BOOK CHAPTER

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Changes in The Temporomandibular Joint after Occlusal Deprogramming

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Abstract: Common signs and symptoms of TMD include masticatory muscle pain, TMJ sounds, limited mouth opening, and deviations in mandibular movements. Treatment generally involves some combination of occlusal splints, physiotherapy, relaxation therapy, pharmacological intervention, arthroscopic surgery, education, and behavioural counselling. One randomized controlled trial indicated that an occlusal deprogramming splint is more effective than other methods in treating TMD, although another study produced contradictory results. Measurements of the radiographic joint space a radiolucent area between the mandibular condyle and the temporal bone were introduced by Ricketts to describe condylar position. The clinical significance of condyle-fossa relationships in the TMJ is controversial, but several studies have suggested an association between eccentric condylar position and TMD. This chapter describes key changes in the condyle-fossa relationship after the use of an occlusal deprogramming splint in patients with TMD.

Keywords: Occlusal deprogramming, CBCT, Temporomandibular disorders, Splint therapy, Centric relation.

Introduction

The masticatory system is extremely complex. It is primarily made up of bones, muscles, ligaments and teeth. Movement is regulated by an intricate neurologic controlling mechanism. Each movement is coordinated to maximize function while minimizing damage to any structure. Precise movement of the mandible by the musculature is required to move the teeth efficiently across each other during function. The mechanics and physiology of this movement are basic to the study of masticatory function. The masticatory system is the functional unit of the body primarily responsible for chewing, speaking and swallowing [1]. Components also play a major role in tasting and breathing.

Anatomy of TMJ

The temporomandibular articulation is closely associated with the functioning of the teeth. It receives its name from the two bones that enter into its formation, namely the temporal bone and the mandible. It allows wide rage of motion to the mandible. Entering

into its construction are bone, ligaments, cartilage and synovial membrane [2].

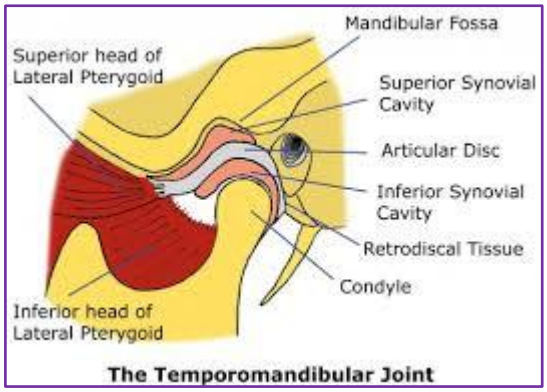

Figure 1. Anatomy of TMJ

The TMJ is an example of diathrosis and its movements are combination of gliding movements and a loose hinge movement. The osseous portions of the joint are anterior portion of the mandible (Glenoid) fossa and articular eminence of temporal bone and condylar process of mandible. The functional substances of both the condyle and eminence are covered by a layer of fibrous tissue. The posterior slope of the eminence and anterior aspect of condyle are the functional articular surfaces not the mandibular fossa. Interspaced between the condyle and temporal bone is articular disc or meniscus. It consists of dense collagen connective tissue which, in the central area is relatively avascular, hyalinised and devoid of nerves.

The Glenoid Fossa

The glenoid fossa is an oval or oblong depression in the temporal bone just anterior to the auditory canal. It is bounded anteriorly by articular eminence, externally by middle root of zygoma and auditory process and posteriorly by tympanic plate of petrous portion of this bone. The shape of the glenoid fossa conforms to some extent to posterior and superior surfaces of the condyloid process of the mandible.

The Condyloid Process

The condyloid process of the mandible is convex on all bearing surfaces although somewhat flattened posteriorly and its knob like from is wide latero- medially than anterioposteriorly. It is perhaps two and one half times as wide in one direction as in the other. The long axis of the condyles are in a lateral plane and at first sight they seems to be out of alignment. Since the long axis, if the lines were prolonged, would meet at a point anterior to the foramen magnum at an angle approximately 135^0. The condyle is perpendicular to the ascending ramus of the mandible.

Ligaments

The TMJ is maintained by ligament and by the powerful muscles of mastication. The ligamentous attachments are capsular ligament, spheno-mandibular ligament, stylo-mandibular and accessory fibres of the stylo-mandibular ligament, a stylo-hyoid ligament.

Capsular Ligament

The capsular ligament is a synovial capsule that completely surrounds the condyle. It has fibres divided into four portions: anterior and posterior and internal and external. The anterior portion is attached below to the anterior margin of the condyle and above to the front of the glenoid ridge. The posterior portion is attached above just in front of the glenoid fissure and is inserted into the posterior margin of the ramus of the mandible just below the neck of the condyle.

The internal portion of the capsular ligament is composed of well defined fibres and has a broad attachment above to the inner edge of the glenoid fossa and is inserted below into the inner sides of the neck of the condyle.

Temporomandibular ligament

Which is the external portion of the capsular ligament and continuous with it, is the strongest portion of the capsular ligament. It has a broad attachment above the zygomatic process of temporal bone, the anterior fibres attaching forward well beyond the articular eminence, these fibres, slanting downward and backward converge with more vertical fibres and are inserted into the outer side and posterior margin of the neck of the condyle. The TM ligament acts as the main suspensory ligament of the mandible during moderate opening movement → "hinge movement", when the forward movement of the condyle is very slight with wider opening of the jaw, the condyles move forward rapidly, relaxing external lateral ligament as sphenomandibular ligament becomes taut [3].

