsule and ligaments, as in overextension injury, following dental procedures that require prolonged mouth opening or excessive yawning, extrinsic trauma (intubation, endoscopy), and connective tissue disorders (Ehlers-Danlos syndrome, Marfan syndrome). History is positive for jaw locking or catching in a wide-opening mouth position, even for a moment, so the patient could not close from the wide-open position in the last 30 days and for inability to close the mouth from wide opening without a self-maneuver. No examination findings are required(Okeson & Leeuw ,2011).

II)Luxation (Dislocation, Open Lock) :

This is a condition in which the disc-condyle complex is positioned anterior to the articular eminence and is unable to return to the fossa without a specific manipulative maneuver by a clinician. This is also referred to as open lock. Causes of luxation include post-traumatic capsular loosening, prolonged wide mouth opening, chronic subluxation, seizure disorders, Parkinsonism, drug-induced tardive dyskinesia (neuroleptics like phenothiazines), defects in the bony surface (shallow articular eminence), or a genetic predisposition (Ehlers-Danlos syndrome, Marfan syndrome). Patient reports of inability to close from wide opening and that mouth closing can be achieved only with a specific mandibular maneuver by the clinician. Examination is positive for wide opening mouth,

protruded jaw position, and lateral position to the contralateral side if unilateral,(Okeson & Leeuw ,2011).

12.Joint diseases

12.1.Degenerative joint disease

-Osteoarthrosis

-osteoarthritis

12.1.1. Osteoarthrosis:

Osteoarthrosis is a multifactorial disease associated with TMJ overloading. Though it is synonymous with osteoarthritis in medical orthopedic literature , in dental TMJ literature, it has been recently identified as a chronic low inflammatory degenerative progressive loss of articular cartilage in the TMJ resulting from an imbalance between predominantly chondrocyte-controlled reparative and degradative processes. Patient generally presents with no symptoms. The past history may reveal a period of time when symptoms were present (osteoarthritis) that can only be confirmed through radiographs. Crepitation is a common finding. In the absence of clinical symptoms like joint pain, treatment of this arthritides is contraindicated. The only treatment that may need to be considered is if the bony changes in the condyle have been significant enough to alter the occlusal condition and, in such cases, dental therapy may need to be considered(Okeson , 2008).

12.1.2.Osteoarthritis(Degenerative Joint Disease, DJD)

Degenerative joint disease (DJD), is primarily a disorder of articular cartilage and subchondral bone, with secondary minimal inflammation of the synovial membrane. It is a localized joint disease without systemic manifestations. The process begins in loaded articular cartilage that thins, clefts (fibrillation), and then fragments leading to sclerosis of underlying bone, subchondral cysts,

and osteophyte formation. The articular changes are essentially a response of the joint to chronic microtrauma or pressure. Microtrauma may be in the form of continuous abrasion of the articular surfaces as in natural wear associated with age or due to increased loading related to chronic parafunctional activity. The fibrous tissue covering in patients with degenerative disease is preserved. This may be a factor in remodeling and the recovery that is usually expected in osteoarthritis and osteoarthritis of the TMJs(**Morel et al.,2021**).

Osteoarthritis presentation:-

The patients who develop (OA) present with a variety of symptoms including pain on opening, limited movement to the opposite side, coarse grinding noise on function, history of clicking that has now stopped, and deviation on opening to the affected side. An unusually large percentage of those diagnosed are women around the age of 35. In addition patients have had a macrotrauma usually from a maximal voluntary contraction (MVC) force or even a blow to the mandible. The clinical findings are pain on palpation of lateral pole, decreased range of motion findings , heavy occlusion on second molar on the affected side, facial asymmetry, and tipped Curve of Wilson. Some other indicators include loss of condylar bone which traumatizes the posterior molar on the same side, pain referral pattern to the ear, pain on eating, talking, or function of the jaw joint, jaw locking, and pain in the front tooth of a bridge (due to torque forces on two molars). In summary, a picture of pain, dysfunction, and disability is involved in osteoarthritis of jaw joint. with flattened condyle, osteophytes on condyle(could be noticed by Xray findings,(**Bumann& Lotzmann,2003;Manfredini et al.,2011**).

12.2.Rheumatoid arthritis (RA)

Is a chronic, systemic, autoimmune inflammatory disorder that is characterized by joint inflammation, erosive properties and symmetric multiple joint

involvement. Temporomandibular joint (TMJ) is very rare to be affected in the early phase of the disease, thus posing diagnostic challenges for the dentist. Conventional radiographs fail to show the early lesions due to its limitations. More recently cone-beam computed tomography (CBCT) has been found to diagnose the early degenerative changes of TMJ and hence ,aid in the diagnosis of the lesions more accurately.

