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Review Article

Temporomandibular Joint And Orthodontics: A Review Article

Rajdeeep Kaur [1], Sudhir Munjal [2], Satnam Singh[3], Amanpreet Singh Natt[4], Harmeet Singh[5]

[1] PG Student, Department Of Orthodontics, Dasmesh Institute Of Research And Dental Sciences, Faridkot, Punjab, India
[2] Professor & HOD, Department Of Orthodontics, Dasmesh Institute Of Research And Dental Sciences, Faridkot, Punjab, India
[3 ,4]Associate Professor, [5]Assistant Professor ,Department Of Orthodontics, Dasmesh Institute Of Research And Dental Sciences, Faridkot, Punjab

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ABSTRACT

The temporomandibular joint receives its name from the two bones that enter into its formation, namely the temporal bone and the mandible. This complex synovial system is composed of two temporomandibular joints together with their articulating ligaments and masticatory muscles. The causes of temporomandibular disorders are complex and multifactorial. There are numerous factors that can contribute to temporomandibular disorders. The successful management of temporomandibular disorders is dependent on identifying and controlling the contributing factors. There is a long time debate whether orthodontic treatment is the cause of Temporomandibular joint disorders (TMD) or it is used to alleviate the symptoms associated with these disorders such as clicking joints, Muscular pains etc..

INTRODUCTION

The masticatory system is extremely complex, functional unit of the body primarily responsible for chewing, speaking, and swallowing. Temporomandibular Joint (TMJ), the articulation of the mandibular condyle with the glenoid fossa of the temporal bone, is a complex skeletal structure that is essential for jaw movement in mammals. TMJ is comprised of multiple tissues, including the mandibular condyle, glenoid fossa, a fibrocartilaginous articular disc located between these two bones that divides the joint cavity into two compartments, and a variety of associated tendons and muscles. The application of forces during certain orthodontic mechanics, especially orthopedic situations, can cause alterations in condylar growth and bone structures of the TMJ. The orthodontist must understand the functional anatomy of TMJ before they can effectively diagnose and treat disease of TMJ.1

Temporomandibular disorders (TMD) as suggested by Dr. James Costen2 as the changes in dental condition responsible for certain ear symptoms which was called as costens syndrome numerous factors can attribute to TMD. Scientific literature3 reveals five major factors associated with TMD. Occlusal condition, Trauma, Emotional stress, Deep pain input, Para functional habits. Occlusal condition can affect some TMD in at least two ways, factors that effect the orthopaedic stability of the mandible and acute changes in the occlusal condition that influences the mandibular function.

* Corresponding author***: Rajdeeep Kaur, PG Student, Department Of Orthodontics, Dasmesh Institute Of Research And Dental Sciences, Faridkot, Punjab***

ANATOMY AND EVALUATION OF TMJ

The TMJ is a ginglymoarthrodial synovial joint (latin:ginglymus = hinge joint) that allows both backward and forward translation as well as a gliding motion. Similar to the other synovial joints in the body, the TMJ has a disk, articular surfaces, fibrous capsule, synovial fluid, synovial membrane, and ligaments. What makes this joint unique is the articular surfaces are covered by fibrocartilage instead of hyaline cartilage. The articular surfaces of the TMJ are formed inferiorly by the mandibular condyle and superiorly by the glenoid fossa (also known as mandibular fossa) and articular eminence of the temporal bone.3

The following are the components of TMJ:

A. BONY COMPONENTS

1. Glenoid fossa
2. Articular eminence
3. Condylar head

B. SOFT-TISSUE COMPONENTS

1. Articular disk
2. Joint capsule
3. Ligaments

C. MUSCLE OF MASTICATION

D. ARTERIAL AND NERVE SUPPLY TO THE JOINT

ETIOLOGICAL FACTORS

The causes of temporomandibular disorders are complex and multifactorial. There are numerous factors that can contribute to temporomandibular disorders. Factors that increase the risk of temporomandibular disorders are called “Predisposing factors” and those causing the onset of temporomandibular disorders are called “Initiating factors” and factors that interfere with healing or

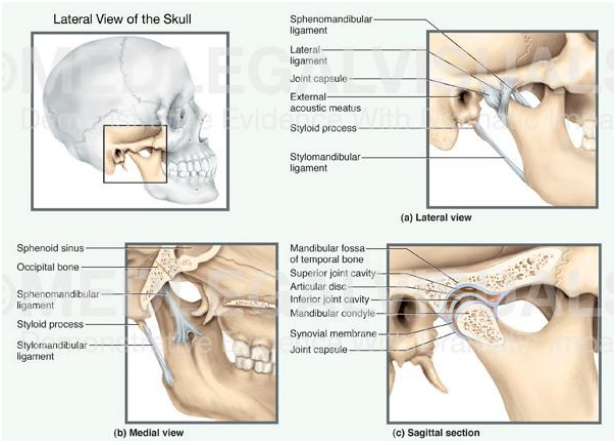

Figure: Normal Anatomy of TMJ[4]

Muscle	Origin	Insertion	Description
Masseter	Zygomatic arch	Mandible (external surface)	Closes jaw; flat, thick muscle
Temporalis	Temporal bone	Coronoid process at the anterior border of the ramus	Closes jaw; fan-shaped
Medial pterygoid	Sphenoid, palatine, and maxillary bones	Inner (medial) surface of the ramus	Closes jaw; parallels masseter muscle
Lateral pterygoid	Sphenoid bone	Anterior surface of mandibular condyle	Opens jaw; allows grinding action side to side, and protrudes the mandible

Figure: 2 : Muscles of masication[5]

enhance the progression of temporomandibular disorder are called “Perpetuating factors.”

The role of occlusion in the development of temporomandibular joint disorders is controversial. Today its role is widely considered as contributing by initiating, perpetuating or predisposing of temporomandibular joint disorders. Initiating factors lead to the onset of the symptoms and are related primarily to trauma or adverse loading of the masticatory system. In the perpetuating factors the following may be included:

a. Behavioral factors (grinding, clenching and abnormal head posture)

b. Social factors (could effect perception and influence of learned response to pain)

c. Emotional factors (depression and anxiety)

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

Predisposing factors are pathophysiologic, psychological or structural processes that alter the masticatory system sufficiently to increase the risk of development of temporomandibular disorders. Pullinger, Seligman and Gornbein applied multiple factor analysis, which indicated the low correlation of occlusion to temporomandibular disorders. However, the following occlusal factors had a slight relation:

a. Open bite

b. Overjet greater than 6-7 mm

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

d. Unilateral lingual cross-bite

e. Five or more missing posterior teeth

f. Faulty restorations and ill-fitting prosthesis.6

Malocclusion and TMD

The four occlusal factors7 that occurred mainly in patients with TMD are Skeletal open bite, RCP-ICP slides of greater than 2mm(greater than 4mm) , overjets greater than 4mm (greater than 6mm) and five or more missing unreplaced missing teeth.8

A radiographic study of pathologic TMJ cases observed that four distinct types of traumatic joint disturbances seemed to stem from four different types of malocclusion.9Type I- Abnormal overjet characterized by the typical class 2 division 1,Type II -Typical class 2 division 2,Type III-Related to bicuspid and molar interferences, Type IV-represented by cases with loss of posterior teeth. MPDS (Myofacial pain dysfunction syndrome) is caused due to occlusal disharmony leading to muscle dysfunction and in turn TMD.10,11 The occlusal irregularities is one of the etiological factors of muscle dysfunction. According to a study made which concluded that functional malocclusion is more important than morphologic malocclusion in explaining the existence of mandibular dysfunction. In a cross sectional study done on subjects with 6-17 years of age analyzed for the prevalence of specific types of occlusion and subjective symptoms and clinical signs of TMJ dysfunction results showed functional shift was negatively associated with TMJ and Muscle tenderness and open bite is positively associated with TMJ and muscle tenderness. Excessive or negative overjets were more likely to have joint tenderness and joint noises, older subjects with cusp to cusp or a class II molar relation were more likely to experience TMJ and muscle tenderness and joint noises and restricted mouth opening. Buccal cross bites had a significantly higher prevalence of joint sounds in older children. In another study done to evaluate whether oral dysfunctions and malocclusions can predispose to TMD in young adults, muscle tenderness, jaw deviation, clicking and occlusion was evaluated. Results showed excessive overjet only predictable variable for TMD and girls are more prone for TMD.12

