Review Article

JRAD Journal of Research and Advancement in Dentistry

J Res Adv Dent 2021;11:3:362-368.

Effect of Orthodontic Treatment on Temporomandibular Joint and Muscles of Mastication

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ABSTRACT

Background: The association between orthodontic treatment and temporomandibular disorders has always been of great interest to oral health professionals. A change in occlusion during orthodontic treatment can affect muscles and joints surrounding the jaw, resulting in temporomandibular disorders (TMD). There are multiple etiological factors that have been associated with the TMDs and they may be manifested by pain and/or sounds of TMJ. Current article aims to provide effect of orthodontic treatment on temporomandibular joint and muscles of mastication.

Keywords: Temporomandibular joint, muscles of mastication, pain.

INTRODUCTION

The relationship between orthodontic treatment and temporomandibular joint and muscles of mastication has long been of interest to the practicing orthodontist, but only during the past decade have a significant number of clinical studies been conducted that have investigated this association.[1] Various studies have been performed to determine relationships between TMJ and malocclusion. Some studies have shown that children with malocclusion, such as a deep bite and unilateral crossbite, tended to experience additional symptoms of TMD with increased age.[2] The most common clinical sign is considered to be the clicking of the TMJ which often appears with a deviation of the mandible during movements. Also, it can be seen that the most frequent symptom is pain originating from the TMJ, masticatory muscles and the supporting soft tissues.[3] The muscle related conditions represent the most prevalent conditions, with at least 50% of cases falling into this category. Pain or ache in the jaw, temporal, auricular area or inside the ear at rest or during function combined with tenderness to palpation of at least three of 20 palpation sites, with at least one ipsilateral to the complaint pain, must be present to be diagnosed as muscle- related TMD.[4]

Anatomy of the TMJ and muscles of mastication

Each TMJ involves temporal articular tubercle and anterior part of mandibular fossa above and mandibular condyle below. It is also called 'diarthrodial' (consisting of two articulating bony surfaces); 'ginglymoid'(as it has hinge like movement component).[5]

Fibrous Capsule:

Each joint is surrounded by short capsular fibers stretch from condyle to disc and from disc to temporal bone forming two joint capsules. [6]

Received: Mar. 13, 2021: **Accepted**: May. 1, 2021
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pISSN 2278-0076
eISSN 2321-9270

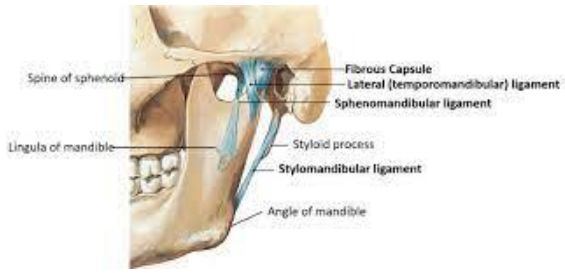

Fig 1: Fibrous Capsule

Glenoid Fossa:

The glenoid fossa accepts the condylar process of the mandible and is formed by the articular tubercle anteriorly and by the postglenoid tubercle posteriorly of the zygoma portion of the temporal bone.[7]

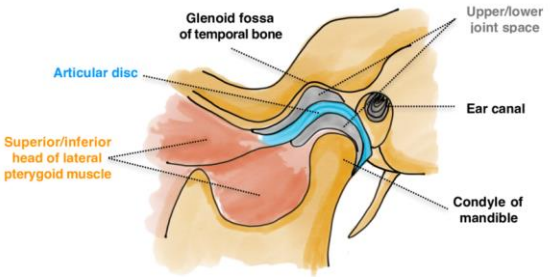

Fig 2: Glenoid fossa of temporal bone.

Meniscus:

The meniscus of articular disc is an oval fibrous plate of great firmness. The disc is concave on its inferior surface and oval in shape. The upper or superior surface is saddle-shaped or concavoconvex accommodating the form of the articular fossa and tubercle.[8]

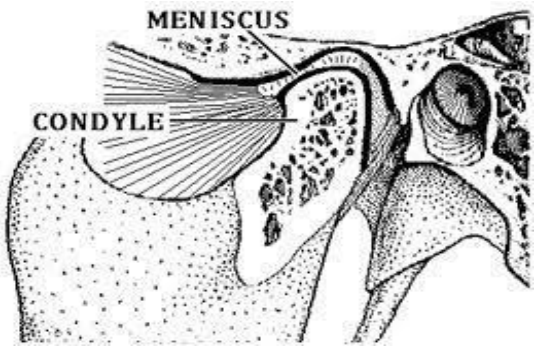

Fig 3: Meniscus of articular disc.