Some common clinical symptoms of Rheumatoid arthritis include TMJ sounds/noises, TMJ pain, facial pain, headaches, limited range of mandibular movement, change in occlusion, masticatory difficulty, earaches, tinnitus, vertigo, and neck, shoulder, and back pain. Some patients may have pathological internal derangement of the TMJ, however, are asymptomatic or have relatively innocuous clinical symptoms,(**Bumann & Lotzmann ,2003;List et al;2017**).

12.3.Infection arthritis:-

Infection arthritis of the temporomandibular joint (TMJ) may result from direct extension of adjacent infection or hematogenous spread of bloodborne organism. The area is inflamed, and jaw movement is limited and painful. Local signs of infection associated with evidence of a systemic disease or with an adjacent infection suggest the diagnosis. X-Ray results are negative in the early stages but may show bone destruction later. If suppurative arthritis is suspected, the joint is aspirated to confirm the diagnosis and to identify the causative organism(diagnosis must be made rapidly to prevent permanent joint damage). Treatment includes antibiotics, proper hydration, pain control, and motion restriction. Parenteral penicillin G is the drug of choice until a specific bacteriologic diagnosis can be made on the basis of culture and sensitivity testing. For methicillin-resistant Staphylococcus aureus (MRSA) infections of the oral structures, IV vancomycin is the antibiotic of choice. Suppurative infections are aspirated or incised. Once the infection is controlled, passive jaw-

opening exercises help prevent scarring and limitation of motion. The Most common symptoms include , difficulty in mouth opening due to pain, fibrous adhesions, anterior disc displacement, muscle contracture, inflammation, or more severe degeneration,(**Bumann & Lotzmann,2003;Gorenflo et al.,2020**).

12.4.Traumatic arthritis:

Rarely, acute injury (eg, due to difficult tooth extraction or endotracheal intubation) may lead to arthritis of the TMJ. Pain, tenderness, and limitation of motion occur. Diagnosis is based primarily on history. X-ray results are negative except when intra-articular edema or hemorrhage widens the joint space. Treatment includes NSAIDs, application of heat, a soft diet, and restriction of jaw movement (**Bumann & Lotzmann,2003;Okeson et al.,2011**).

12.5. Osteochondrosis Dissecans:

Osteochondritis dissecans is a disorder of unclear pathophysiology wherein fragments of articular cartilage and bone freely move within the Synovial fluid (“joint mice”). It usually occurs in the knee and elbow and is often related to sports. Reports have described this condition in the TMJ but little is known about the signs and symptoms. History is positive for arthralgia as previously defined and joint noises with mandibular movement or swelling. Examination is positive for similar clinical findings as operationalized for arthralgia, or crepitus detected by the examiner during palpation or reported by patient during mandibular movements or maximum assisted opening with vertical overlap ,(Aiyer et al.,2020).

13.Neoplasm:-

A neoplasm is new, often uncontrolled growth of abnormal tissue arising or involving the TMJ or supporting structures. Tumors of the TMJ are rare, can be malignant or benign, and present with symptoms similar to intra-articular

disorders. Occasionally metastatic tumors have also been reported. Presenting symptoms include reduced mouth opening which is progressive, joint pain, malocclusion, swelling in the TMJ region, skin reactions in the TMJ region, lymphadenopathy, and crepitus. If the condyle is involved, there is frequently development of a facial asymmetry with a midline shift as that noticed in condylar hyperplasia. Diagnostic imaging and biopsy are essential when a neoplasm is suspected. Treatment options include surgery, radiotherapy, and chemotherapy (Mehrotra et al., 2011).

14. Congenital/developmental disorders

14.1. Hyperplasia

Is the overdevelopment of the mandible or cranial bones that occurs unilaterally or bilaterally as a localized enlargement such as condylar hyperplasia or as an overdevelopment of the entire mandible or side of the face. Hyperplasia normally occurs during adolescence, leading to facial asymmetry, mandibular deviation, and a malocclusion . Facial asymmetry resulting from excessive condylar growth is of two types :

- Type I: Hemimandibular hyperplasia (HH).
- Type II: Hemimandibular elongation (HE).

To diagnose hyperplasia, the history must be positive for progressive development of mandibular or facial asymmetry, and the examination must confirm this history. Imaging using panoramic radiography and/or CT/CBCT and single-photon emission CT is positive for asymmetry in mandibular ramus height and there is an increased uptake of technetium-99 m hydroxy diphosphate on bone scintigraphy scan (nuclear imaging)(Mehrotra et al., 2011).

