Chapter

Exploring the Association between Temporomandibular Joint Disorder (TMD) and Orthodontics

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Abstract

Temporomandibular joint is an important bilateral synovial joint of body. This chapter focuses on the basic anatomy of TMJ and its disorders. Any pain or symptom of TMJ falls under the category of temporomandibular joint disorder. There is a decade old debate of cause-effect relationship of malocclusion and temporomandibular joint disorder. How orthodontic treatment can positively contribute to this problem is highlighted in this chapter.

Keywords: temporomandibular joint disorder, orthodontics, malocclusion, anatomy

1. Introduction

The temporomandibular joint is the joint that joins lower jaw (mandible) to the skull. It is a bilateral synovial joint formed between the articular surface of temporal bone and condylar head of the mandible. The functioning of the joint is together and not independent of the other. The main components of the joint are the capsule, disc, articular surface of temporal bone, temporomandibular ligament, stylomandibular ligament, sphenomandibular ligament, and lateral pterygoid muscle [1].

The articular capsule (capsular ligament) is a thin loose envelope, attached above to the mandibular fossa and the articular tubercle below. The disc is a dense fibrocartilage positioned between the mandibular fossa and the articular surface of the head of condyle. This synovial joint is divided into two compartments by the disc viz. upper and lower joint compartment. Capsule's synovial membrane fills these compartments with synovial fluid and provides lubrication. The central area of the disc is avascular with no innervation, and synovial fluid nourishes the disc. The posterior ligament and the surrounding capsule have both blood vessels and innervation. The central area is thinner and of denser consistency; peripheral is thicker and cushioned. Age-related changes may thin the disc and add cartilage to the center and may lead to impaired movement of the joint. Disc is a fibrous extension of the capsule between the two bones, and is biconcave and attached to the condyle medially and laterally. Anterior portion of the disc divides backward vertically and continues as retrodiscal tissue; forwardly, the split becomes coincident with the superior head of lateral pterygoid. The lower joint compartment allows the rotational movement, while opening and upper joint compartment allows translation.
TMJ has three ligaments: one major and two minor ligaments. Ligaments define the extent of movement of mandible. If movements go beyond the extent allowed by muscles, pain will arise. Major ligament, the temporomandibular ligament is in reality, thickened lateral portion of the capsule. It has two parts: an outer oblique and an inner horizontal portion. This ligament is shaped like a triangle with base attaching to the zygomatic process of temporal bone and articular tubercle, and apex at lateral side of the neck of the mandible. This ligament prevents the retraction/distal movement of the mandible and thus protects the joint. The rest of the minor ligaments sphenomandibular and stylomandibular ligaments are not attached to the joint. Stylomandibular ligament runs from the styloid process to the angle of the mandible and becomes tight on mandibular protrusion. Sphenomandibular ligament, a remnant of Meckel's cartilage, runs from the spine of sphenoid to the lingula of mandible, which also becomes tight with mandibular protrusion. Other ligaments are otomandibular, discomalleolar, and malleomandibular ligament.

**Blood supply:** Superficial temporal branch of external carotid artery majorly innervates the joint.

**Nerve supply:** Auriculotemporal and masseteric branches of mandibular branch of trigeminal nerve provide sensory innervation to the TMJ. Proprioreception occurs through four receptors: Ruffini endings, Golgi tendon organs (static), Pacinian corpuscles (dynamic), and free nerve endings (pain). Free nerve endings are present in the bones, ligaments, and muscles except the fibrocartilage.

2. **Temporomandibular dysfunction (TMD)**

TMD is a term involving dysfunction and pain of the masticatory muscles, joint, and surrounding tissues. It is one of the most common cause of facial pain, which is non-dental in origin [2–4].

Signs and symptoms of TMD:

1. Headache.
2. Pain behind eyes.
3. Ear pain with no infection.
4. Discomfort and limited mouth opening.
5. Bruxism/tooth grinding at night.
7. Wear facets.
8. Clicking sounds.
11. Swallowing difficulties.
12. Sore throat with no infection.

2.1 Prevalence

In a systematic review published by Lai et al. in 2020, it was reported that prevalence of TMD ranges from 21.1 to 73.3%. About 3.4–65.7% of patients reported pain as TMD signs and symptoms and non-painful ranged from 3.1 to 40.8%. The study showed greater predilection of TMD for females than males and adults (>18 years) than young patients. Though this study reported no correlation of malocclusion to TMD, there are implications of several occlusal traits.

2.2 Temporomandibular dysfunction (TMD) and malocclusion

Relationship of occlusion with TMDs has long been debated. Costen’s syndrome as given by Dr. James Costen correlated TMJ pain, headache, limited mandibular opening, and ear symptoms with increased overbite. Thompson suggested correction of malocclusion to correct TMJ symptoms.

Malocclusion, be it skeletal or dental, shows disharmony in all the three planes of space—sagittal, vertical, and transverse.

