

SPLINTS IN TMJ DYSFUNCTION. HOW EFFECTIVE? A REVIEW

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ABSTRACT

Background: Temporomandibular disorders (TMD) are recognized as the most common non-tooth-related chronic orofacial pain conditions that confront dentists and other healthcare providers. Functional disturbances of the masticatory system can be as complicated as the system itself. Although numerous treatments have been advocated, the complex nature of TMD requires a multidisciplinary team. Effective treatment selection begins with a thorough understanding of the disorder & its etiology.

Objective: The purpose of this review is to examine the evidence concerning the management of temporomandibular dysfunction using various splints.

Data collection: The articles reported in this literature review were searched on PubMed/MEDLINE database, considering only the scientific journals written in English.

Outcomes: Occlusal splints must be chosen by dentists as therapeutic appliances based upon appropriate diagnosis, as opposed to a simple cure for all TMD conditions. Occlusal splints, and stabilization splints, in particular, have a positive effect as a treatment option for patients with TMD. Stabilization splints provide temporary and removable ideal occlusion. Providing an ideal occlusion by the use of splint therapy reduces abnormal muscle activity and produces "neuromuscular balance".

Conclusion: Occlusal splints are effective in many circumstances but not in all. Therefore, an accurate and specific diagnosis of a particular TMD condition is needed to effectively treat patients. In order to make definitive conclusions, the authors suggest a need for more myalgia specific clinical studies with larger sample sizes, which may enable us to evaluate the efficacy of occlusal splints in comparison with other modes of treatments.

Keywords: Temporomandibular disorders, occlusal splints, intraoral appliance.

1. Background

Temporomandibular disorders (TMD), according to the American Academy of Orofacial Pain, are defined as 'a collective term embracing a number of clinical problems that involve the masticatory muscles, the Temporomandibular joint (TMJ) and associated structures, or both'. TMD are a sub-classification of musculoskeletal disorders,¹ having a recurrent or chronic course with noticeable fluctuation over time.² Patients suffering from TMD often present with pain in the jaws, earache, headache, and myofascial pain. The pain is often aggravated by mandibular movements, like chewing and yawning. It is also frequently associated with disturbed function and limited and/or asymmetric movements of the lower jaw.³ Myofascial pain represents a neurosensory disorder involving peripheral and centrally sensitized

muscle nociceptors. It is characterized by pain and dysfunction that arises from pathologic and functional processes in the masticatory muscles. In 1969, Laskin described the myofascial pain dysfunction syndrome (MPDS) as having certain clinical characteristics and denotes to any muscle disorder (not an intracapsular disorder).⁴ Myofascial pain arises from hypersensitive areas in muscles called trigger points. These localized areas in muscle tissues and/or their tendinous attachments are often felt as taut bands when palpated, which elicits pain. The exact nature of the trigger point is not known.⁵

In most cases, the symptoms are the reason for the increased tension of the masticatory musculature, and the parafunctions.^{6,7} Due to the large subjectiveness of the symptoms, TMDs are very difficult to diagnose, especially because patients usually search for help from other

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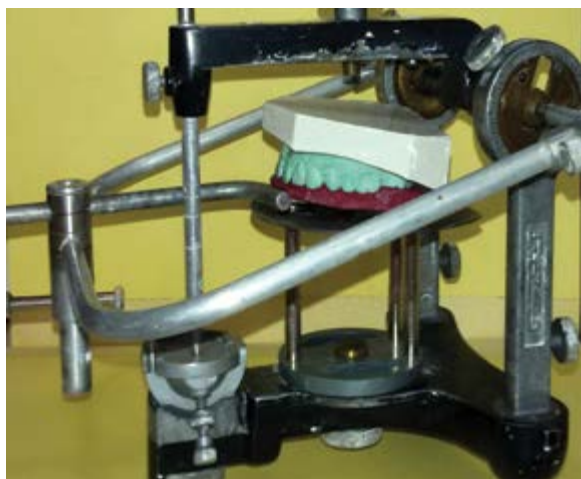


