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Temporomandibular Disorders in Orthodontics: Review on Current Evidence and Protocols

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***Abstract*: Temporomandibular disorders (TMDs) are the most common cause of pain of non-dental origin with uncertain etiology involving several direct, indirect, precipitating, initiating and perpetuating factors. Over the years studies focusing on long term orthodontic procedures and its impact on temporomandibular joints were carried to evaluate the relationship between occlusal factors, orthodontic treatment and TMDs. Thus it is important to rule out other causes of Temporo-mandibular joint (TMJ) pain before considering occlusal disturbances as potential etiological factor. The present brief review was carried to outline the possible association between orthodontic procedures, treatment and occurrence of TMDs. The present assessment revealed there is little supportive evidence currently available to establish orthodontic treatment as a substantial predisposing factor for TMDs. Several studies hypothesized that TMJ disturbances by muscular hyperfunction, increased masticatory muscle activity and occlusal interferences resulted in pain and dysfunction at the joint. However it was also postulated that orthodontic treatment combined with orthognathic surgery significantly reduced pain on patients who show TMDs pre-operatively. It must be noted that vast majority of patients with TMDs, show favorable prognosis that subsides with appropriate treatment strategies.**

***Keywords*: Bruxism, Crossbite, Malocclusion, Occlusal disturbances, Trauma from occlusion.**

1. Introduction

Temporomandibular disorders (TMDs) are musculoskeletal disorders of multifactorial etiology that involves the masticatory muscles, the temporomandibular joint (TMJ) and the associated structures resulting in clicking sound or grating sensation during masticatory/mandibular movements, difficulty in mouth opening, facial deformities and predominantly pain at the oro-facial region including head, face and jaw-related structures [1, 2]. It is the most common cause of pain of non-dental origin with uncertain etiology involving several direct, indirect, precipitating, initiating and perpetuating factors [3]. Psychological stress, systemic diseases, TMJ structural abnormalities and genetic factors are precipitating factors that increases the risk of TMDs. On the other hand, Trauma from occlusion, para-functional habits, malocclusion and traumatic injuries can initiate the onset of disorder whereas metabolic disorders, muscular tension, stress and mechanical tension interfere with healing and management of TMDs [3, 4]. Among these, occlusion deviations, correction of malocclusion are frequently mentioned as one of the major etiological factors from an orthodontic perspective causing TMDs [5].

Various theories have been put forwarded such as mechanical displacement, trauma, osteoarthritis, muscle theory, neuromuscular, psychophysiological, psychosocial theory to cause TMDs [6]. Over the years studies focusing on new esthetic therapy, prosthetic rehabilitation, long term orthodontic procedures and its impact on temporomandibular joints were carried to evaluate the relationship between occlusal factors, orthodontic treatment and TMDs [7, 8]. Certainly, claims that orthodontic treatment may induce or cure TMDs should be supported by good evidence based studies. However, literature review, evidence based reports, metanalysis and systematic review are not sufficient enough to provide a conclusive evidences except few systematic reviews, case report and case control trials focused on establishing the possible relationship. Thus the present brief review was carried to outline the possible association between orthodontic procedures, treatment and occurrence of TMDs.

2. Methodology

A structured literature search for articles written in the English language in PubMed/MEDLINE, EBSCOhost, Google Scholar, Scopus, and Web of Science databases was retrieved by using MeSH terms “Temporomandibular disorders” OR “Orthodontics” AND “Dental”, “Dentistry” AND “Occlusal Interference” "Occlusal factors, Dental" OR “Orthodontics” OR “Malocclusion” OR "All Metadata", “Dental, Orthodontic treatment”.

1) Temporomandibular Disorders

The temporomandibular joint (TMJ) is a ginglymo-bi-arthrodial synovial joint comprises of the mandibular fossa and articular tubercle from the squamous part of the temporal bone, and the head of mandible forming the articulating surfaces enclosed in a fibrous capsule separated by an articular disc into

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two (upper and lower) compartments each lined by a synovial membrane. Lateral ligaments, Spheno-mandibular ligaments and Stylo-mandibular ligaments ate the three extra-capsular ligaments act together to stabilize the joint cavity. Movements at this joint namely protrusion, retraction, elevation, and depression are produced by the muscles of mastication, and the hyoid muscles [9, 10]. Temporomandibular disorders (TMDs) are musculoskeletal disorders that involves the masticatory muscles, the temporomandibular joint (TMJ) and the associated structures.