14.2. Hypoplasia :-

An incomplete development or underdevelopment of the cranial bones or the mandible occurs often secondary to trauma during adolescence. It may result in asymmetric growth of the mandible, and may be associated with malocclusion that includes open bite. History must be positive for progressive development of mandibular asymmetry or micrognathia from birth or early childhood and development of malocclusion, which may include posterior open bite. Examination must confirm this history. Imaging using CT/CBCT will show at least one of the following:

hypoplasia of the fossa, hypoplasia of the condyle, or shortened mandibular ramus height(Nakano et al.,2009).

14.3. Aplasia:-

A failure of the condyle to develop or incomplete development of the articular fossa and eminence is usually associated with congenital anomalies such as oculo-auriculo-vertebral spectrum (Goldenhar syndrome), hemifacial microsomia, and mandibulofacial dysostosis (Treacher Collins syndrome). Such aplasia is unilateral, causing facial asymmetries, and might cause a malocclusion. In rare occasions, it may be bilateral, without facial asymmetry, but with a definitive micrognathia and open bite. History must be positive for progressive development of mandibular asymmetry or micrognathia from birth or early childhood and development of malocclusion, which may include posterior open bite. Examination reveals mandibular asymmetry, with deviation of the chin to the affected side or micrognathia and inability to detect the condyle upon palpation during mandibular movements. Imaging will show severe hypoplasia of the fossa and eminence and aplasia of the condyle ,(Nakano et al., 2009).

15. Masticatory Muscle Disorders:-

15.1. Trismus :-

Also called locked jaw, is reduced opening of the jaws (limited jaw range of motion). It may be caused by spasm of the muscles of mastication or a variety of other causes. Usually temporary trismus occurs much more frequently than permanent trismus. It is known to interfere with eating, speaking, and maintaining proper oral hygiene. This interference, specifically with the patient's ability to swallow properly, results in an increased risk of aspiration. In some instances, trismus presents with altered facial appearance. The condition may be distressing and painful for the patient. Examination and treatments requiring access to the oral cavity can be limited, or in some cases impossible, due to the nature of the condition itself, (**Bumann & Lotzmann, 2003; Gröbner et al., 2018**).

15.2. Myalgia :-

Myofascial pain or myalgia is the most common muscle disorder characterized by pain and dysfunction that arises from pathologic and functional processes in the masticatory muscles. It is diagnosed when the patient's muscle pain is aggravated by mandibular movement, function, or parafunction and can be reproduced by palpating the painful muscles such as temporalis or masseter. Types: Myalgias can be acute or chronic and are of three subtypes, (**Fricton et al., 2010**):-

- Local myalgia.
- Myofascial pain with spreading.
- Myofascial pain with referral.

15.3. Tendonitis

Tendonitis involves pain of tendon origin aggravated by mandibular movement, function, or parafunction, and it can be reproduced by provocation testing of the painful tendon. Limitation of mandibular movements secondary to pain may be present. The only masticatory muscle tendon that can be palpated separately from the muscle is the temporalis muscle tendon, which can be palpated intraorally. Also, the temporalis tendon is a common site of tendonitis with referred pain to the teeth or other structures, (Nakano et al., 2009; Fricton et al., 1985).

15.4. Spasm

Spasm refers to the sudden, involuntary, reversible tonic contraction of a muscle that is diagnosed when the muscle meets the criteria for myalgia, it causes a limited range of motion. The pain and limited range of motion had an immediate onset. Acute malocclusion may be present. Certain local muscle conditions known to predispose to muscle spasm include muscle fatigue, alteration in local electrolyte balance, and deep pain. The patient usually complains of inability to put the ipsilateral posterior teeth together without excruciating pain (the first tooth contact is in the area of the contralateral canine) and a difficulty in translating the condyle forward leading to a marked limited opening. To diagnose a spasm, the patient must report immediate onset of muscle pain modified by function and parafunction as operationalized in myalgia and immediate report of limited range of jaw motion, (Fricton et al., 2010).

15.5. Myositis

Myositis is diagnosed when the muscle meets the criteria for myalgia and has clinical characteristics of inflammation or infection: edema, erythema, and/or increased temperature. Onset of symptoms is usually acute, related to direct

trauma to the muscle or infection of the muscle from orodental causes such as pericoronitis or cellulitis, or it can occur chronically from an autoimmune disease. To diagnose myositis, the patient must have local myalgia, and the examination of the temporalis or masseter muscle must confirm both of the following:

- Local myalgia.
- Presence of edema, erythema, and/or increased temperature over the muscle,(Fricton et al.,2010).

15.6. Myofascial Pain with Referral:

Myofascial pain with referral is diagnosed when the disorder meets the criteria for myalgia and the referral of pain beyond the boundary of the masticatory muscles being palpated. To diagnose myofascial pain with referral, the patient must have myalgia, and the examination of the temporalis or masseter muscle must confirm both of the following:

- Familiar muscle pain with palpation.
- Pain with muscle palpation beyond the boundary of the muscle.

