



Occlusal Splint for the Treatment of Temporomandibular Disorders

Mbédé NMR¹, Zing S², Tamoh FS^{1*}, Akono ANG¹, Edjimbi OLS³ and Bengondo MC¹

¹Department of Oral Surgery, Maxillofacial Surgery, and Periodontology, University of Yaounde I, Cameroon

²Higher Private School of Dental Medicine, Cameroon

³Department of Odontostomatology, Jordan Medical Services, Cameroon

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***Corresponding author:** Tamoh Fokam Stive, Department of Oral Surgery, Maxillofacial Surgery, and Periodontology, Faculty of Medicine and Biomedical Sciences, University of Yaounde I, Yaounde, Cameroon, Tel: 00237 674 611 783; Email: fokamstive05@gmail.com

Abstract

Introduction: Occlusal splints are intraoral appliances used for the treatment of temporomandibular disorders. There is wide variety of occlusal splints according to their size, their form, the material they are made of, and their actions. Their efficacy varies from one type to another according to the initial diagnosis. However, the occlusal splints have an undoubtable favourable therapeutic effect in the management of temporomandibular disorders when used properly, unless this one is limited.

Objectives: To provide an understanding of various aspects of splint therapy and update the practitioners about their proper use.

Materials and Methods: Reviews articles, systematic reviews, original research published in various electronic database such as Pubmed, Google scholar, and Cross reference were examined and the informations provided were analysed and resumed.

Result and Conclusion: This review presents the occlusal splints in their different aspects such as their functions and how they work, their types, their uses, and the general considerations on how to ensure their proper design.

Keywords: Disorder; Interference; Occlusal; Splint; Temporomandibular

Abbreviations: TMD: Temporomandibular Disorders; VDO: Vertical Dimension of Occlusion; ARA: Anterior Repositioning Appliance.

Introduction

Occlusal splints are removable intraoral appliances, covering the masticatory surfaces of the teeth of a part or the entire dental arch, and which aim is to alter the relations

between the mandible and the maxilla. According to McNeill the first occlusal splint was described in 1881 by Goodwillie. Nevertheless, they became widely used in the 60s with the « Michigan » type occlusal splint designed by Ramfjord and Ash.

Occlusal splints can be used for providing diagnosis information, or as a therapeutic tool in the management of temporomandibular disorders (TMD). Unless their mechanism

of action is still unclear, they are recognized to provide benefits in the treatment of disorders of the masticatory apparatus from articular or from muscular origin [1-3].

Many types of occlusal splints are reported in the literature. They vary according to their form, their consistency, their function [4,5]. This diversity in the design of occlusal splints motivated the authors to investigate new therapeutic perspectives with the occlusal splints. Some clinical trials have been conducted to compare the efficacy of different types of occlusal splints, but the results present many controversies. So, the clinicians are in need of evidence-based results in order to make good decisions in front of their patients. In this context, an actualisation of knowledges on various aspects of occlusal splints seems to be a necessity for improving the quality of their therapeutic uses.

Function

It is recognised that occlusal splints function by many ways. They provide the masticatory muscles relaxation, protect the occlusal surfaces of teeth from abrasion during bruxism, maintain the centric relation, help in the diagnosis of TMD, and reduce the intra-articular pressure of the temporomandibular joints [2-9].

Relaxing the Masticatory Muscles

The relation between the vertical dimension of occlusion (VDO) and the masticatory muscle's function has been clearly demonstrated. Physiologists defined the muscular resting length as the one that develops maximum tension. It has been assumed that the clinical rest position (postural position) of masticatory muscles would be the vertical dimension of minimal muscle strain. So, the elevator muscles are assumed to be the most relaxed at rest. Rugh and Drago, in their study using surface electrodes and a kinesiograph, reported that as the vertical dimension increases from occlusal contact, muscular effort decreases. So, the increase of the VDO is associated to a relaxation of masticatory muscles. In contrast, a reduction of the VDO is followed by an hyperactivation of the elevator muscles of the mandible causing myofascial pain. An hyperactivation of temporal muscles can also cause tension headache, or induce sympathetic vascular modifications at the origin of migraines [2]. Thus, by modifying the VDO, the occlusal splints can reduce the myogenous pain secondary to the hyperactivation of masticatory muscles, and the reduction of headache [7-10].

Protecting Occlusal Surfaces of Teeth during Bruxism

Bruxism is an involuntary contraction of masticatory muscles, with direct effects the clenching and grinding of

teeth surfaces [11,12]. Parafunctional clenching and grinding is considered one of the common etiologic factor in TMD, and the forces generated during bruxism can be as much as 6 times the maximal force generated by normal chewing [2]. Occlusal splints are mechanical protections against the consequent abrasion of tooth surfaces. They also provide tooth contacts with equal intensity that help to redistribute the occlusal forces initially limited to one or certain teeth. It has been suggested that the amelioration of the symptoms in case of bruxism is the result of this occlusal forces redistribution [4]. Richard found that splint therapy in sleep bruxism patient led to a change in the topographical condyle fossa relationship, and seemed to create an "unloading" condition for the temporomandibular joints.