Orthodontics and TMD relationship

1. Extractions vs TMD
2. Condylar position vs TMD
3. Head gear and class II elastics
4. Herbst appliance vs TMD
5. RPHG and class III elastics
6. Chin cup vs TMD
7. Cross elastics

Extractions Vs TMD[2,13,14,15,16,17,18]

Orthodontic treatment with fixed appliance either with or without tooth extractions did not increase the prevalence of symptoms and signs or worsen pre-existing symptoms and signs of TMD. Subjects with class II malocclusion

and pre-existing signs of TMD of muscular origin seemed to benefit functionally from orthodontic treatment in a 3 year perspective.

Condylar Position and TMD19,20

Distal pressure exerted on the mandible and ultimately on the condyle induces temperomandibular disorder. In patients treated for Class II division I with extraction of maxillary first premolars and in patients treated for class I with non-extraction; condylar position was measured in anterior and posterior displacement from tomographic sections of each joint,the condyles were located more posteriorly in patients with extraction and in cases with clicking than in those without.An apparent association exists between joint sounds and posterior displacement of the condyles.

Head Gear and Class II Elastics21,22

Orthodontic mechano-therapies such as class II and extractions have little effect or no effect on general TMD signs and symptoms. There is no immediate benefit or risk for children receiving early class II treatment with bionators and head gears/bite planes with respect to temperomandibular joint.

Herbst Appliance Vs TMD23,24

In studies conducted on cases with herbst appliance all condyles were positioned significantly forwards but returned to normal position after removal of the appliance a temporary capsulitis was present during the course of treatment, but did not have the potential to cause TMD.

RPHG (Reverse pull Head Gear) and class III elastics

RPHG and Class III elastics produce a distal driving force of the mandible and condyle. This would produce a reciprocal forward displacement of the disc and pressure on retrodiscal tissues.

Chin Cup Vs TMD25

A clinical evaluation of TMD treated with chin cup reported that 28 out of 86 subjects showed one or more symptoms of TMD. Spontaneous pain was found most often during active treatment but clicking sound occurred more often during the retention phase. In a long-term follow up of the subjects treated with chin cup indicated that chin cup treatment is neither a risk factor nor prevention for TMD. Age and stress factors should always be considered in the evaluation of TMD.

Cross Elastics

When cross elastics are used there is a displacement of the mandible and condyle to one side resulting in unilateral distal driving force on the condyle. However they can be used during the day alone when the resting muscle tone can counter act the distal driving force.

Developing The Orthodontic /Temperomandibular

Disorder Treatment Plan

Orthodontic therapy is indicated only when orthopaedic instability is present and this instability is contributing to the TMD. The mere presence of orthopaedic instability is not enough evidence to be certain that it is contributing to the TMD, so clinician should first determine whether orthopaedic instability is contributing to TMD, the best way to identify this relationship is by first providing Orthopaedic stability reversibly with an Occlusal appliance. If the occlusal appliance does not reduce the symptoms orthopaedic stability is not related to the symptoms and orthodontics should not be considered. Orthodontic therapy can only affect TMD symptoms by changing the occlusal contact pattern of the teeth and the resulting function of the masticatory system. If an occlusal appliance successfully reduces the TMD symptoms Occlusion and Orthopaedic instability is an etiologic factor in the TMD.

Occlusal appliances reduce symptoms associated with TMD by

1. Alteration of the occlusal condition
2. Alteration of the condylar position
3. Increase the vertical dimension
4. Cognitive awareness
5. Placebo effect
6. Increase peripheral input to the central nervous system
7. Regression to the mean

To summarize permanent treatment is delayed until significant evidence exists to determine which factor or factors are in reducing the symptoms. Allow the patient to wear the appliance for several weeks or months to ensure that the symptoms have been controlled adequately. Discontinue use of the appliance and not experience the return of the symptoms indicates the muscle origin. These patients do not need orthodontic therapy.