Sphenomandibular ligament

It has its attachment above the sphenoid bone and below to the mandible. Its main origin from spinous process of sphenoid bone with lateral fibres from the temporal bone in the immediate vicinity, the ligament passes down and forward and inserted into the lingula of the mandible with some fibres attached below the mandibular foramen and some posterior to it.

Stylomandibular ligament

Extends from styloid process downward and forward inserted into posterior border or ramus of mandible just above the angle. It acts as checking on the mandible and helps to prevent excessive anterior drift at the angle during more extreme opening movements.

The inter articular fibro cartilage or meniscus is a tough, fibrous disc placed between condyle and its temporal bearing areas, the glenoid fossa and the articular eminence of zygomatic process, adapting itself exactly to the bony surfaces, making up for any discrepancy in these two surfaces and promoting smooth articulation and movements. It is attached at its periphery to the capsule and a section of their tissues shows a superior joint compartment above the meniscus and an inferior joint compartment below. These are synovial cavities lined with synovial membrane and lubricated by synovial fluid. The upper compartment is larger. Being attached to the capsules the upper part of disc allows – gliding movement. The attachment of lower part is considered to provide hinge movement of the condyle. The disc has concavo convex superior surface and concave inferior surface.

The mechanical properties of the disc are related to the structure and properties of the intercellular substances which are present including collagen and proteoglycans. The proteoglycan is a molecule that tend to expand in solution and to resist compression into a smaller volume of solution. Important are the hydrophilic extracellular matrix thus proteogylcans influence the mechanical and lubricating properties of the disc [4].

Blood supply – Superficial temporal and maxillary artery.

Nerve supply → Auriculo-temporal and massetric nerves.

Masticatory muscles

Masticatory functions, as well as speaking and swallowing involves reflex contraction and relaxation of the muscles of mastication whose activity is initiated voluntarily. Patterns of muscle contraction are complex and even in the same muscle different areas may have different function. The masticatory muscles concerned with mandibular movements include the lateral pterygoid, digastric, masseter, Medial pterygoid and temporalis muscle. Also the mylohyoid and geniohyoid muscles are

involved in masticatory functions. They develop from mesoderm of 1st branchial arch and supplied by mandibular nerve.

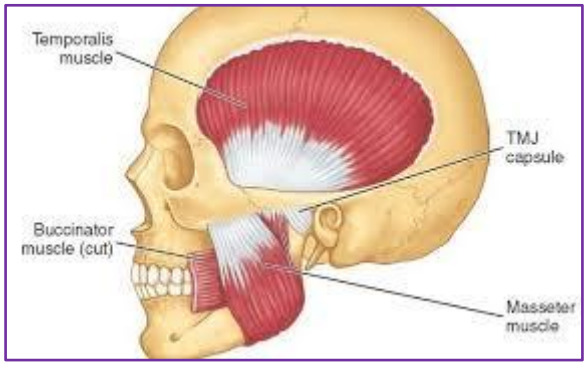

Figure 2. Masticatory Muscles

Optimum Functional Occlusion [5]

The stable occlusal condition should allow for effective functioning while minimizing damage to any component of masticatory system. The following conditions appear to be least pathogenic for the greatest number of patients over the longest time.

1) When the mouth closes – the condyles are in their most superio-anterior (Musculo skeletally stable) position. Resting on the posterior slopes of articular eminence with disc properly interposed in this position there is even and simultaneous contact of all posterior teeth. The anterior teeth also contact but more lightly than posterior teeth.
2) All tooth contacts provide axial loading in occlusal forces.
3) When the mandible moves into latero-trusive position, there are adequate tooth guided contacts on the latero-trusive side to disocclude the medio-trusive (non working) side immediately. The most desirable guidance is provided by canines (canine guidance)
4) When mandible moves into protrusive portion, there are adequate tooth guided contact on the anterior teeth to disocclude all posterior teeth immediately.
5) In the alert feeding position, posterior tooth contact are heavier than anterior tooth contacts.

Etiology of TMD[6]

The causes of TMD is complex and multifunctional and it is difficult to pin point exact cause. Factors that increase the risk of TMD are predisposing factors. Factors that cause the onset of TMD are initiating factors and the factors that interfere with healing or enhance the progression of TMD are perpetuating factors.

Costen in (1934) gave his name to the symptoms related to TMJ dysfunctions as **costen syndrome.** Later over the years, it has been given different names, TMJ dysfunctions syndrome, MPDS, Occlusomandibular disorder, craniomandibular disorder etc.,

Bell suggested the term Temporomandibular disorder (TMD) which is commonly used and also adapted by ADA.

Theories:

1) **Mechanical displacement theory** → condylar displacement after loss of molars and premolar caused (by TMD) by impingement on auriculo- temporal nerve and related structures.
2) **Neruomuscular theory**: Functional disharmony between dental occlusion and TMJ is considered by many clinician as most chosen factor.

   Geering, Carlson et al, Ranigford, Olson choistenson supported this theory.
3) **Psychophysiologic theory:** The primary factors for the pain dysfunction symptoms is the spasm of

the masticatory muscles (Franks, Laskin)

4) **Muscle theory:** The imbalance between lack of adequate muscle exercise and overstimulation contribute to TMD (Krans, Swanson, Bell).