Figure 1. Face bow record transfer for centric stabilization splint



Figure 2. Centric stabilizing splint in use



Figure 3. Occlusal contacts in centric relation position



Figure 4. Corresponding contacts in mandibular arch during use of centric stabilizing splints

specialists besides dentists (e.g., neurologist, otolaryngologist or ophthalmologist).^{8,9} Management of TMD aims at relief of pain, reduction of load on masticatory muscles and TMJ, and restoration of normal function. Several different therapies, most of them conservative and reversible, others irreversible, have been advocated for patients with TMD. A number of successful treatment outcomes have been reported. Therapies may include occlusal appliances, pharmacological interventions, physical therapy, physical self-treatment, psychological intervention, acupuncture, and biofeedback.¹⁰ More complex TMD conditions are recommended to be managed using combinations of single therapies.^{11,12} Orthopaedic appliances, also referred to as intraoral appliances, occlusal splints, orthotics, night guards, or bruxism appliances, have reported 70-90 % rate of clinical success.

2. Data collection

The articles reported in this literature review were searched on PubMed/MEDLINE database,

considering only the scientific journals written in English; case reports were excluded.

The keywords selected were "temporomandibular disorders", "occlusal splints" and "intraoral appliances".

2.1. Occlusal splint therapy

To achieve the proper relation of the jaw, the centric relation (CR) should be restored. It is easily performed by occlusal splints. An occlusal appliance is any removable artificial occlusal surface used for diagnosis or therapy affecting the relationship of the mandible to the maxilla. Occlusal appliances may be used for occlusal stabilization, for the treatment of temporomandibular disorders, or for the prevention of dentition wear.¹³ Occlusal splints are used in a vast majority of patients with TMDs to restore the static and dynamic symmetry of the stomatognathic system. Most commonly, they are used in cases with disc displacement.^{14, 15, 16} Different types of splints used in occlusal splint therapy include permissive, nonpermissive, hydrostatic, and soft rubber (silicone) splints. The type of splint utilized is dependent on the diagnosis. One of the most popular occlusal splints is the Michigan-type bite splint (Figs 1 - 4),

Table 1. Classification of occlusal appliances

Type of occlusal appliances	Activity	Recommendations
Reflex appliances e.g. Interceptor, Anterior Plateau, NTI-tss	Prevent habitual tooth contact prevent gnashing and clenching	Acute symptoms that can be attributed to overloading of the tissues
Stabilization appliances e.g., Michigan type splint	Synchronous tooth contact in a centric condyle position in static occlusion and an anterior tooth position with disclusion in the lateral teeth region in dynamic occlusion.	For acute or chronic symptoms and also in psychological and physiological overloading reactions.
Repositioning appliances e.g., Anterior repositioning splint	The temporomandibular joint or joints is/are set in a therapeutic position by the splint to support healing and to maintain a symptom-free joint posture.	Anterior disc displacement with and without reduction, temporomandibular joint compression, retral displacement of the condyle and osteoarthritis. Can be used as a short-term or long-term therapy.
Superior repositioning appliance	To allow complete reseating of the condyle disk assembles up the eminence to the superior centric relation axis.	Establish the correct skeletal relationship before the correct occlusal relationship is determined.
Anterior bite plane	To disengage the posterior teeth and thus eliminating their influence on the function of the masticatory system.	For treatment of muscle disorders related to orthopedic instability or an acute change in occlusal condition. Parafunctional activity may also be treated with it but only for a short period.
Posterior bite plane	To achieve major alterations in vertical dimension and mandibular positioning.	Advocated in case of severe loss of vertical dimension or when there is a need to make major changes in anterior positioning of the mandible. For disc derangement disorders.
Soft and resilient appliance	To achieve even and simultaneous contact with the opposing teeth.	Protective device for persons likely to receive trauma to their dental arches e.g. athletic splint. For patients exhibiting high levels of clenching and bruxism, they help dissipate some heavy loading forces encountered during parafunctional activity.