Other masticatory muscles may be examined as required. Though it is not significant to differentiate between local myalgia and myofascial pain with spreading, when a patient's pain is due to referred pain from a muscle, it should be diagnosed as myofascial pain with referral (Fricton et al.,2010).

16. Management of the TMD

16.1. Nonpharmacologic Management:

Patient education is the recommended initial treatment for TMD. Adjunctive measures include jaw rest, soft diet, moist warm compresses and passive stretching exercise . On the other hand TMJ immobilization has shown no benefit and may worsen symptoms as a result of muscle contractures, muscle

fatigue, and reduced synovial fluid production. Patients should be counseled on behavior modifications such as stress reduction, elimination of parafunctional habits (e.g., teeth Grinding, pencil or ice chewing, teeth clenching), and avoidance of extreme mandibular movement (e.g., excessive opening during yawning, tooth brushing, and flossing), (Bordoni et al., 2019).

16.1.1. Physical Therapy:-

There is evidence that supports the use of physical therapy for improving symptoms associated with TMD. Techniques may be Active or passive (e.g., scissor opening with fingers, use of medical devices) with the goal of improving muscle strength, coordination, relaxation, and range of motion. Specialized physical therapy options such as ultrasound, , electrotherapy, or low-level laser therapy have been used in the management of TMD (Bender et al., 2018)

16.1.2. Acupuncture

Acupuncture is a commonly used strategy for pain relief in which an acupuncture needle or, more often acupuncture needles are inserted around the ear, face and jaw, and the trigger points are the masseter, the lateral pterygoid, the medial pterygoid, and the temporalis muscles. Acupuncture can help with muscle relaxation and reduce muscle spasms of the TMJ (Lee & Ernst, 2011).

16.2. Pharmacological Management

Pharmacologic treatments for TMD are largely based on expert opinion. Several classes of medication are used to treat the underlying pain associated with TMD. Nonsteroidal anti-inflammatory drugs (NSAIDs; including salicylates and Cyclooxygenase inhibitors), benzodiazepines, anti-epileptic agents, and muscle relaxant. Despite the multiple choices of NSAIDs available, only naproxen (Naprosyn) has proven benefit in reduction of pain ,also muscle relaxants can be prescribed with NSAIDs if there is evidence of a muscular component to TMD.

Tricyclic antidepressants—most commonly amitriptyline, desipramine (Norpramin), doxepin, and nortriptyline (Pamelor)—are used for the management of chronic TMD pain. Benzodiazepines are also used, but are generally limited to two to four weeks in the initial phase of treatment, diazepam [Valium], Clonazepam [Klonopin], gabapentin [Neurontin] may provide more benefit than Shorteracting agents. Opioids are not recommended and, if prescribed, should be used for a short period in the setting of severe pain(Kalaykova et al.,2011;Michael et al.,2021).

16.3. Dental occlusal splinting and permanent occlusal adjustment

Occlusal splint has been the mainstays of TMJ disorder treatment. It can be defined as “the art and science of establishing neuromuscular harmony in the masticatory system by creating a mechanical disadvantage for parafunctional forces with removable Appliances.” . Other goals of treatment are to improve jaw-muscle function and to relieve associated pain by creating a stable balanced occlusion. Two main types of splinting are available occluding and non-occluding Occluding splints, also called stabilization splints are specially fabricated to improve the alignment of the upper and lower teeth. Non-Occluding splints ,also called simple splints ,primarily open the jaw to release muscle tension ,and prevent the teeth clenching, usually made of a soft –vinyl and are easier and cheaper to fabricate(Bender et al.,2018;Michael et al.,2021).

16.4. Surgical intervention

Surgical intervention is appropriate only when: (Michael et al.,2021).

- 1) There is identifiable pathology amenable to surgical intervention.
- 2) There is resultant loss of mechanical function
- 3) There is pain related to joint pathology.

Conclusion

TMD are common, more prevalent in women, and are conditions that dental professionals are likely to encounter in everyday clinical practice. TMD can be caused or exacerbated by physical changes, stress and parafunctional jaw habits. TMD includes a constellation of symptoms, of which pain is the most common. Other symptoms include joint sounds, limited jaw opening and deviation on opening. A brief screening history regarding pain and activities that make the pain worse can help determine if a patient has a potential TMD problem. A clinical examination that incorporates an assessment of pain and joint sounds on opening and excursive movements is recommended. The examination should also include palpations of the muscles of mastication and the TMJ, and findings from the clinical examination are used to determine the diagnoses. Dental professionals recommended that conservative and reversible self-management treatment strategies are beneficial for most patients, with very few patients requiring non-reversible surgical treatment.

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