5) **Psychological theory:** Claims that emotional, behavioral and personality characteristics are causative factors (Moulton McCall et al, Lefer, Luptor, DOMs et al).

Predisposing factors for Etiology of TMD [7]

A Anatomic conditions:

1) Mainly developmental abnormalities of jaws.

2) Morphologic malocclusions.

Certain skeletal and Dental malocclusion may cause TMD, Potential causes leading to TMD are

Vertical discrepancies

Lack of posterior tooth support

Molar or bicuspid fulcrum.

Horizontal discrepancies

Anterior slides or anterior posturing

Distal displacement.

Lateral Discrepancies

Functional side shift

True vertical asymmetry.

Classically individual with Angles class –II div 2 malocclusion have been considered to be vulnerable to TMD.

3) Functional malocclusion and occlusal disharmonies.

4) Misalignment of mandible.

A popular concept is that an unstable occlusion resulting from either premature tooth contact loss para-functional habits causes mal alignment of the mandible. Usually posterior displacement of the mandible results in compression of soft tissue of the joint. Undue stress is placed on muscles, ligaments, bone. Pain, impairment of blood supply and degeneration of joint follow. However this hypothesis is not universally accepted.

Signs and symptoms of TMD

The clinical signs and symptoms of TMD can be grouped into categories according to structures that are affected, the most common breakdown in masticatory system.

1) Muscles

2) TMJs

3) Dentition.

A sign is an objective clinical finding that the clinician uncovers during clinical examination. A symptom is a description or complain reported by the patient.

I Functional disorder of muscles [8]

Functional disorder of masticatory muscles are probably the most common TMD complaint of patient seeking treatment in dental office.

2 major symptoms

1) pain. 2) Dysfunctions.

Pain

Most common complaint is muscle pain, range from slight tenderness to extreme discomfort. MYALGAI → can arise from increased levels of muscular use. Some authors suggest that it is related to vasoconstriction of relevant nutrient arteries and the

accumulation of metabolic waste products in muscle tissue → within ischemic area of muscle certain algogenic substances (eg. Bradykinin and prostaglandins) are released → causing muscle pain.

Another very common symptom → Headache.

Dysfunctions:

Is a common clinical symptom associated with masticatory muscle disorders usually it is seen as a decrease in the range of mandibular movement, when the muscle tissue has been compromised by over use . Any contractions or stretching increases the pain, therefore to maintain comfort the patient restricts the movement within a range that does not increase pain levels.

II Functional disorder of TMJs

Pain in any joint structure → Arthalagia. In healthy joint however since there is no innervation of articular surface. Arthanlgia therefore can originate only from nociceptors located in soft tissues surrounding a joint.

3 Peri-articular tissues contain such receptors: they are

1) Distal ligaments
2) Capsular ligaments and
3) Retrodiscal tissues

When these ligament are elongated or retrodiscal tissues compressed, the receptors send out signals and pain in perceived.

Dysfunctions- It presents as a disruption of normal condyle disc movement with production of joint sounds.

The joint sounds may be a single event of short duration → click

if this is loud → referred as POP

Crepitation is a multiple, rough, grave like sound described as grating and complicated.

Dysfunction may also present as catching sensation when the partient opens his / her mouth.

Sometimes jaw can actually lock

Dysfuntion of TMJ is always directly related to jaw movement.

III Functional disorder of Dentition [9]

These are normally associated with breakdown created by heavy occlusal forces to teeth and their supportive structures.

1) Mobility	→ loss of bony support → Periodontal diseases
	→ Unusually heavy occlusal forces.
2) Tooth wear	→ Wear facet parafunctional activity. Ecentric tooth contact.
	→ Bruxism.

Cardinal signs and symptoms of TMJ disorders

1) Pain → in the TMJ, muscle of masticator and adjacent soft tissues.
2) Joint sounds → like CREPITUS, CLICKING
3) Tenderness
4) Limitation of functions

Other signs and symptoms which may be present:

- Headache
- Neckache
- Dizziness
- Visual disturbance

- Paresthesis
- Sinus complaints
- Gastrointestinal complaints.
- Stuffiness in ear.

Pain:

Most important symptom, may be dull intermittent or continuous. It most often expresses itself in the form of chronic, recurrent headache or myofacial pain in auriculo temporal area. It can radiate to the side of head and neck to the gonial regions, suboccipital region, submandibular regions and so on. It may unilateral or bilateral depending upon involvement of one or both joints.

Lateral pterygoid always is tender some other muscle may also show tenderness especially the trapezius and sternocleidomastoid muscle.

Clicking one of the most widely observed clinically significant finding of TMJ examination. Audibly the click is nearly always reciprocal, that is the joint pops or clicks at a given point in the arc of opening and conversely clicks again at about the same point in the arc of closure usually less audible.

The presence of reciprocal click is a sign that the full opening range of movement is still present. Under normal circumstances the mesiosuperior portion of condyle rests singly against concavity of inferior surface of the disc. The disc in turn is positioned against the shape of eminence.

In patient with TMD, the starting point of mandibular arc of opening is more posterior and superior. In this position the condyle does not rest in the center of concavity of the disc but is resting against the bilaminar zone up past the thickened heel of disc superiorly and posteriorly. When head rests in such a manner it is said to be riding off the disc.