TMDs are categorized into three major types as follows: 1) Joint disorders that includes a) Derangement of condyle-disc complex: Disc displacements, Disc dislocation with reduction, and Disc dislocation without reduction; b) Structural incompatibility with articular surfaces: Deviation in the form, adherences and adhesions, subluxation and luxation, hypermobility of the joints, and dislocations; c) Inflammatory disorders: Synovitis, Capsulitis, Arthritis, Retrodiscitis, Arthralgia, Osteoarthritis, Osteoarthrosis and Systemic arthritis. 2) Chronic Mandibular Hypermobility (CMH) that includes ankylosis, muscle contracture, or coronoid process resistance and 3) Growth Disorders and disturbances such as agenesis, atrophy, hyperplasia, hypoplasia, hypotrophy, hypertrophy and neoplasia from deficiencies or alterations in growth patterns that typically result from trauma. Trauma at the joint cavity, trauma from occlusion, straining of joint structure due to parafunctional habits, malocclusion, and deformities can initiate the onset of TMDs [3, 11]. Numerous etiological and therapeutic theories have observed that use of therapeutic approaches such as occlusal appliance therapy, occlusal adjustment therapy, orthodontic appliance therapy, orthognathic surgical interventions, anterior repositioning appliances and restorative procedures as potential factor for incidence of TMDs [12, 13].

2) Occlusal Interferences and TMDs

Relationship between occlusion and temporomandibular joint has been considered as a risk factor for TMDs. Earlier studies have shown loss of vertical dimension and increased deep bite led to anatomical changes in the joint causing otalgia. Similarly occlusal interferences by bruxism or any parafunctional habits triggered muscular imbalance induced excessive workload of the masticatory muscle, tenderness, pain and TMJ clicking. Hence, the dental experts focused on massive occlusal equilibration to ensure an ideal occlusal equilibrium is achieved without compromising the supporting structures [14]. In accordance with this Michelotti et al [15], Le Bell et al [16] in their respective studies to observe the effect of occlusal interference on masticatory muscles noticed active occlusal interference condition such as lower contact angle, reduced contact surfaces, and disturbances in intercuspal position caused myofascial pain and discomfort followed by rapid adaptation to the disturbed occlusal condition with gradual decrease in occlusal distress. These studies hypothesized that TMJ disturbances by muscular hyperfunction, increased masticatory muscle activity and occlusal interferences resulted in pain and dysfunction at the joint.

According to Thomson hypothesis, malocclusion induced TMDs by posterior and superior displacement of the condyle necessitates downward and forward placement of the condyle to ensure free movement of the mandible [6]. Population based studies by John et al [17], Hirsch et al [18] failed to demonstrate a relationship between overbite or overjet and TMD signs and symptoms. Sato et al [19], Lippold et al [20] showed altered morphological occlusal relationship between maxilla and mandible resulted in reduced height of the condyle, variations in condyle-fossa relationship with differences in functional unilateral posterior crossbite during early growth phase. Thus the association between TMJ disc displacement and unilateral posterior crossbite has been well established in several similar population-based cross-sectional study. However it was also postulated that early treatment of unilateral crossbite or posterior crossbite during mixed dentition period prevent malocclusion and asymmetric facial growth in contrast to reduced skeletal adaptations seen in adults. Simultaneously, asymmetric pattern of jaw reduced masseteric muscle form and induced reverse chewing pattern. LeResche et al in an exhaustive review of evidence based literature concluded occlusion is now considered only as a cofactor while etiological factors, such as trauma, parafunctional behavior, psychosocial disorders, gender, and genetics should be considered of more importance [21].

3) Orthodontic Treatment and TMDs

Occlusal correction rather than occlusal interference was believed to possess more possible association with TMDs. Orthodontic procedures that included extraction, functional appliances, class II elastics, class III elastics, chin-cup, headgear, fixed or removable appliances were explored by cross sectional studies to identify incidence of TMDs. Orthodontic treatment performed during adolescence generally does not increase or decrease the chances of developing TMDs later in life though TMDs are more prevalent with increase in age, particularly during adolescence [22]. Orthodontic treatment reduces the occurrence of parafunctional habits and restricts the possibility of injury to the oral and paraoral tissues caused by bruxism. No earlier literature studies have shown association of extraction, orthodontic mechanics and simple orthodontic procedures including extrusion, intrusion, overjet and overbite correction with TMD signs and symptoms. Gateno et al [23] described increased prevalence of retro-positioned condyle in disc displacement patients suggestive of importance of maintaining the condyle in the centric relation position during orthodontic treatment. In particular, it has been put forwarded that premolar extractions in the maxilla can cause a posterior displacement of the condyle which in turn could increase risk of temporomandibular joint dysfunction.

The assumption that functional appliances, class II elastics, class III elastics, chin-cup, and headgear, fixed or removable appliances as etiological factors for TMDs has also been evaluated in recent decades. Henrikson and Nilner [24] showed orthodontic treatment did not increase the risk or aggravated the pre-treatment signs of TMD instead reduced significantly with fixed appliances over the duration of 2 year treatment. Pahkala and Heino [25], Wolford et al [26] in an observational study on patients undergoing orthognathic surgeries suggested that

surgery may alleviate signs and symptoms of TMDs. Conversely Farella et al [27], Abrahamsson et al [28] reported that bi-maxillary osteotomy did not initiate or aggravate signs and symptoms of TMDs. A literature review by Michelotti and Iodice [6] on role of orthognathic surgery with frequency of TMDs revealed inconsistent findings owing to wide range of surgical techniques, limited skeletal malocclusion reported cases with TMDs and insufficient follow-up period. Finally, several longitudinal studies investigating the relationship between orthodontic treatment and TMDs concluded that orthodontic treatment neither causes nor prevents TMDs and that individuals with previous history of traditional orthodontic treatment, including Begg appliance, Herbst appliance, Class II elastics and extraction, activator, bionator and headgear, facial mask and chin-cup did not show higher risk of new or long-term TMDs.

4) Treatment Protocols in Patients with TMDs

Prior to orthodontic treatment complete medical and dental history should be evaluated. Physical examination includes observation of unusual TMJ sounds, crepitation, decreased or abnormal jaw movements, signs of bruxism, tenderness of muscles of mastication, myalgia over neck, and shoulder, and postural asymmetry should be recorded regularly at 6-month intervals, and informed consent should be signed by the patient after each evaluation. Further radiographic examination of teeth and TMJ, Diagnostic casts, advanced imaging studies like computed tomography (CT) or magnetic resonance imaging (MRI) are beneficial in severe, chronic, or suspected structural abnormalities of TMJ [29, 30]. Following diagnosis, conservative treatment including physiotherapy, exercises, counselling, cognitive behavioral therapy and pharmacotherapy with or without occlusal appliances is performed initially. Intraoral appliances, such as occlusal stabilization splints, have been recommended for many decades for jaw disorders and continue to be a common treatment modality. The stabilization splints are fabricated to reproduce the functional occlusion arrangement, to eliminate harmful protective co-contraction during the splint therapy and also to achieve a musculo-skeletal stable position of the TMJ condyles [31].

Once the pain subsides completely orthodontic therapy can be initiated as per patient's requirement. Activating orthodontic appliances in patients with TMDs can cause transient discomfort or pain thus aggravating the disease. The treatment should be planned and altered as signs and symptoms of TMDs are inconsistent and unpredictable that can occur during the course of orthodontic treatment. Perhaps poorly completed orthodontic therapies do reveal risk factors for TMDs. Studies focusing on TMDs including development disorders, arthritis, condylar resorption, and osteoma also showed marked facial asymmetry that can induce significant malocclusion. It is thus crucial, that orthodontists recognize the presence of TMDs signs and symptoms with pre-treatment history before beginning orthodontic treatment so that patients will not consider TMDs as a consequence of orthodontic therapy [32, 33]. As a result, their identification is of great significance in planning and managing orthodontic treatment. It must be noted that vast majority of patients with TMDs, show favorable prognosis and TMDs subsides with appropriate treatment strategies.

3. Conclusion

Trauma at the joint cavity, trauma from occlusion, straining of joint structure due to parafunctional habits, malocclusion, and deformities can initiate the onset of TMDs. There is little supportive evidence currently available to establish orthodontic treatment as a substantial predisposing factor for TMDs. Several studies hypothesized that TMJ disturbances by muscular hyperfunction, increased masticatory muscle activity and occlusal interferences resulted in pain and dysfunction at the joint. However it was also postulated that early treatment of TMDs caused by unilateral crossbite or posterior crossbite during mixed dentition period prevent malocclusion and asymmetric facial growth in contrast to reduced skeletal adaptations seen in adults. Orthodontic treatment combined with orthognathic surgery significantly reduced pain on patients who show TMDs pre-operatively. It is thus crucial, that orthodontists recognize the presence of TMDs signs and symptoms before planning and managing orthodontic treatment. It must be noted that vast majority of patients with TMDs, show favorable prognosis that subsides with appropriate treatment strategies.

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