Occlusal Splint Therapy in Temporomandibular Joint Disorders: An Update Review

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Abstract:
Occlusal splint therapy has been used routinely for diagnosis and treatment of various masticatory system disorders. Treatment with these appliances is non-invasive, reversible, and provides proper treatment. Literature provides an understanding of treatment protocol for the use of splints for temporomandibular disorders. The selection of particular splint design appropriate for patients’ disorder will be facilitated by a better understanding of its physiologic and therapeutic effects. This review article enables reader with basic splint designs and explains how and when to use these effectively.

Key Words: Bruxism, intraoral orthotic, occlusal appliance, occlusal device, occlusal splint, temporomandibular joint disorder, temporomandibular dysfunction

Introduction
Stomatognathic system is the functional unit that performs masticatory tasks such as swallowing, speaking, and helps in esthetics. It consists of temporomandibular joint (TMJ) components, masticatory muscles, and dental occlusion. All these components are interrelated and coordinated by the central nervous system (CNS). Pain is one of the most common complaints seen among TMJ dysfunction patients. It commonly originates from TMJ and masticatory muscle dysfunctions. Temporomandibular disorders (TMD) was first described by Costen (1934) as - Abnormal, incomplete, or impaired function of TMJ - A collection of symptoms frequently observed in various combinations, caused by altered anatomic relations and derangements of the TMJ associated with loss of occlusal vertical dimension, loss of posterior tooth support, and/or other malocclusions.¹

TMD is a collective term for a group of musculoskeletal and neuromuscular conditions which includes several clinical signs and symptoms involving the muscles of mastication, TMJ and associated structures.² While TMD has been defined as “functional disturbances of the masticatory system.”³ Others include masticatory muscle disorders,⁴ degenerative and inflammatory TMJ disorders,⁵ and TMJ disk displacements,⁶ under the umbrella of TMD.

In a recent update, the American Academy of Orofacial Pain divided TMD into two broad categories:
• TMJ disorders
• Masticatory muscle disorders.

Pediatric Prevalence of TMD
The reported prevalence of TMD in infants, children, and adolescents varies widely in the literature.⁷-¹⁰ This variation may be due to differences in populations studied, diagnostic criteria, examination methods, and inter- and/or intra-rated variations of examining practitioners.¹¹,¹² Prevalence of signs and symptoms increases with age. The TMD has multifactorial in origin. There are predisposing (or risk) factors, precipitating (or initiating) factors, and perpetuating factors that contribute to the development of TMD.¹³,¹⁴

Many studies show a poor correlation between any single etiological factor and resulting signs (i.e., findings identified by the dentist during the examination) and symptoms, i.e. findings reported by the child or parent. The goal of an occlusal appliance is to provide orthopedic stability to the TMJ. These alter the patient’s occlusion temporarily and may be used to decrease parafunctional activity.

Indications
• Growth modification during mixed dentition
• Limited (tippling) tooth movements desired (arch expansion, individual tooth malposition)
• Retention following orthodontic treatment
• Adjunct to fixed orthodontic appliances
• Interfere with (or prevent the development of) abnormal orofacial habits
• TMJ disorders
• Fractures of the mandible.

Contraindications
• Severe skeletal discrepancy
• Severe rotation-bodily movement needed
• Vertical discrepancy
• Severe crowding
• Very dense bone.

Occlusal splint/occlusal device
Any removable artificial occlusal surface used for diagnosis or therapy affecting the relationship of the mandible to the maxillae. It may be used for occlusal stabilization for treatment of TMJ disorders or to prevent wear of the dentition.1

Principle
Most occlusal splints have one primary function: To alter an occlusion, so they do not interfere with complete seating of the condyles in centric relation (CR).15-17

An occlusal appliance or a splint is a removable device, usually made of hard acrylic. It fits over the occlusal and incisal surfaces of teeth in one arch, creating precise occlusal contact with the teeth of opposing arch. It is commonly referred to as a night guard, bite guard, interocclusal appliances, intraoral orthotic.18 These appliances are used in TMJ disorders management. They show a positive response to myofascial pain. It has more of diagnostic value, for example, if a patient response favorable to an occlusal device then there is a positive response to the same restorative permanent treatment. Hence, it serves as an important diagnostic value before any fixed prosthodontic therapy.18 The stabilization type of splint covers all of the teeth on either the maxillary or mandibular arch and is balanced so that all teeth are in occlusion when the patient is closed, and the jaw is in a musculoskeletally stable position.18,19

Theories of Splint Action20
• Restored vertical dimension theory
• TMJ reposition theory
• Occlusal disengagement theory
• Cognitive awareness theory
• Maxillomandibular aligment theory.