The mandibular arc of opening involves essentially 2 types of movements of head or condyle → Rotation and translation. In a patient where condyle is riding off the disc as the condyle begins to rotate at the beginning of the opening movement no sounds are heard as condyle is merely rotating against the posterior ligaments. Then as the condyle translate, the condyle moves forward but the disc remains stationary due to increased tension from surrounding ligaments and the posterior attachments. As the condylar head advances, it slides over the thickened bulbous head of the disc and snaps into the concave depression in the center of the disc, then producing the distinctly audible click. From then on the condylar head translates normally down the slope of the eminence of the glenoid fossa to its maximum opening. Upon closing the reverse takes place, the condyle and disc travel up the slope of the eminence to approximately the same point in the path where the opening click occurred, at which time the disc stops its ascent but the condyle keeps going superiorly and posteriorly. As the condyle head passes over the heel of the disc it makes another usually less audible click and rests in its final position riding off the disc.

Sometimes only a single opening click is observed with no reciprocal clicking observed. This single opening click phenomenon usually occurs due to the thinner or distorted shape of the heel of the disc. Some patients have classic TMJ signs and symptoms except that there is a noticeable absence of joint sounds of any type during functions. This may result from various types of circumstances. First due to “DBC ironing”. Under certain conditions the disc may have suffered functional abuse from the condylar head for so long that its posterior band has been worn flat or otherwise distorted such that there is not enough of a bump at the back edge to generate a sound as the condylar head passes back and forth over it during opening closing cycle. There is simply not enough change in contour between the

back edge of the disc and its center to cause an audible click.

One important finding always accompanies such circumstances of disc, ironing, there is always a full range of opening.

Another TMD in which there is no joint sound is when the posterior ligament of disc and other ligament are so abused and elongated that the condyle merely pushes the disc ahead of it during the opening movement and never regains the disc. The disc constantly moves down and forward ahead of the condyle and "jams up" as mass of disc and connective tissue at the base of the eminence in the anterior recess of the capsule of the joint.

This not only prevents the condyle from regaining the disc but also prevents the condyle from traveling any further along the articular pathways thus limiting the range of mandibular translation → this condition is also referred as "Balled up disc" mandibular opening in such a condition is grossly restricted this condition is referred to "CLINICAL CLOSED LOCK" type of situations.

Crepitus or crepitations [10]

Is the tragic and natural conclusion of joint – abuse taken to extremes. It is the sound of denuded bone on bone. The noise of crepitus results from contact of head of the condyle with either the roof of glenoid fossa or slope of articular eminence, when the intervening shock absorbing and lubricating articular disc cartilage has been obscured and perforated. Chronic mechanical irritation, trauma to the sensitive posterior ligament, the bilaminar zone leads to chronic inflammation. This lead to osteoarthritic breakdown and remodeling of the bony surfaces, which may result in rough surfaces or osteophytic irregularities. This crepitus is a sign of long standing and an advanced level of intra articular degeneration.

Pathophysiologic conditions:

Specific soft tissue alterations have been identified as being related to occlusal and mandibular position. An additional consideration is that these alterations are progressive disorders of the disc-condyle complex and can be provoked by changes in the condylar position during treatment.

Movement disturbances

Clicking → Painful locking → locking

Crepitus and stiffness

Discomfort

Fatigue headache → painful function

→ painful restriction

Complicated (Chronic pain)

Emotional changes

Behavioral changes

The sequence of temporo-mandibular symptoms for the major categories of movement disturbances and discomfort. These symptoms form a progressive continuous toward severe masticatory pain and dysfunction that, if prolonged may result in intractable disorders and adverse psychological changes.

Changes in joint form and structure occur before radiographic indications of organic disease appear. Early changes likely to produce clinical symptoms are

1) Shape change due to remodeling
2) Laxity of disc and capsular ligament of TMJ
3) Benign anterior displacement of articular disc and other changes in relationship of the disc and condyle that promote mechanical dysfunctions.
4) Abnormal condyle position, usually retropositioned.

I Shape change [11]

Although TMJ ceases to grow when individual is about 20 years of age, the soft and hard tissue of joint continues to be remodeled. When pronounced, these shape changes interfere with the functions of the disc condyle complex and can initiate an adaptive thinning of articular disc that may become pathologic.

Changes in loading from occlusion disorder / alterations could initiate or hasten progressive remodeling, if remodeling becomes advanced, localized TMJ changes may interfere with total mechanics of the joint. Early clinical symptoms are pain and clicking which with time progress to grating and arthrolytic lesions.

Joint Laxity

Tendency towards hypermobility, an elongation of ligaments that impairs the functional capacities of the joints. The clinical consequences of this impairment include clicking, joint in-coordination, hypermobility and tissue impingement with resultant pain.

Internal derangement of TMJ [12]

Internal derangement is an orthopedic term encompassing a variety of disorders that have one thing in common.

They cause mechanical disturbances and interfere with smooth joint function. This condition includes anterior displacement of articular disc and abnormal condyle position in addition to problems due to remodeling and joint laxity. These derangement also cause irritation to sensory innervation of joint, resulting in painful limitation, inflammation, capsular pain and reflex muscular splinting and tension that cause secondary muscular symptoms.

Characteristic clinical picture that can be progressive and debilitating. The initial symptom is clicking and popping, which is seldom troublesome. Clicking may progress to painful displacement of the articular disc with arrest of condylar motion along the functional path, a condition known as locking because it involves jaw limitation at mid opening.