Splints-an occlusal appliance called a splint is a removable appliance usually made of hard acrylic that fits over the occlusal and incisal surfaces of the teeth in one arch creating precise occlusal contact with the teeth of the opposing arch. It is commonly referred as bite guard, night guard, interocclusal appliance, orthopaedic device.

Types of Occlusal Appliances

- Stabilization splints
- Anterior stabilization splints
- Anterior bite plane
- Posterior bite plane
- Pivot splint
- Soft splint

The specific purpose of the splint should be determined before it is designed. Stabilization splint is a muscle relaxation appliance because it is primarily used to reduce muscle pain. It is generally fabricated on the maxillary arch and provides an optimum functional occlusion for the patient. The treatment goal of the stabilization splint is to eliminate any orthopaedic instability between the occlusal position and the joint position thus removing this instability as an etiologic factor in the TMD.26,27,28

Anterior repositioning splint is an interocclusal device that encourages the mandible to assume a position more anterior than the intercuspal position, its goal is to provide a better a condylar- disc relationship in the fossa so that tissues have a better opportunity to adapt to repair. The goal is not to alter the position of the mandible permanently but only to change the position temporarily as to enhance adaptation of retrodiscal tissues, once the tissue adaptation has occurred the appliance is eliminated allowing the condyle to assume the musculoskeletally stable position.29

Anterior bite plane is a hard acrylic appliance worn over the maxillary teeth, providing contact with only the mandibular anterior teeth. It is primarily intended to disengage the posterior teeth and thus eliminate their influence on the function of the masticatory system.

Posterior bite plane is fabricated for the mandibular arch and consists of areas of hard acrylic located over the posterior teeth and connected by a cast metal lingual bar. The treatment goal of the posterior bite plane is to achieve major alteration in vertical dimension and mandibular positioning.

Pivoting appliance is a hard acrylic device that covers one arch and usually provides a single contact in each quadrant which is usually established far posteriorly as possible. When superior force is applied under the chin the tendency is to push the anterior teeth close together and pivot the condyles downward around the posterior pivoting point. The appliance reduces interarticular

pressure and thus unload the articular surfaces of the joint. whereas it was originally suggested that this therapy would be helpful in treating joint sounds, it now appears that anterior repositioning splint is more suitable for this purpose.

Soft or Resilient appliance is a device fabricated of resilient material that is usually adapted to the maxillary teeth the treatment goals are to achieve even and simultaneous contact with the opposing teeth.

According to classification by Slavicek there are myopathic splint, decompression splint, compression splint, verticalisation splint, anterior repositioning splint. The first four types are reference position splints, the last is a deranged reference position splint.

According to classification by Willis three major types of splints have been used traditionally they are Flat plane, anterior repositioning and canine protected splint works by prevention of lateral movements which reduces loading in the TMJ. Reduction in para functional activity and immediate complete anterior guidance development which is effective in the treatment of MPDS.30

Rule of thirds by Neffan aid to determine the appropriate treatment.Each inner incline of the posterior centric cusps is divided into three equal parts if when the mandibular condyles are in their desired position the centric cusp tip of one arch contacts the opposing centric cusp inner incline in the third closest to the central fossa selective grinding done without damage to the teeth. If opposing centric cusp tip makes contact in the middle third of the opposing inner incline –crown and bridge prosthodontics procedures are appropriate for achieving the treatment goal, as selective grinding is likely to perforate the enamel. If the cusp tips contacts the opposing inner incline on the third closest to the cusp tip or even the cusp tip-orthodontic procedures are initiated as crown and fixed prosthodontics create restorations that cannot adequately direct occlusal forces through the long axis of the roots thus producing unstable occlusal relationship.31

CONCLUSION

The relationship between Orthodontics and patient with TMD is complex and controversial. Most of the studies revealed that Orthodontic treatment do not predispose to TMD .Orthodontic therapy in patients with TMD is beneficial only if orthopaedic instability contribute to TMD.

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