precisely described by Ramfjord and Ash Jr.¹⁷ This splint could be used in both dental arches, but preferably in the maxilla. The mandibular splint is used when the posterior area misses teeth in the mandible and unwanted tooth movement must be avoided. The main purpose of this device is to disengage the occlusion, place the condyle in the centric position, relax the masticatory muscles and prevent further tooth wear due to nocturnal parafunctional activity. The main features of this splint are freedom in centric and canine guidance. It is important to note that the relation of the maxillary and mandibular arches may differ after the treatment when compared to the initial state,

especially when partial coverage splints are used.^{14,18} The occlusal splints are also used in the initial phase of treatment in patients with mouth overclosure caused by a pathologic deep bite. Before the prosthetic rehabilitation of the severe tooth wear, one should remember that initially, splint therapy should be applied to adapt the stomatognathic system to the new occlusion.²⁰ A classification of the occlusal appliances with activities and recommendations is presented in Table 1. Normally, it is suggested that patients wear the splint only at night. The splint needs to be adjusted (rebalancing of the splint to the new position of the jaw by

grinding some of its surface points, since the lower jaw will adopt a new position as a result of wearing the splint) over several visits as the masticatory muscles relax until a consistent jaw relationship is reached.

The patients then should be reviewed at regular intervals.

After a period of successful splint therapy (normally between two and three months), patients can be weaned off the splint.⁸

3. Outcomes

There are various ways of evaluating the effectiveness of occlusal splint therapy such as:

1. Visual analogue scale (VAS).
2. Clinical stomatognathic examination
3. Initiative on Methods, Measurement, and Pain Assessment in Clinical Trials (IMMPACT)
4. Research diagnostic criteria. RDC/TMD
5. Clinical and anamnestic index
6. Radiographs and CT-scans
7. MRI scans
8. Real-time ultrasonography
9. Vibratography
10. Electromyography
11. Jaw tracking device

Most of the patients who suffer from TMD problems of mainly muscular origin benefit from stabilization splints, but there is not enough evidence that they are better than placebo splints, soft splints or other conservative treatment methods.²¹ Recently, randomized clinical trials (RCT) have found that stabilization splints are more effective than other treatments.^{22,23} However, there are studies that have yielded contradictory results.^{24,25} Because of these diverse opinions, there obviously is a strong need for further RCTs to identify if a stabilization appliance is really effective.

Walczynska-Dragon and Baron⁸ have proven that occlusal splint therapy using the SVED (Sagittal Vertical Extrusion Device) appliance decreases not only aches in the head and all parts of the spine but also disc displacements within 3 weeks of treatment. The next decrease in frequency of unwanted, unfavorable symptoms was observed after 3 months of treatment with splints. When properly performed, these splints also unblock a limited mouth opening.

Research performed by Lee et al.¹⁹ in a group of 59 patients with somatic TMJ dysfunction showed that intraoral appliance could improve cervical spine alignment and alleviate symptom severity.

Meyer et al.²⁶ designed a special type of occlusal splint in which, the condyle-disc unit is largely intact and the interarticular space should not be constricted. The therapeutic approach consists in eliminating centric and eccentric occlusal disturbances, rebuilding lost support zones, and changing the mandibular motion pattern in order to improve muscle tone and neuromuscular coordination. As a rule, it also leads to a more physiological positioning of TMJ structures with

a positive, therapeutic effect. If TMJ pain persists nonetheless, targeted, geometric decompression of the very probably compressed articular structures should be performed. The splint described can be modified into a decompression splint by inserting an approximately 0.8 mm space holder craniodorsally into the condylar box of the articulator on the side of the joint requiring decompression (also possible bilaterally). This yields a corresponding vertical increase of the splint, which in the patient can produce a ventrocaudal decompression of the compressed articular structures.