What Occlusal Splints Do?
It can stabilize weak teeth, uniformly distribute occlusal forces, reduce wear of teeth, and stabilization of unopposed teeth.

What Occlusal Splints Cannot Do?
Occlusal splint does not unload the condyles. They cannot cause effects that are in violation of mechanical laws. The popular claim that a posterior occlusal splint serves as a pivot for the distraction of the condyles is in violation of facts of anatomy, laws of physics, and clinical data (Figure 1).

Types
According to Okeson3
1. Orthopedic repositioning appliance/anterior repositioning appliances
2. Stabilization appliance which reduces muscle activity/muscle relaxation appliance.

Figure 1: Occlusal splint does not unload the condyles. A posterior occlusal splint serves as a pivot for distraction of the condyles.

Other types:
3. Soft/resilient appliance
4. Anterior bite plane
5. Pivoting appliance

According to Dawson:21
1. Muscle deprogrammer or permissive splints
2. Directive splints or non-permissive splints
3. Pseudo permissive splints, for example, soft splints.

Types of occlusal splints
Permissive splints
The primary function is to unlock the occlusion and to remove deviating tooth inclines from contact areas. These eliminate noxious occlusal contacts and promote harmonious masticatory muscle function. These splints have flat occlusal surfaces. The condyles are allowed to return to their correct seated position in CR. Permissive splints are referred to as muscle deprogrammers.21

Directive splints/non-permissive splint
Directive splints guide the mandibular condyles away from the fully seated joint position when a painful joint problem is present. The sole purpose of these is to position or align the condyle-disk assemblies. These prevent full seating of the joints by guiding the mandible into a forward posture on closure into the occlusal splint. Anterior repositioning directive splints are useful in two scenarios of joint management: Severe trauma with retrodiscal edema and chronic, painful disc displacement disorders.

CR splint/superior repositioning splint (SRS)
A CR splint is a full arch hard acrylic appliance. The SRS is an interocclusal appliance that provides an occlusal relationship in the masticatory system that is considered optimal. The teeth are contacting simultaneously and musculoskeletally; the condyles will be in their most stable position. There
is canine disocclusion of posterior teeth during eccentric movement. It can be given in both the arches, but maxillary arch provides more stability. The SRS is a full coverage splint, and it incorporates a full occlusal scheme with incisal guidance. The anterior inter-occlusal acrylic is balanced to allow lateral and protrusive movements with incisal guidance.

Indications
Muscle hyperactivity, myospasms or myositis and parafunctional activity associated with increased level of emotional stress. It is very difficult to achieve proper anterior contact and guidance with the mandibular appliance. Verification that the condyle-disk assemblies are capable of normal function in the most superior position can be achieved on a tentative basis by testing in this manner:
- Load testing the joints with bilateral pressure
- Doppler auscultation
- Clench testing with the teeth separated.

Adjusting the CR contacts:
- Mark with pencil the deepest area of each mandibular buccal cusp tip and incisal edge
- The acrylic surrounding the pencil marks is removed so that the flat occlusal surface allows for freedom in eccentric movements
- Anterior and posterior contacts should be carefully refined so that they will occur on flat surfaces and occlusal forces are equalized.

Adjusting the eccentric guidance
The acrylic prominences labial to the mandibular canines is smoothed. They should exhibit about a 30-45° angulation to the occlusal plane and allow the canines to pass over in a smooth and continuous manner during protrusive and laterotrusive excursions. Mandibular canines should move freely and smoothly over the occlusal surface of the appliance (Figures 2 and 3).