The mechanism of internal derangement involves anteromedial displacement of articular disc at the point of final occlusion of teeth, a situation that is of great importance to orthodontic treatment planning. With excessive muscle tension from overuse, trauma or bruxism, compression of retrodiscal tissue can occur, producing pain often during the power strokes of chewing.

Figure 3. Internal Derangement of disk

Abnormal condyle position

TMJ derangement (clicking and locking) have significantly more condylar retropositioning. Abnormal forward position of condyle has been associated with class II malocclusion and dual bite. True condylar distractions and mandibular fulcrum of condyles → have been associated with open bite. Superior condylar positioning is classic radiographic sign associated with TMJ atheist or acute trauma to articular disc.

Classification of temporomandibular disorders

According to BELL E WELDEN

I Masticatory muscle disorders

These are classified according to clinical symptoms displayed

A. Protective muscle splinting Characterized by functional myalgia without structural restraint or acute malocclusion.

B. Masticatory Myospasm Functional myalgia and muscular dysfunctions due to sustained isotonic and isometric contractions.

   a. Elevator muscle spasm – restricted opening and pain with opening and chewing.

   b. Lateral pterygoid muscle spasm – acute malocclusion and pain with clenching of teeth in maximum intercuspation.

   c. Masticatory myositis Dysfunction due to immobility of muscle, soreness at rest and accentuated myalgia with every use.

II Disc – Interference Disorders [12]

Abnormal sensations, noises and movements, arthralagic pain and arrested movement (locking) are frequent secondary symptoms. Classified according to when clinical symptoms occur relative to the translatory circle from maximum intercuspation to spontaneous anterior dislocation.

(a) **Class I:** Interference disorder

Symptoms occur during the act of clenching the teeth in the maximum intercuspation.

(b) **Class II** Interference disorder

Symptoms occur during first opening movement after maximum intercuspation or after a period of inactivity. Especially if burning has taken place.

(c) **Class III** Interference disorder

Numerous instances of interference symptoms that occur during the course of normal translatory movement.

Class III disorder are divided into 4 clinical identifiable groups

1) Due to excessive passive inter articular pressure → sudden onset, variability and periodicity.

2) Due to structural irregularity → of temporal articular surface → characterized by persistence, replicability and soreness.

3) Due to non inflammatory regeneration joint disease → crepitus and irregular translatory movement.

4) Due to Derangement of disc – condyle complex (D-C complex) □ induces disc-interference symptoms-depending upon structures involved 4 types of internal derangements are clinically identifiable.

a. Disc-condyle adhesion → prevent rotatory movement in D-C complex induce noisy, skidding, subluxation type of movement.

b. Damaged articular disc → deformation, perforation or fracture of articular disc predispose to degenerative joint disease generating grating noise (crepitus) and irregularity of movement.

c. DBC displacement → Linear sliding movement in disc condyle complex that result from loss of disc contour and elongation of discal collateral ligaments permit displacement of articular disc which causes clicking, catching and locking may be accompanied by arthralgia.

d. Detached superior retrodiscal lamina → from articular disc causes irregular movement during forward phase of translatory cycle predisposes to anterior dislocation of the disc.

d. Class IV Interference disorder

When mouth opening is extended beyond the normal anterior limit of translatory movement of the Disc – condyle complex characterized by hypermobile sub luxation symptoms consists of a momentary pause near full opening followed by a rapid, noisy skidding movement of condyle to full opening.

e. Class V Interference disorder

Isolated instances of spontaneous anterior dislocation that results from opening too widely or from premature contraction of superior lateral pterygoid muscle at full open position → articular disc space collapses and disc is trapped anterior to condyle then preventing closure of mouth (open lock).

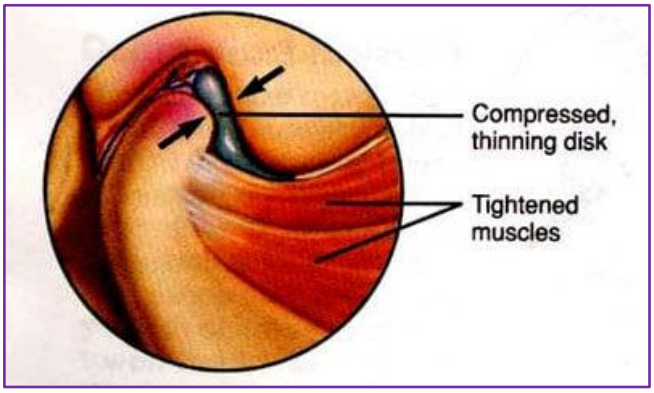

Figure 4. Disc interference

III Inflammatory disorder of the joint [13-16]

Characterized by inflammation arthalgia that is accentuated by movements. Secondary central excitatory effects may complicate the symptoms picture.

Classified according to joint structures involved.

Synovitis and capsulitis [17-20]

Characterized by palpable tenderness over joint proper and accentuated capsular arthalgia when condylar movement stretch the capsule.

Retrodiscitis → inflammatory retrodiscal arthalgia, especially when teeth are brought into maximum intercuspation and degree of acute malocclusion due to swelling of retrodistal tissue (no intracapsular inflammatory exudates)

Inflammation arthritis:

Inflammatory arthritic arthralgia accompanied by symptoms of capsulitis.

Several types of inflammation arthritis

a) Degenerative A → is the inflammation phase of degenerative joint disease.

b) Traumatic A → typically is a single joint condition that results from external trauma.

c) Infectious A → acute inflammation condition of joint due to bacterial invasions.

d) Rheumatoid A → chronic systemic autoimmune disease in which hyperplastic synovial membrane encroaches on the articular surfaces.

e) Hyper uricemia → sub clinical gout → sort frequently involvement is diffuse inflammatory arthralgia associated with an elevated or high normal level of serum uric acid.

Figure 5. Clinical examination of TMJ

Diagnosing Temporomandibular Joints [20-25]

Clinical Examination:

The objective of an examination is to obtain the data necessary to make a proper diagnosis. The data needed to make a diagnosis consists of five parts.

1) Historical background of the complaint for clues to etiology**.**
2) Positive identification of the source of masticatory pain.
3) Identification of location of restricted range of motion.
4) Recognition of disc-interference symptoms as they relate to translatory cycle.
5) Recognition of occlusal disharmony and classifying it as etiologic, symptomatic or irrelevant.

Criteria for Diagnosis of the main categories

These criteria help in identifying the main category of TM disorder represented by the patient's complaint.

I. Masticatory muscle disorders.

History

Sudden onset, variability, prior emotional upset, alteration in sensory or proprioceptive input, trauma, abusive use, dental treatment, deep somatic pain or myofacial trigger point mechanism.

Pain

Myalgic pain is predominant symptom

Restricted range of movement → Restriction of opening is extra capsular and soft.

Disc interference:

If any, is due to excessive passive inter articular pressure.

Acute malocclusion:

Muscle-induced malocclusion is due primarily to shortened inferior lateral pterygoid muscle.

II. Disc – interference disorders:

History: usually insidious onset, persistence, progressiveness.

If sudden onset: Follows trauma, biting incident, dental treatment, emotional crisis.

If recurrent: during periods of elevated emotional stress

Pain → if any, non inflammatory, intermittent, disc attachment arthralgia coincident with other disc – interference symptoms.

Restricted Rage of motion: if any intra capsular and due to an obstructed or dislocated disc. Rigid end feel, if obstructed soft if dislocated.

Disc interference: Disc symptoms dominate the complaint.

Acute Malocclusion: If any is joint induced and due to fractured or dislocated disc.

III. Inflammatory disorders:

History: Prior trauma, disc-interference symptoms, arthritis illness.

Pain: Inflammatory arthrolgia.

Restricted Range of motion: If any chiefly capsular unless due to central excitatory myospasm.

Disc interference: If any, due to degenerative, traumatic or rheumatoid changes in articular surfaces.

Acute malocclusion: If any, joint induced due to retrodiscitis intracapsular effusion or rapid osteolysis.

IV Chronic mandibular hypomobilities

History: Slowly changing, persistent, painless, restricted range of motion, prior trauma, Inflammation, infection, surgery.

Pain: None unless strained or abused.

Restricted Range of motion: Dominant symptom

Disc interference : None

Acute malocclusion: None

V. Growth Disorders of Joint

History: Functionally evident disorder in joint structure.

Pain: none, unless due to developing dysfunction

Restricted Range of motion: if any due to developing dysfunction

Disc interference : None.

Acute malocclusion: If any, due to osseous change.

After a clinical decision is reached, a decision should be made whether such a diagnosis has sufficient merit and reasonableness to warrant initiating management procedures or whether further confirmation is needed.

There are number of ways by which clinical diagnosis can be confirmed of these radiography, no doubt the most useful.

The radiographic methods applicable to TM diagnosis may be grouped into several categories, frequently more than one category is required to properly visualize the condition present.

1. Panaromic projections: Panaromic viewing of teeth and jaws including TM joints, provides a useful screening visualizations of masticatory structure. It often furnishes clues that justify more adequate radiograph: Examination of joints.
2. Transcranial, transpharyngeal, transorbital projection.
    a. Transcranial: Outer lateral margins of the joints are visualized by transcranial fairly accurate estimate of inclination of articular eminence. The marked advantage of availability and low cost to patient make this method by far the most practical or routine use.
    b. Transpharyngeal of TMJ gives excellent profile views of the condyle but does not show upper structure of joint cavity. Serves best as an auxillary film to transcranial series.
    c. Transoribital Very satisfactory frontal view of condyle. Its value is

largely to supplement tomographic films that show osseous defect in the condyle.

Tomography: Yields most accurate radiographic visualization of TM joints, accurately measuring the articular disc space at functional position of the joint.

Provides visualization of medial and central portion of joint.

Superior method for visualizing subarticular osseous structure of joint and for measuring width of articular disc space.

Computed Tomography (CT scanning) [26]

Data can be displayed on computer to reflect tissue radiolucency bilaterally or in either the sagittal or frontal planes without additional radiation. It can be manipulated for either soft tissue or bone.

Figure 6. Computed tomography of TMJ

Fluoroscopy: is a radiographic method of examining TM joint movements. Permanent recording by means of video or cinefluorography enhances its value in that frame by frame examination is possible

Arthrotomography: Injecting a contrast medium into the synovial sac renders the synovial fluid radiopaque. It is needed to visualize the disc space.

Double contrast Arthrotomography: is a superior technique. For the first time torqued, displaced (posteriorly) articular discs have been seen radiographically.

Scintigraphy (Nuclear scanning): Injecting a radioisotope intravenously and detecting the resultant gamma ray emission with scintillation camera. Bone reactivity and osseo-arthritic changes in the TM joint.

Magnetic Resonance Imaging: Visualizing soft tissue structures that fill articular disc space. Disc position, complete imaging of TM joint possible non ionizing, non invasive, eliminating hazards of radiations and tissue damage.

Arthroscopy: Excellent method for recognizing adhesion, perforation and synovitis.

Analgesic Blocking: When positive confirmation of true source of pain is needed especially when it is necessary to distinguish between primary pain and referred pain secondary hyper allergy, skillful use of local anesthesia is dependable and accurate.

Eg: External injection of masseter muscle.

Electromyography: (EMG) record the summation of electric signals or action potential generated by contracting muscle fibres. The summation can be taken as a measure of the total contraction force exerted by the muscle, it is useful in identifying asymmetry of muscle actions.

Mysospasm: Increases EMG activity at rest, as a result of pain resulted in muscle.

Sonography: Electronic auscultations and sonographic audiospectral analysis of TM Joint – symptomatic point yields shorter, coarse, irregular bursts of sound during opening and closing movements.

Thermography: Records variations in the surface temperature of skin. Tissue in distress

generate heat that can be imaged using thermography.

Laboratory tests:

Serum uric acid test → hyperuricemia

Sedimentation rate
Sociological test
} Synovial fluid → synovitis.

Optimum Orthopedically Stable Joint [27-32]

POSITION (Seated condylar position)

- The term centric relation has been used in dentistry for years. Earlier definitions described centric relation as the most retruded position of the condyles.
- Centric relation become useful to the prosthodontist because it was a reproducible position that could be used during construction of complete dentures. The reliable reference point obtainable in an edentulous patient for accurately recording the relationship between the mandible and maxilla and ultimately for controlling the occlusal contact pattern.
- A number of studies have been conducted to discover whether ligaments muscles or bones are the individual or combined determinants of the centric jaw position. Mc Millar (1972), stated the normal muscle tonicity is important in maintaining the relationship of the condyles to the Glenoid fossa.
- Bony structures may also be determinants of the seated condylar position, stating that thickness and translucence of the roof of glenoid fossa are evidence of non - stress bearing area.
- Willianson et al (1977) concluded that through the action of ligaments, muscular and bony determinants, the condyles assumes their normal seated position, high on the posterior surface of the articular eminence.
- The complete definition of the optimum orthopedically stable joint position therefore is where the condyles are in their most supero - anterior position in the mandibular fossa resting against - the posterior slopes of the articular eminences, with the articular disks properly interposed.
- This position is therefore considered to be the most musculoskeletal stable position of the mandible.
- The condylar vertical and antero posterior positioning undoubtedly is guided by the low co-efficient of friction of the synovial joints and by the overall force - vector of the muscles of mastication.
- Electromyographic studies have shown that the temporalis muscle and superior head of the lat. Pterygoid muscle predominate in seating the condyles bilaterally in a stable position prior to any post tooth contacts. On the other hand the masseter and med pterygoid muscle do not contact until the post teeth contact.
- Experiments in monkey that the sup head of the lateral ptergoid muscles is the first to show electro myographic activity upon closure of mandible. Inferior head of lateral pterygoid is the primary contributor to protrusive and lateral protrusive movement.

Tomographic Assessment of TMJ in Pts [33-37]

With Malocclusion

- Literature suggests that the healthy conducive condyle - fossa relationship

is where the condyle is centred anteroposteriorly in the glenoid fossa.

- A computer automated pleuridirectional x-ray tomograph is taken and ascertaining the proper condyle angulations.
- The Ratio of post to anterior joint space P/a as post joint space measurement divided by anterior joint space measurement, whereby a perfectly entered condyle would be expressed as 1.00.
- Percentage of post to anterior joint space expressed as

$$\frac{\text{Post joint space - anterior joint space}}{\text{Post joint space + anterior joint space}} \times 100\%$$

- This formula represents the condylar position as percent displacement from absolute concentricity, where a perfectly centred condyle would be expressed as 0%.
- A positive value indicates a anterior condylar positioning seen in Cl III pts and negative value is indicative of a post condylar positioning seen in Cl II pts.

Cbct Evaluation Splint Fabrication [38-41]

An occlusal deprogramming splint, which can be made of a variety of materials, provides a temporary rest for the occlusion, thus reducing abnormal muscle activity and facilitating neuromuscular balance. To construct the splint, a bite fork impression and face bow transfer are used to mount the patient's casts on an articulator. We make our splint from transparent, heat-cured acrylic, which is adequately trimmed before placement in the mouth. CBCT imaging of bilateral TMJs is performed with the patient standing and biting in maximum intercuspation. The head is positioned with Frankfort horizontal parallel to the floor. Pre- and post-treatment CBCT images are compared\ by linear and angular measurements derived from three-dimensional imaging software. In the axial view, the axial condylar angle is formed between the long axis of the mandibular condylar process and a line perpendicular to the mid sagittal plane.