Maintain the Centric Relation

The Glossary of Prosthodontic Terms define the centric relation as a «maxillomandibular relationship, independent of tooth contact, in which the condyles articulate in the anterior-superior position against the posterior slopes of the articular eminences» [13]. It is the optimal arrangement of joint, disk, and muscles, and constitutes the reference position of splint therapy. For the condyle to completely seat under the disk in this anterosuperior position, the lateral pterygoid muscle must completely relax because of its attachment to the disk through the superior belly. If this muscle stays contracted after hyperactivity, the disk will be pulled anteromedially (along the direction of the muscle origin) and will not seat completely over the condyle [14]. Occlusal interferences during the establishment of the centric relation will induce the hyperactivation of the lateral pterygoid, causing an anteromedially displacement of the articular disc towards the origin of the muscle. This will result in displacement of condyle/disc assembly and the loss of the centric relation [9]. Occlusal splints will eliminate the occlusal interferences and thus reduce the neuromuscular responses, maintaining the condylar position in centric relation [15]. Nevertheless, they cannot provide the permanent stabilization of this reference position since the occlusal interferences remain present after the definitive removal of the splint [3].

Help in Diagnostic Procedures

Occlusal splints can provide diagnosis information concerning the bruxism habits, the need of an anterior guide, or the information concerning the VDO. These informations can help the clinician to anticipate the damages on natural or prosthetic teeth before a restorative dental treatment [2]. They can also reveal the anatomical and physiological status of the TMJ, and the nature of the TMD. If a patient becomes comfortable with a splint immediately, it may be an indication that the disorder is muscular. If symptoms worsen with permissive splint wear, this may indicate an internal disk

derangement problem or an error in the initial diagnosis [8].

Intra-Articular Pressure Reduction

Occlusal splints can help to reduce or modified the intra-articular pressure by reducing the intensity of the muscular forces, the frequency and/or the duration of parafunctions [4]. The second hypothesis proposed is the unloading of the joint by condylar distraction, reducing the pain in case of intra-articular disorders and/or osteoarthritis [15].

Limitations

The efficacy of occlusal splints has not yet been demonstrated concerning the following action: prevention or permanent elimination of bruxism, unload the joint by pivot or condylar distraction, and definitively « heal » the patient [4,14].

Occlusal splints act on bruxism by redistributing the occlusal forces, thus harmonizing the activity of the masticatory muscles. Nevertheless, the process by which they achieve this goal is still unclear. Although they reduce the muscle activity, they are not known to prevent or definitively eliminate the bruxism [8]. They can reduce the frequency, but not the intensity of bruxism episodes [2,11].

The theory of the joint unloading by condylar distraction or pivot on the posterior teeth contact have been proposed by some authors. This theory has been disproved by Kuboki and remains unexplained by anatomical or physiological considerations. The elevator muscles of the mandible are located behind the most posterior teeth, and therefore ensure that the joint will always be loaded when the elevators contract [15]. Thus, this joint unloading theory by pivot on the posterior teeth or condylar distraction is still disapproved by others, limiting the indications and the use of « pivot splint » or « decompressive splint ». The anterior repositioning of the mandible seems to be a better intra-articular decompression procedure by acting on the frequency and/or duration of parafunctions [16].

The aetiology of TMD is multifactorial, including neurophysiological and psychosocial factors. Thus, a simple mechanical approach seems to be insufficient for the long-term remission of symptoms. There is a necessity to have a global approach combining the physiological, psychological, and social dimensions of the TMD, as well as their interactions, to manage the chronic pain associated to these pathologies [4]. Once the final mandibular position is obtained, it is imperative in case of tooth or bone structural anomalies to complete the splint therapy with a definitive occlusal adjustment such as additive or subtractive occlusal rehabilitation, restorative dental treatment, orthodontic,

segmental alveolar surgery and/or maxillofacial surgery, in order to fixe and stabilize permanently the maxillomandibular relation [2,12,14]. Thus, the treatment of the patient requires a coordinated multimodal approach including behavioural changes, psychosocial support, physiotherapy, and occlusal splint [1,4].

Subtypes

Permissive Splints or Muscle Deprogrammer

There are also called « muscle reconditioning splint ». They allow the teeth to move on the splint unimpeded, which in turn allows the condylar head and disk to function anatomically [8,9]. There are two subgroups of permissive splints according to their size: full coverage or stabilization splints, and partial coverage or anterior bite splints (retroincisal bite planes, Lucia jig) [16].