Criteria for the Muscle Relaxation Appliance
The following eight criteria must be achieved before the patient is given the muscle relaxation appliance:
1. In CR, all posterior mandibular buccal cusps must contact on flat surfaces with even force
2. It must accurately fit the maxillary teeth, with total stability and retention when contacting the mandibular teeth and when checked by digital palpation
3. During any lateral movement, only the mandibular canine should exhibit laterotrusive contact on the appliance
4. During protrusive movements, the mandibular canines must contact the appliance with even force. The mandibular incisors may also contact it but with less force than the canines
5. There should be no imprints of mandibular cusps on the occlusal surface of the appliance. Surface should be flat
6. Only in the CR closure, the mandibular posterior teeth must contact the appliance
7. Posterior teeth must contact the appliance more prominently than the anterior teeth during the alert feeding position
8. The appliance should be polished so that it will not irritate any adjacent soft tissues.

Instructions and adjustments
The patient is instructed in proper insertion and removal of the appliance. When bruxism is the problem night time use is essential, while day use may not be as important. When the disorder is retrodiscitis, the appliance may need to be worn most of the time. It has been demonstrated that myogenous pain disorders respond best to part-time use (especially night time use) while intracapsular disorders are better managed with continuous use. If wearing causes increased pain, the patient should discontinue wearing and report the problem immediately for evaluation and correction.
On certain occasions fabrication of a mandibular muscle relaxation appliance may be desirable. Evidence suggests that maxillary and mandibular appliances reduce symptoms equally. The primary advantages of the mandibular type are that it affects speechless and esthetics may be better.

### Anterior Repositioning Splints

It encourages the mandible to assume a more anterior position to the centric occlusion to provide more favorable condyle relationship in the fossa. The condyle head being held in more inferior, anterior position it will mechanically persuade disk on top the condylar head position that is more favorable condylar head position. This unloading of joint decreases the inflammation in the joint and range of mandibular movement increases with a decrease in symptoms and signs of TMJ disorder. The purpose of anterior repositioning therapy is fulfilled when the retrodiskal tissues have healed sufficiently to regain a backward pull on the disk.

The fabrication of anterior repositioning splint is identical to the CR splint. It is especially important that the anterior guidance on the splint must disocclude all posterior teeth in all jaw positions except CR. Once the function is optimal, treatment consists of gradually eliminating the splint and returning the patient to a pre-existing condition.

### Indications

1. To treat disc derangement disorders. Patients with joint sounds (e.g., a single or reciprocal click) can sometimes be helped by it
2. Intermittent or chronic locking of the joint (e.g., retrodiscitis)
3. Some inflammatory disorders are symptomatically treated as the slight anterior position is more comfortable position for mandible.

### Simplified fabrication technique

Like the muscle relaxation appliance, the anterior repositioning appliance is a full-arch hard acrylic device that can be used in either arch. The anterior stop is constructed and the appliance is fitted to the maxillary teeth.

### Locating the correct anterior position

The key to successful anterior repositioning appliance fabrication is finding the most suitable position for eliminating the patient’s symptoms. The anterior stop is used to locate it. The patient is instructed to protrude slightly and to open and close in this position. The joint is revaluated for symptoms and the anterior position that spots the clicking, is located and marked with red marking paper. This contact is grooved approximately 1 mm deep with a small round bur. Self-curing acrylic is added to the remaining occlusal surface so all occlusal contacts can be established. The anterior stop must not be covered by the acrylic. This position is verified by opening and closing a few times.

### Adjusting the occlusion

The difference with this appliance is the anterior guiding ramp, which requires the mandible to assume a more forward position to intercuspal position. Flat occlusal contacts are developed for the posterior teeth, and the large lingual ramp in the anterior region is only smoothed. The ramp is developed into a smooth sliding surface so as not to promote catching or locking of the teeth in any position.

### Final criteria for the anterior repositioning appliance

The following four criteria should be met by the anterior repositioning appliance before it is given to the patient:

1. When in contact with the mandibular teeth, it should accurately fit the maxillary teeth with total stability and retention. In the established forward position all the mandibular teeth should contact it with even force
2. The forward position established by the appliance should eliminate the joint symptoms during opening and closing to and from that position
3. In the retruded range of movement the lingual retrusive guidance ramp should contact and upon closure it should direct the mandible into the established forward position
4. The appliance should be polished with smooth surfaces and compatible with adjacent soft tissue structures.