Most comparative studies of different splint designs have relied only on medical history and clinical examination to diagnose disk displacement.²⁷ Soft splints, which are more convenient for patients than hard splints, can be used immediately after provisional diagnosis with TMD.²⁸ The rationale for using soft splints is that the soft resilient material may help in distributing the heavy load associated with parafunctional habits.²⁹ Hard splints are thought to reduce TMD symptoms by altering the occlusal equilibrium, changing the afferent impulses to the central nervous system, improving the vertical dimension, correcting the condylar position, and aiding cognitive awareness.³⁰

Littner et al. reported that hard splints offer more successful outcomes than soft splints for patients with functional disorders of the masticatory system.³¹ However, other studies have shown that both soft and hard appliances are equally beneficial in improving masticatory muscle pain in the short term.

The findings of one of the randomized controlled study show that stabilization splint treatment in combination with counseling and masticatory muscle exercises has no additional benefit in relieving facial pain and increasing the mobility of the mandible than counselling and masticatory muscle exercises alone over a 6-months' time interval. However, the efficacy of the stabilisation splint treatment on TMD in long-time follow-up remains to be confirmed.³²

A systematic review which has included a total of 47 publications citing 44 RCTs with 2,218 subjects suggest Hard stabilization appliances, when adjusted properly, have good evidence of modest efficacy in the treatment of TMD pain compared to non-occluding appliances and no treatment. Other types of appliances, including soft stabilization appliances, anterior positioning appliances, and anterior bite appliances, have some RCT evidence of efficacy in reducing TMD pain. However, the potential for adverse events with these appliances is higher and suggests the need for close monitoring in their use.³³

Because headache causes are manifold, diagnostics and therapy require an interdisciplinary medical approach. From the dental and maxillofacial standpoint, diseases and disorders of the teeth, periodontium, other craniofacial hard and soft tissues, as well as craniomandibular dysfunction

(CMD) must be taken into consideration in treating such patients.³⁴

In case of reasonable suspicion of craniomandibular dysfunction, an estimate for the detailed clinical and possibly instrumental diagnostics and optionally (grinding teeth guard/bite splint) pre-treatment must be done. Only after pre-treatment definitive treatments can be planned and carried out.³⁵

4. Conclusions

Due to the diverse causes of these disorders, TMD pain management requires various methods of treatment that are compliant with the origin of the dysfunction. Most of the TMD patients are helped

by incorporation of a stabilization splint. There is not enough data on the long-term efficacy and effectiveness of this widely used therapeutic tool. In the future, there is a need for well-conducted randomized controlled trials paying attention to adequate sample size, blind outcome assessment, duration of follow up, and using standardized methods for measuring treatment outcomes. Occlusal splints must be chosen by dentists based upon appropriate diagnosis, as opposed to a simple cure for all TMD conditions.

Conflict of interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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Questions

Permissive splints:

- ☐ a. Also referred to as muscle deprogrammers;
- ☐ b. Are designed to position mandible in a specific relationship to maxilla;
- ☐ c. They align the condyle-disk assemblies;
- ☐ d. Used when a centric relation should be corrected.

Occlusal splint therapy can be recommended for the following purposes except:

- ☐ a. To protect oral tissues in patients with oral parafunction;
- ☐ b. To eliminate occlusal interferences;
- ☐ c. To stabilize the unstable occlusion;
- ☐ d. To test the effect of changes in occlusion on the TMJ and jaw muscle function before extensive restorative treatment.

A directive splint is contraindicated in following conditions except:

- ☐ a. If condyle and disc can be aligned correctly;
- ☐ b. If discs can maintain their alignment with condyles during function;
- ☐ c. If it unlocks occlusal incline contacts;
- ☐ d. First two options.

Indications of centric stabilization splints are all except:

- ☐ a. TMJ arthralgia;
- ☐ b. Myospasm or myositis;
- ☐ c. Parafunctional activity;
- ☐ d. Disc-interference disorders.