Figure 8. Splint

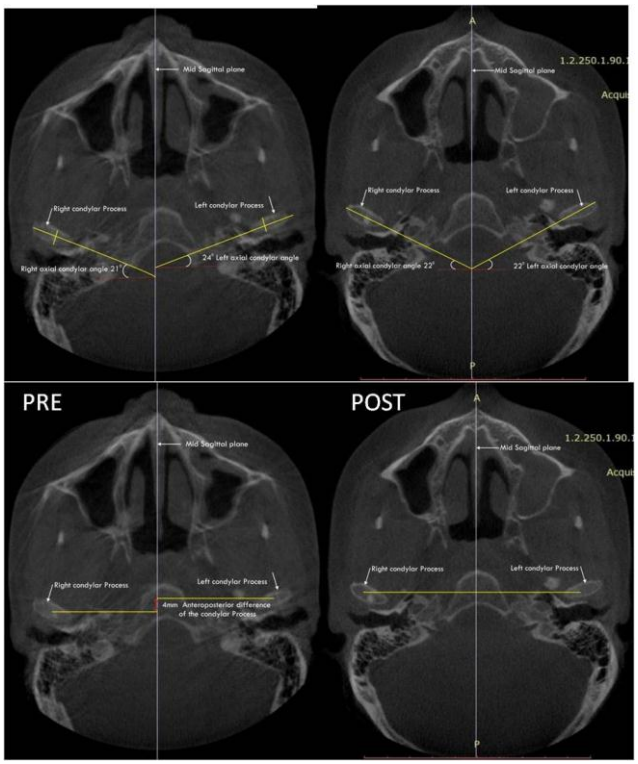

Figure 9. **CBCT scans before and after occlusal deprogramming**

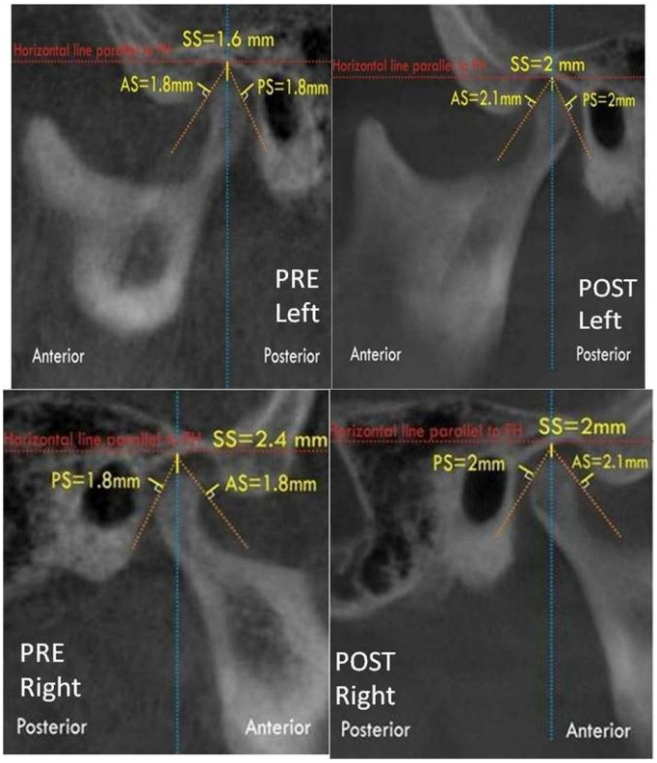

Figure 10. **Lateral view**

Anteroposterior differences between the left and right condylar processes are measured on a reference line from the geometric center of the condylar processes to the midsagittal plane. The sagittal view is assessed at the point where the mediolateral diameter of the left and right condyles is greatest in the axial view. The right and left joint spaces are measured from the most anterior, superior, and posterior condylar

points to the glenoid fossa along a reference plane parallel to Frankfort horizontal.

Establishing a stable occlusion prior to orthodontic treatment is the key to preventing undiagnosed skeletal discrepancies. Seemingly uncomplicated malocclusions with vague symptoms or joint morphology may not always be what they appear. Careful diagnosis and treatment planning can help eliminate an unsuspected occlusal relationship that would otherwise result in the need for modification of the original plan. The etiology of TMD is not clear, but it has generally been accepted as multifactorial. The key role of occlusion has been widely discussed. One study found that the degree of CR-CO discrepancy has a strong correlation with the severity of TMD symptoms, and that such a discrepancy may be the main contributory factor to the development of TMD. If occlusal interferences are not removed, muscle spasms can cause articular disc

derangement and forward displacement of the condyle. This in turn results in TMJ clicking, and further progression may lead to intracapsular disorders,

condylar resorption, and even osteoarthritis. There is some controversy regarding whether patients with malocclusions have normal condyle fossa relationships; some studies have associated asymmetrical TMJ spaces with TMD [42].

The present case indicates that treatment with an occlusal deprogramming splint may be an effective modality for TMD with CR-CO discrepancy,

allowing stabilization of the condyles in CR before development of an accurate diagnosis and treatment plan. CBCT imaging allows condyle fossa relationships to be evaluated in any desired orientation of the volumetric data and slices. In our patient, changes in the TMJ were evident from a comparison of pre- and post-treatment CBCT images, providing a clear picture of what can occur in the joint after occlusal deprogramming [43].

Conclusions

Thus it is clearly seen that occlusal deprogramming has a significant effect on the condyle fossa relationship which in turn is directly related to the TMJ function. The TMJ is very important for the well being of humans. Further studies are required to clarify the advantages of using splint therapy in patients with TMDs.

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