### Instruction and adjustments

Instructed to wear the appliance at night and during the day as needed to reduce symptoms. On occasion, patient may need to wear this appliance all the time depending on the severity of the symptoms (Figure 4).

### Anterior deprogrammers

It is a hard acrylic appliance worn over the maxillary teeth providing contact only with the mandibular anterior teeth. It is primarily intended to disengage the posterior teeth. By disengaging, it eliminates the influence on the function of the masticatory system.
Indications
Muscle disorders related to orthopedic instability or an acute change in the occlusal condition (Figures 5 and 6).

Disadvantages
If the appliance is worn continuously for several weeks or months, there is a great likelihood that the unopposed mandibular posterior teeth will supraerupted and the result will be an anterior open-bite. Hence, therapy must be closely monitored and used only for short periods.

Posterior bite plane
It is fabricated for the mandibular teeth. It consisted of areas of hard acrylic located over the posterior teeth and connected by a cast metal lingual bar. The treatment goal is to achieve major alterations in vertical dimension and repositioning of mandible (Figure 7).

Indications
Severe loss of vertical dimension or when there is a need to make major changes in the anterior repositioning of the mandible. Some therapists have suggested that this appliance be used by athletes to improve athletic performance. However, scientific evidence does not support this theory.

Disadvantages
Potential supraeruption of the unopposed teeth and/or intrusion of the occluded teeth. Constant and long-term use should be discouraged.

Pivoting appliance
The pivoting appliance is a hard acrylic device that covers one arch and provides a single posterior contact in each quadrant. This contact is usually established as 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 pivoting appliance was originally developed with the idea that it would lessen interarticular pressure and thus unload the articular surfaces of the joint. Unfortunately, the forces of the elevator muscles are located primarily posterior to the pivot, which therefore disallows any pivoting action. However, the pivoting appliance has been advocated for the treatment of symptoms related to osteoarthritis of the TMJs and also for the treatment of an acute unilateral disc dislocation without reduction.

Soft or resilient appliance
Description and treatment goals
The soft appliance is a device fabricated from resilient material that is usually adapted to the maxillary teeth. Treatment goals are to achieve even and simultaneous contact with the opposing teeth.

Indications
1. Protective device for persons who are likely to receive trauma to their dental arches
2. Protective athletic splints decrease the likelihood of damage to the oral structures when trauma is received
3. Clenching and bruxism.

Okeson demonstrated that nocturnal masseter electromyographic (EMG) activity was increased in
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5-10 subjects with a soft appliance; in the same study 8 of the 10 subjects had significant reduction of nocturnal EMG activity with a hard muscle relaxation appliance.

Common Treatment Considerations of Appliance Therapy

However, much controversy exists over the exact mechanism by which occlusal appliances reduce symptoms. Most conclusions are that they decrease muscle activity (particularly parafunctional activity). Before any permanent therapy is begun, one needs to be aware that there are six general features common to all devices that may be responsible for decreasing muscle activity and symptoms.

1. Alteration of the occlusal condition
2. Alteration of the condylar position
3. Increase in the vertical dimension
4. Cognitive awareness
5. Placebo effect: 40% of the patients suffering from certain TMDs respond favorably to such treatment
6. Increased peripheral input to the CNS: Any change at the peripheral input level seems to have an inhibitory effect on this CNS activity.

Conclusion

It is imperative that clinicians have a strong working understanding of masticatory system dynamics. Differential diagnosis through the screening of muscles, joints, and dental occlusion will clarify the presence of signs and symptoms of dysfunction. Various types of splints are used to treat different conditions. A proper examination and differential diagnosis is necessary to lead to a decision regarding the appropriate role of splint therapy for the particular condition. Many designs are described in the literature. This article enables clinicians to be better equipped for successful implementation of splint therapy into their treatment planning options in managing masticatory system disorders.

References