Stabilization Splint

They provide muscle relaxation, protect the occlusal surfaces of teeth during bruxism, and balance the occlusal forces distribution which permit the stabilization of the temporomandibular joint (TMJ). The wearing of the splint allows the patient to be conscient of the abnormal jaw habits, thus helping to modify the resting position of the mandible into a more relaxed and distended position [4]. Stabilization splint will cover the entire occlusal surface of the maxilla or the mandible to ensure the maximum retention.

It is fabricated in the laboratory with hard acrylic resin, on the casts mounted in a centric relation on an articulator. Stabilization splint should have a smooth surface and provide simultaneous occlusal contacts of the entire antagonist dental arch without any interference. It is recommended to maintain the lateral canine guide in order to achieve the posterior teeth disocclusion during eccentric movements [2,5,9,17]. The thickness of the splint is variable.

This type of splint is the most widely used, and the undesired effects are rare. The splint should be worn at night, and it will be associated to the self-controlling technics of parafunctions by the patients during the day for a better result [1,4]. The treatment duration should be short because of the irreversible changes of the surrounding striated muscles [18].

Anterior Bite Splint

In its traditional form, it is made of a palatal plate maintained by retainers, presenting in its anterior part with a retroincisal bite plane. Such occlusal appliances include the Jeanmonod plate and the Sved plate. The other types including the Lucia jig does not have the palatal coverage. The anterior bite splint will induce the disocclusion of the

posterior teeth during mouth closing [2]. The study of Becker on the electromyography have demonstrated the influence of posterior occlusion on the masticatory apparatus and their role in the genesis of parafunctions such as muscles hypercontraction [9]. The elimination of the posterior contacts by the anterior bite splint will be in favour of the reduction of these parafunctions [17].

There is a lack of significant difference of efficacy between the anterior bite splint and the stabilization splint in the literature. Kui in its study demonstrated that when they are used properly according to the diagnosis, the effectiveness of the Jeanmonod anterior bite plane and the Michigan splint are similar. The first was applied to patients diagnosed with TMD associated with muscle disorder, and the second was used for patients diagnosed with intra-articular disorders associated with disc displacement with or without reduction [3].

Because of the risk of irreversible dental migration (extrusion, intrusion and laterotrusion), the Anterior Bite Splint will be proposed for emergency treatment, or very short duration in an acute form of musculoarticular symptoms [4,12]. The small pieces such as the Jigs present the risk of accidental inhalation during the sleep. So, they will be worn in the day as much as possible.

They are fabricated in the laboratory on an articulator in centric relation, but the Lucia jig can be fabricated directly in the mouth of the patient. The palatal coverage will reach the canines for the Sved plate, and the second molars for the Jeanmonod plate. The thickness of the incisal bite plane will have a smooth surface and provide symmetrical contacts with antagonist teeth. It will also provide the posterior teeth disocclusion. After the complete remission of the symptoms, the retro-incisal bite plane can be transformed into a stabilization splint by adding resin on the posterior quadrants [5].

Non-Permissive Splint or Directive Splint

A nonpermissive splint has indentations and a premolar anti retro position guides that position the mandible inferiorly and anteriorly and secure it there. Examples include « anterior repositioning appliance (ARA) », and « mandibular orthotic repositioning appliance (MORA) » [8,9,18]. It was first described in 1971 by Farrar, and was designed to recapture the articular disc in case of TMD with reducible disc luxation [18]. Non-permissive splints have shown a superior effect compared to the permissive ones in the recapture of the articular disc [2]. However, the MRI imaging demonstrated that this recapture is not systematic [16], and there are unfavourable results in case of severe disc displacement or when there are structural modifications

of the articular bone surface. Some authors suggested that the first goal of the non-permissive splints should be the induction of the neoformation of a pseudo-disc by the way of a cicatricial fibrosis secondary to the frictions exerted by the condyle on the retro discal zone [12].

Wearing non-permissive splint is a good initial method of releasing symptoms, and sometimes recapture the displaced disc momentarily. But the long-term treatment is associated to the risk of irreversible and permanent occlusal and bone changes, limiting their wearing to a short-duration period and a closed follow-up [16,17]. They should be worn permanently and the new mandibular position should be adopted spontaneously by the patient. If the patient presents some difficulties to maintain this new position, it is sometimes better to renounce to the articular repositioning, and transform the repositioning splint into a decompressive or stabilization one [5].

The fabrication of non-permissive splints requires the setting of the models on an articulator in centric relation, and the axiographical programming. It is important to well know the exact repositioning, the amplitude, and the angulation of the propulsion. The axiography will permit to visualize and adjust the condyle displacement. The lateral canine guide will suppress the occlusal interferences during the eccentric movements of the mandible [5].