2.2.1 Transverse malocclusions

Unilateral posterior cross-bite is found to be mostly related to TMJ clicking and myofascial pain. It is thought that patients with such a situation have abnormal contacts that affect the relationship between condyle and fossa. Case studies have shown that improving the occlusal factors by orthodontic treatment did not completely improve the TMD symptoms reflective of anatomic contribution of glenoid fossa and condyle head. Through electro-myographic studies, it was concluded that unilateral posterior cross-bite causes asymmetric activation of masticatory muscles leading to overloading on one side and joint symptoms. Though symptoms were more commonly observed in adults than in growing patients, surveys have shown role of emotional well-being and sleep bruxism on TMD symptoms. A recent study by Yap et al. reported a higher level of psychological disturbance and poor quality of life in patients with moderate-to-severe TMD [5, 6]. Acupuncture has been shown to be effective in reducing pain and improving quality of life in TMD patients [7].
2.2.2 Sagittal and vertical malocclusions

Evidence shows correlation between TMD and increased overjet, vertical growth patterns, open bite malocclusions, disc displacements and degenerative changes.

To sum up, TMDs have a multifactorial etiology and cause effect relationship between occlusion and disorders have to be further explored as some occlusal changes may be the result rather than a cause of malocclusion.

2.3 Temporomandibular disorders (TMDs) and orthodontics

Clinical management of TMDs has been a topic of controversy for nearly 100 years. There have been two events in the history that have attracted attention of the dental fields. The first was in 1934 when Costen related TMJ and ear pain to changes in the vertical dimension. Second was Gnathological society papers that correlated balance between functioning of the jaw and occlusal positions. The aim was to achieve a canine protected occlusion and no centric relation-centric occlusion (CR-CO) discrepancy [2].

Since then, various theories have been formulated to understand TMDs. Orthodontic Stalwarts like Brodie, Moyers, Ricketts have worked significantly to understand the concept of TMJ, jaw function, and occlusion. Ronald Roth played an important role in introducing the concept of gnathology and prosthodontics into orthodontic patients. He suggested optimal functional occlusal goals by coinciding CR with CO. To achieve these goals, he suggested Roth power bite registration and use of articulators. These philosophies were in contrast to another group of orthodontists who were against traditional premolar extraction in orthodontics and retainer wear and attributed TMDs to extraction.

Interesting turn of events happened in 1987 in Brimm vs. Malloy Michigan lawsuit in which a 16-year-old female was treated for a class 2 malocclusion with a 7-mm overjet with upper first premolar extraction, fixed orthodontics, and headgear. After removal of fixed appliances, during retainer wear, she complained of headache and joint pain. She had no signs of TMD before or during the treatment. She was referred to an oral surgeon for removal of lower third molar. This further increased her problem as she developed severe pain, clicking, and locking of joint.

Following lawsuit, Oral surgeon was sued for $2500 for not being able to diagnose TMD and Orthodontist was sued for $85,000 for causing internal derangement of TMJ by extraction and over-retraction of incisors resulting in distal displacement of mandible.

In 1992, January issue of AJODO, studies done by American Association of Orthodontists were published concluding no association between jaw structure and TMDs. It also stated that the development of TMDs cannot be predicted. TMD symptoms may increase with age; thus, TMD symptoms may arise during orthodontic treatment but may not be related to treatment. TMD correction may not be assured once present, though evidence supports the beneficial effect of orthodontics in reducing the symptoms of TMD.

3. What do we know till now?

Based on evidence accumulated over years, it is supported that orthodontic treatment with or without exodontia, head gear use, chin cup, elastics or deep bite
correction do not cause TMDs and upper incisors can be safely retracted. This does not cause distal position of condyles and consequent anterior position of the disk.

Best way to plan treatment is in patients with original jaw relation in centric occlusion and no dual bite present. Patients’ condyle position should be protected throughout fixed orthodontic and adjunctive treatment, and any procedure that may shift the condyles away from the original physiologic position may affect the patient.

Clinical Trials by OPPERA (Orofacial Pain: Prospective evaluation and risk assessment trials) have shifted emphasis of TMDs from a mechanical to a biopsychological mode of management. Placebo medications, deprogramming appliance therapy, and occlusal equilibration only have yielded favorable responses, and it becomes clear that there may be another pathway to alleviate pain and shifting to invasive, and more aggressive treatments should be deferred if conservative and reversible TMJ treatments are possible [2, 8–11].

4. What can be the contribution of orthodontists?

1. Develop an evidence based clinical practice.

2. Conduct a proper TMJ examination and educating the patient about appearance of symptoms during or after treatment if predisposing factors exist.

3. Document all findings and informed consent.

4. Address TMJ pain before starting orthodontic therapy.

5. Avoid diagnosis and treating TMDs within mechanical boundaries. If symptoms arise during the active treatment phase, stop all the treatments and focus on managing TMJ pain. Try to manage with conservative and reversible methods.

5. Do’s for TMD patients

1. Biopsychosocial profile modulation by the patient has shown to be beneficial.

2. Fruit and vegetable diet is helpful to reduce the pain.

3. Use of cannabidiol oils help reduce anxiety.

4. Craniosacral therapy—Gentle fascia palpation techniques help release restrictions between cranium and sacrum.
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