Lateral Temporomandibular Ligament:

Close to capsule, is attached above to the tubercle on zygoma's root, below to the lateral surface and posterior border of mandibular condylar neck. [9]

Sphenomandibular Ligament:

It is an accessory ligament that lies on the deep plane away from the fibrous capsule. It is attached superiorly to the spine of the sphenoid , and inferiorly to the lingual of the mandibular foramen. The ligament is related laterally to:

a) Lateral pterygoid muscle
b) Auriculotemporal nerve
c) Maxillary artery
The ligament is related medially to:
a) Chorda tympani
b) Wall of pharynx

Stylomandibular Ligament:

It stretches from apex and adjacent anterior aspect of styloid process to mandibular angle and posterior border. It is also an accessory ligament. It represents a thickened part of deep cervical fascia which separates the parotid gland and submandibular gland.

Disc

An oval plate of fibrous tissue. Upper surface sagittally concavo-convex and inferior concave surface. Its circumference blends with fibrous capsule, antero-medially the tendon of lateral pterygoid.

Vessels and Nerve Supply

- Auriculotemporal and masseteric branch of mandibular nerve.

- Superficial temporal and maxillary arteries[9]

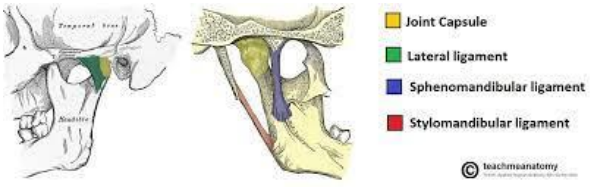

Fig 4: Stylomandibular ligament and Sphenomandibular ligament.

According to Okeson there are 5 major factors responsible for TMD-

- **Occlusal Factors-**

Teeth grinding and teeth clenching (bruxism) increase the wear on the cartilage

lining of the TMJ. Many patients awaken in the morning with jaw or ear pain,

habitual gum chewing or fingernail biting, misalignment of the teeth

(malocclusion)

- **Trauma-**

Trauma to the jaws: Previous fractures in the jaw or facial bones can lead to TMJ disorders. Problematic relation between the jaw and malocclusions with deflective contacts in the teeth.

- **Stress-**

Stress frequently leads to unreleased nervous energy. It is very common for

people under stress to release this nervous energy by either consciously or

unconsciously grinding and clenching their teeth.

- **Deep pain input-**

It centrally excites the brainstem and produces muscle response. It is normal body response to pain and restricts mouth opening.

5) Parafunction-

Occupational tasks or habits such as holding the telephone between the head and shoulder may contribute to TMJ disorders.[10]

Symptoms associated with TMD are:

Pain or tenderness of the aching pain in and around the ear

- Difficulty chewing or discomfort while chewing
- Aching facial pain, locking of the joint
- Difficulty with opening or closing of the mouth
- Headaches, uncomfortable bite, or uneven bite
- Clicking, popping or grating sounds in the joint with opening and closing of the mouth.
- Other common symptoms include toothaches, neck pain, dizziness, earaches and hearing problems.[11]

Warning signs-

- Head, neck, and shoulder pain, including general headaches. Tender and sore muscles, and trismus in the joint area are related problems of patients suffering from TMJ disorders.
- Hearing problems frequently accompanied by tinnitus or a ringing in the ears, has been suggested as indicative.
- Joint sounds (monitored with or without a stethoscope), which would include crepitus, crackling sound indicating a rough condyle, disk, or eminence surface), must be evaluated.
- "Clicking" or "popping" sounds, which can occur at any point in jaw opening, indicated sound may occur on one or both sides of the face. If it is unilateral, the midline of the jaw will shift towards the affected side.[12]

MUSCLES OF MASTICATION

There are 5 muscles of mastication-

Masseter: From zygomatic arch to the lateral aspect of lower border of ramus of mandible. It has got three layers.

a) Superficial layer:

b) Middle layer:

c) Deep layer:

Arises from the deep surface of the zygomatic arch and are inserted into the upper part of the ramus and the coronoid process.

Nerve supply:

Masseteric nerve, a branch of the division of the mandibular nerve.

Blood supply:

Maxillary artery – a branch of the external carotid artery. Action: The main function of this muscle is, mandibular elevation (Closure) and is adductive of the mandible

Temporalis

This is a fan-shaped muscle occupying the whole temporal fossa with converging fibers to a tendon along a broad attachment. In its three parts - anterior, middle, and posterior.

Nerve supply:

By deep temporal branches of the anterior division of the mandibular nerve.

Action: Elevates mandible and the posterior fibers retract the protruded mandible.

According to studies conducted by Vitti and Basmajcon (1977) the temporalis was found to be more active in forced elevation but less active in slow elevation. It also takes part in lateral movement of the mandible.

Lateral Pterygoid

This is comprised of upper and lower parts of heads, which act on mouth opening and also on closing (eccentric contraction or giving up its concentric action slowly).

Function: Depresses the mandible to open the mouth acting along with the suprahyoid muscles.

 Protrudes mandible along with medial pterygoid

Lateral movements along with medial pterygoid

Medial Pterygoid

This is a thick quadrilateral muscle that strongly assists in the elevation of mandible and also protrusion. It also acts to laterally deviate the mandible to the opposite side.