Pseudo Permissive Splints

There are two types of pseudo permissive splints because of their different mechanism of action: soft rubber splint, and hydrostatic splint. They can exacerbate the bruxism, possibly due to premature posterior contacts related to the fact that these splints cannot be balanced [18].

Soft Rubber Splint

This appliance is generally made of a resilient material (2 mm thick polyvnyl sheet). It should be worn only at night and generally produces symptomatic relief within 6 weeks. The soft splint is less likely to cause significant occlusal changes that are occasionally noted with hard occlusal splints [9]. It should be used just as a protective device for Okeson [1]. This splint is rapidly altered and seems to exacerbate muscle crispation. Okeson in 1987 demonstrated that the soft splint exacerbates the nocturnal activity of masseter in 5 of 10 subjects, while the hard splint reduces the muscle activity in 8 of 10 subjects [1,2]. He concluded that the use of a soft splint may not be indicated for reducing parafunctional activity in patients with symptoms. Other studies have shown the same efficacy between hard and soft splint in the management of TMD of muscular origin, suggesting the reconsideration of their indications in the treatment of these pathologies [19,20]. However, it is admitted by many authors

that soft splints have limited efficacy in TMD of articular origin, and are not recommended in these cases [20]. It is difficult to make occlusal adjustments, so they are assumed to exacerbate the bruxism probably due to the inability to achieve optimal balanced occlusal contacts [8,9].

Hydrostatic Splint

Hydrostatic splint is made of bilateral water-filled chamber on posterior teeth related by a flexible tube. These splints are working based on a new application of a physical law of nature called « Pascal's Law », which states that an enclosed fluid will apply equalized fluid pressure regardless of the shape of the splint [8]. So, the occlusal forces are balanced by the way of the water redistribution between the two chambers, and the TMJ are stabilized. The comfortable mandibular position is thus achieved by the mandible itself and the balancing of the splint is not required [15]. This hypothesis concerning the mechanism of action of hydrostatic splint have not yet been demonstrated, and their efficacy is still unknown due to the rarity of the studies on the topic [21].

It is a prefabricated appliance with the commercial name Aqualizer. It is available in three sizes: Aquasplint mini, Aquasplint classic and Aquasplint ultra. It is inserted either in upper or lower dental arch [17].

Occlusal Splint for Maxilla or Mandible?

It is presumed to achieve the same therapeutic results regardless of the maxillary or mandibular situation of the splint, but the choice of the individual situation of the occlusal splint depends on a few basic anatomical and functional principles. Thus, the occlusal splint will be preferably seated on the biggest toothless arch to increase the stability effect of the mandible by creating additional contact points [12]. The incisor overjet will also be taken into consideration. In the case of severe Angle class II-1 malocclusion, a maxillary occlusal splint will be proper to compensate the overjet and restore an optimal anterior guidance. In contrast, a mandibular occlusal splint will be preferred in Angle class III malocclusion to achieve proper anterior contact and mandibular stability [9].

Some arguments related to the comfort (aesthetic, elocution) and the presence of lingual dysfunctions will be in favour of the mandibular occlusal splint [1,12].

Conclusion

Occlusal splints are intra oral appliances wich have shown diverse efficacy in the management of TMD. The correct use of these devices requires a good knowledge of the biomechanical and physiological factors implicated in

their mechanism of action. The clinician should be aware of the effects the occlusal splint will induce in order to make a proper choice. The type, the form, and the position of the occlusal splint will therefore be specifically adapted to the patient, with regards on their limits in the management of TMD when used alone.

Conflict of Interest: Authors declare there is no conflict of interest.

References

1. Ré JP, Chossegras C, El Zoghby A, Carlier JF, Orthlieb JD (2009) Occlusal splint: state on the art. *Rev Stomatol Chir Maxillofac* 110(3): 145-149.
2. Choudhary S, Rao HM, Rohilla AK, Jayam C (2015) The occlusal splint therapy: a literature review. *Indian J Dent Sci* 7(1): 101-108.
3. Kui A, Buduru S, Iacob S, Manziuc M, Mitariu L, et al. (2020) The use of occlusal splints in the management of temporomandibular disorder. *Health, Sports Rehab Med* 21(2): 82-87.
4. Société Française de Stomatologie, Chirurgie Maxillo-Faciale et Chirurgie Orale. Orthèses (Gouttières) occlusales: indications dans les Dysfonctions Temporo-Mandibulaires Recommandations de Bonne Pratique, SFSCMFCO, pp: 54.
5. Abdelkoui A, Fajri L, Abdedin A (2011) