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Types of Occlusal Splint in Management of Temporomandibular Disorders (TMD)

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Abstract

Treatment options for TMD include reassurance (patient education, self-care and behavior therapy), physiotherapy (such as ultrasound, acupuncture, short wave diathermy laser, heat exercises, and biofeedback), occlusal splint therapy, drug therapy, occlusal adjustment, surgical intervention and combined treatment.

The purpose of this paper was to review information regarding the types, designs, and materials of occlusal appliances. In this review article, authors reviewed the literature concerning Occlusal Splint in Management of Temporomandibular disorders (TMD).

Keywords: Occlusal appliance; Temporomandibular disorders

Introduction

The Temporomandibular joint (TMJ) is the joint between the lower jaw and the base of the skull. TMJ disorders (TMD) refers to a group of disorders with symptoms that include pain, clicking, noise, grating in the jaw joint or problems chewing or opening the jaw. It is also known as Craniomandibular disorders (CMD) and is one of the most frequent causes of facial pain.

The signs and symptoms of TMD commonly include pain, joint sounds (clicking, grating), and limited or asymmetrical jaw movement that may have an effect on the quality of life.

Anderson et al. [1] reported that approximately 75% of the population having at least one sign of joint dysfunction (abnormal jaw movement, tenderness on palpation, joint noises, etc.).

Treatment options for TMD include reassurance (patient education, self-care and behavior therapy), physiotherapy (such as ultrasound, acupuncture, short wave diathermy laser, heat exercises, and biofeedback), occlusal splint therapy, drug therapy, occlusal adjustment, surgical intervention and combined treatment.

In this paper, we will review the literature concerning Occlusal Splint in Management of Temporomandibular disorders (TMD).

Review of Literatures

According to the glossary of prosthodontic terms [2], occlusal Splint defined as a removable artificial occlusal surface used for diagnosis or therapy affecting the relationship of the mandible to the maxillae. Occlusal appliances may be used in different ways for occlusal stabilization, prevent wear of the dentition, or to for treatment of TMJ disorders [3].

Although, there are different types of occlusal appliances have been used a long time ago to treat temporomandibular disorders, till now still there is considerable debate about the design of occlusal appliances, how they should be used, and mode of curing action.

Based on literature, the concept that occlusal appliances curing action still controversy, some of investigator believed that this curing action may be owing to their placebo effect rather than the actual therapeutic effect in the management of some TMDs.

Occlusal appliances were originally made from acrylic resin and cover all or most of the teeth in one arch. Now day there are recent advance in materials, designs and using occlusal appliances as therapeutic devices [4].

The mechanisms of action of the occlusal appliances as a treatment including occlusal disengagement, restoring vertical dimension of occlusion, muscles relaxing, joint unloading, or TMJ repositioning [5].

The occlusal appliances are considered as deprogrammers or jaw repositioners to establish ideal maxillomandibular relationships and thus relieve pain and restore the function. Unfortunately, these concepts are defective for the following reasons: firstly, their underlying assumptions that both muscular and TMG pain and dysfunction primarily arise from the strain of dealing with improper occlusal ;secondly, their failure to recognize the multiple effects that occlusal appliances can produce; and finally, their presumption that, the symptomatic improvement if occur as a result temporary occlusal changes produced by the occlusal appliances, permanent alterations to the patient's occlusion through extensive and irreversible dental treatments must be followed [4].

Occlusal Appliances (splints) Materials

Commonly there are two different materials, based upon consistency, which are used in the fabrication of occlusal appliances. There are hard acrylic resin Occlusal appliances that are either self-

cured (by chemical reaction) or heat cured, resulting in hard and rigid tooth-borne and occlusal surface. In other hand, there are soft or resilient occlusal appliances, the soft appliance are somewhat flexible and pliable tooth-borne and occlusal surface. A third variation of material known as dual laminated, as its occlusal surface consists of hard acrylic resin and the tooth-borne surface consist of a soft material. This produces an occlusal appliances with advantages of a soft material (fitting well and providing comfort for the supporting teeth), and an adjustable occlusal surface of the hard acrylic resin [6].

Hard acrylic resin occlusal appliances can be either custom fabricated at chairside or indirect fabrication in the dental lab rotary by use of stone casts. The soft occlusal appliances can be purchased readily from dental supply houses this type of occlusal appliance ("boil and bite") is molded and adapted by boiling the product in water and then placing the material intra-orally with a biting force to establish the preferred correct occlusion. Another variation of the soft occlusal appliance is a dental office fabricated type, in which the material is vacuum formed to fit stone casts, and then the occlusion is later established at chairside. A third variation involves a similar processing technique which occurs at a commercial laboratory and then the occlusion established once again at chair side [7].

Hard acrylic resin occlusal appliances have several advantages over the soft appliances; hardness and resistance of the acrylic resin enable easily and quickly adjustments, easily repaired, the fit of a hard acrylic resin is more accurate, methods of fabrication is more reliable and greater longevity, more color stable, less food debris accumulation and more durable than that of the soft version. In contrary, the adjustment of soft material is more difficult and often results in a less adequate occlusal scheme. And these appliances are more susceptible to wearing that in turn result in occlusal changes [6,7].

Form economic point of view the soft occlusal appliance compared with the hard appliances are of low cost [4]. Soft occlusal appliances recommended by some investigators for the reduction of both muscular and arthrogenous TMD symptoms [8,9]. However, in an electromyography (EMG) crossover study, between hard and soft occlusal splints involving ten bruxism subjects who wore hard appliances at first and then were switched to soft appliances after a washout period, the authors found that eight of the ten subjects experienced a significantly reduced nocturnal muscle activity with the use of hard occlusal appliances [10]. In comparison, the soft occlusal appliances significantly reduced muscle activity in only one participant and caused a statistically significant increase in EMG activity in five of the participants.

Supporting the pervious trail finding, another EMG study comparing the effects of hard and soft Occlusal appliances on the activity of the masseter and temporalis muscles during controlled clenching, the muscles activity was decreased more with use of a hard occlusal appliance, and the soft Occlusal appliances produced a slight increase in master and temporalis muscles activity [11].

Another EMG study, after the immediate insertion of a soft occlusal appliance during maximum clenching it was found that the masseter muscle activity was increased [12]. In Contrary, other studies involving hard and soft occlusal appliances comparisons in management TMD subjects, the authors found no differences in either clinical findings or in self-reported symptoms between the two modalities [8,9].

Types of Oral appliance for Treatment of TMD

Different types and designs of occlusal splints with different classification were reported in the literature. Classification of occlusal appliances according to Okeson [5] include 1) Muscle relaxation appliance/ stabilization appliance used to reduce muscle activity 2) Anterior repositioning appliances/ orthopedic repositioning appliance e 4) Anterior bite plane 5) Pivoting appliance 6) Soft/ resilient appliance classification of occlusal appliances according to Dawson [13] include 1) Permissive splints/ muscle deprogrammer 2) Directive splints/ non-permissive splints 3) Pseudo permissive splints (e.g. Soft splints, Hydrostatic splint)

Flat Plane Stabilization Appliance (Michigan splint)

Also known as the gnathologic splint, Michigan splint, or muscle relaxation appliance. This appliance is generally fabricated for the maxillary arch but, for esthetics and avoid interference with a speech; some clinicians have recommended that it could be placed for the mandibular arch. Turp et al. [14] concluded that, based on their systematic review, no differences in reduction of symptoms whatever the appliance placed either for maxilla or mandible.

The purpose of stabilization appliance as outlined by the American Academy of Orofacial Pain guidelines is to "provide joint stabilization, protect the teeth, redistribute the occlusal forces, relax the elevator muscles, and decrease bruxism." Additionally, it is stated that "wearing the appliance increases the patient's awareness of jaw habits and helps alter the rest position of the mandible to a more relaxed, open position" [15].

The occluding surface of the appliance should be occlude uniformly, evenly, and simultaneously with the opposing dentition. Many practitioners recommended the incorporation of canine- protected occlusion to disocclud the posterior teeth during eccentric movements. Some investigators preferred this design in asymptomatic individuals and reported that this concept is more effective in reducing muscle activity [16,17]. However, other studies have shown no differences in muscle activity in healthy subjects [18] or in TMD symptom reduction by applying the canine protected occlusion to the appliances [19]. The muscle relaxation appliance is the most commonly used type of occlusal appliance, and it has the least adverse effects to the oral structures when properly fabricated [20].

Anterior Bite Plane: Traditional Anterior Bite Plane

The origin of anterior bite plane related to orthodontist many years ago. In general, these appliances are designed as a palatal-coverage horseshoe shape with an occlusal table covering 6 or 8 anterior maxillary teeth. Advocates for using such appliances to treat TMDs based on their ability to prevent clenching, as posterior teeth are not engaged in functional or in Para-functional activities. However, an adverse effect may occur in the form of overeruption of posterior teeth which is extremely unlikely if worn only at night and without posterior support the TMJs will be overloaded [4].

Anterior Bite Plane: Mini Anterior Appliances

It's an oral appliance that engaged only 2-4 maxillary incisors. Different designs of minianterior appliances include the Nociceptive Trigeminal Inhibition Tension Suppression System (NTI), the Anterior Midline Point Stop (AMPS) devices, and the Best Bite. All made of hard acrylic resin that are either developed directly at chairside or

produced in prefabricated designs commercially. The commercial types of these appliances require custom fitting at chairside by relining the tooth born side with acrylic resin or hard elastic impression materials to fit on the maxillary incisors, after that the occluding surface is adjusted to allow 2-4 mandibular incisors to contact a platform. The purpose of this appliance is to disengage the posterior teeth, thus eliminating the influences of the posterior occlusion on the masticatory system. The anterior bite plane thought to be effective in treating TMDs and headaches [21].

Jokstad et al. [21] In a double-blind randomized parallel trial, compared the NTI to a flat plane appliance in TMD subjects with a headache, thy found no differences between appliances over a three month period in respect to muscle tenderness upon palpation, patients self-reported TMD-related pain and headache, or improvement on mouth opening. In a study comparing the anterior midline point stop device to a flat plane stabilization appliance, they found that there was no significant difference between the appliances regarding their efficiency in relieving muscular pain [22]. In another well-designed RCT, the NTI was found to be less effective than the stabilization appliance in the treatment of TMDs [23].

The possibility of adverse occlusal changes occurring with a minianterior appliance with continuous and long-term use is of major concern. The design of the appliance only covers the maxillary anterior teeth, leading to the potential for overeruption of the posterior teeth resulting in an anterior open bite. Furthermore of the intrusion maxillary anterior teeth which retain the appliance could exaggerate the problem of an anterior open bite. It also is possible that the one point design for occlusal contact with the lower anterior teeth may create unfavorable mobility of these teeth, or instead the maxillary anterior teeth supporting the appliance could be displaced by the occlusal forces. Furthermore, there is a possibility of a serious life-threatening event owing to the small size of these devices, in which the device may be swallowed; reports of such distressing events have been recorded [21].

Anterior Repositioning Appliance (Orthopedic Repositioning Appliance)

The intent of this appliance, is to alter the maxillomandibular relationship so that a more anterior position assumed by the mandible. Acrylic guiding ramp added to the anterior third of the maxillary appliance that direct the mandible into a more forward position, upon closing. This type of appliance designed to be used in treating patients with anterior disk displacement with reduction. It was supposed that by altering the mandibular position in this manner, the anteriorly displaced disks could return back to its normal position (recaptured), to stabilized condyle-disk relationship a new comprehensive dental or surgical occlusal procedures [24]. With long term use of this appliance, there are permanent and irreversible occlusal. so the anterior bite plane appliance should be used with caution only for short periods of time as a temporary therapeutic measure to relieve internal derangements pain [24].

Neuromuscular Appliances (NMA)

Neuromuscular dentistry (NMD) have Advocated that by use of jaw muscle stimulators with jaw-tracking machines to produce an occlusal appliance that is at the ideal vertical and horizontal position of the mandible in relation to the cranium [25]. The data regarding this concept are scars in the literature. Proponents of this methodology recommended dental reconstruction at the new jaw relationship after using these appliances.

Posterior Bite Plane Appliance (Mandibular Orthopedic Repositioning Appliances)

These appliances made to be worn on the lower arch. The design consist of a bilateral hard acrylic resin table, creates a disocclusion of the anterior teeth, located over the mandibular molars and premolars and connect with a lingual metal bar. These appliances intended to produce vertical dimension and horizontal maxillomandibular relationship changes. Moreover, some authors reported that this type of appliance able to enhance athletic performance by increase overall physical strength [26,27]; however, no scientific evidence to support this claim [28,29]. Posterior bite plane appliances were supposed to produce an “ideal” maxillomandibular relationship, and should be followed by occlusal procedures to maintain that relationship permanently. The major concern regarding posterior bite plane design is that occlusion only on posterior teeth that allow overeruption of the anterior teeth or intrusion of the opposing posterior teeth, Eventually lead to a posterior open bite [30].

Pivot Appliances

The pivoting device is fabricated with hard acrylic resin that covers the maxillary or mandibular arch with a single posterior occlusal contact, placed as far posteriorly as possible, in each quadrant. These appliances reduce intra-articular pressure by condylar distraction as the mandible fulcrums around the pivot, resulting in an unloading of the articular surfaces of the joint. The pivoting appliance was suggested for patients with internal derangements or with osteoarthritis [4]. Nevertheless, studies [31,32] have concluded that there is no distractive effect on the TMJ by occlusal pivots and instead of that can actually lead to compression of the joint. A modified version of this appliance with a unilateral pivot placed in the posterior region so that when the mandible close on this pivot this will load the contralateral joint and slightly distract the ipsilateral joint. Unfortunately, a potential adverse effect with the use of this modified appliance may cause occlusal changes as a posterior open bite in pivot area [31].

Hydrostatic Appliance

A bilateral water-filled plastic chamber attached to an acrylic palatal appliance, and the patient’s posterior teeth occlude with water filled chambers. This appliance originally designed by Lerman [33]. Latter on a modified design, retained under the upper lip, was suggested. The mode of mechanism of this appliance depends on the concept that the mandible finds its ideal position automatically as the appliance was not directing where the jaw should be. No evidence support this claims till now.

Conclusion

There are different types of occlusal appliances, each one has its special design, indication and precautions that should be followed so that clinicians strongly advised to thoroughly understand the masticatory system dynamics and perform a comprehensive examination to the TMJ and its related structures to be able to choose correct appliance perfectly with fewer complications.

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