Superficial Head:

Arises from the tuberosity of the maxilla and the adjoining bone and the deep head arises from the medial surface of the lateral pterygoid plate and the adjoining part of the palatine bone.

Nerve supply:

Branch of the main trunk of the mandibular nerve.

Actions:

Take part in elevation of the mandible and also to protrude the mandible and to produce side to side movements contracting alternately with the lateral pterygoid.[13]

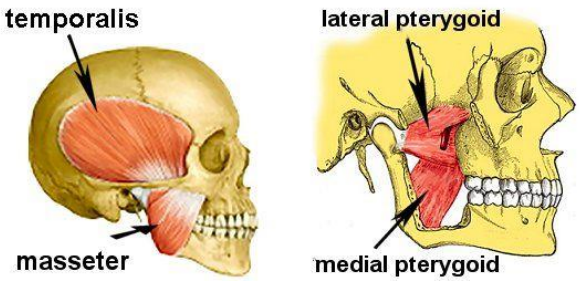

Fig 5: Muscles of mastication.

Classification

Masticatory muscle disorder-

1)Myofascial pain and dysfunction

i) Nocturnal bruxism

ii) Habitual daytime parafunction

a) Clenching

b) Postural

iii) Trauma—whiplash

2) Myositis, myospasm, etc.

3) Neoplasia [14]

Masticatory Muscle Disorders (Myalgia)

Masticatory muscle disorders are most commonly associated with painful guarded muscles of mastication (myalgia) with the presence of taut myofascial bands and trigger points and may progress to include tendonitis, commonly of the temporalis tendon. Palpation of the involved muscles and chewing/biting on the ipsilateral side of the pain provoke the symptoms. Masticatory muscle disorders may be associated with limited or normal mandibular opening. [15]

MANAGEMENT OF TMD and MUSCLES OF MASTICATION

TMD management-

Nocturnal-

The patient awakes with TMD pain.

• Improve sleep positions.

• Wear an occlusal orthotics at night.

• Prescribe medications that decrease electromyographic (EMG) activity, e.g., amitriptyline (10 mg, 1–5 tabs 1–6 hours prior to bedtime), nortriptyline (10 mg, 1–5 tabs 0–3 hours prior to bedtime), or diazepam (5 mg, 1–2 tabs).

• Relaxation prior to sleep.

Daytime-

The patient has symptoms associated with tooth-related pain such as:

• Pain occurs or intensifies upon drinking hot or cold beverages.

• Throbbing pain occurs spontaneously

• Throbbing pain awakes him or her from sleep (there can be other causes for this symptom, e.g., neck pain) procedures be used first and if this adequately resolves the pain, no other treatment is needed. It is appropriate for patients to wear an occlusal orthotic / splint at night for as long as it is beneficial.

Treatment-

• Wearing an occlusal orthotic during the day (as a temporary crutch until daytime habits are broken or to increase awareness of daytime habits and facilitate breaking them).

• Learning to relax masticatory muscles and maintain this relaxed state throughout the day.

Medicative-

• Prescribing a tricyclic antidepressant that can be taken during the day [e.g., desipramine 25 mg, 1 tab in the morning and afternoon].[16]

Transcutaneous electrical nerve stimulation (TENS)–

TENS is a method by which controlled, low voltage electrical pulses are applied to the nervous system. TENS is used to reduce the symptoms of pain. Several studies have been done to study the effectiveness of TENS on pain relief in TMD.[17]

TENS may act by neurologic, physiological, psychological, and pharmacological mechanisms.[18] It is widely used to relieve acute and chronic pain and in various conditions like back pain, neck pain, phantom limb pain, extremity pain, etc., but studies on orofacial pain relief are few.[19]

Management of Muscles of mastication-

Treatment may include use of heat modalities, such as moist heat, therapeutic ultrasound, or warm water rinses. Instruction in proper tongue/teeth/lip positioning and isometric opening exercises may assist in inhibition of the guarded closing/clenching muscles.

The controlled mandibular opening exercise can facilitate muscle relaxation and strengthen the proper tongue function and placement. Intraoral and extraoral soft tissue mobilization techniques are also indicated.The patient can be instructed in self–soft tissue mobilization techniques and educated to limit par functional activities.Muscle

reduction and TMJ proprioception exercises can assist to improve masticatory muscle control and function.[20]

CONCLUSION

Occlusion has been an important consideration in orthodontics since the beginning of the discipline. Early emphasis was placed on the alignment of the teeth, stability of the intercuspal position and the esthetic value of the proper tooth positioning. Orthopedic stability in the masticatory structures should be a routine treatment goal to help reduce the risk factors associated with developing temporomandibular disorders.

Symptoms of TMDs were found in 17% of the patients before treatment and in 7% after treatment. Temporomandibular Disorder (TMD) is the main cause of pain of non-dental origin in the orofacial region including head, face and related structures.

It is well known from epidemiologic studies that TMD-related signs and symptoms, particularly temporomandibular joint (TMJ) sounds, are frequently found in children and adolescents and show increased prevalence among subjects between 15 and 45 years old.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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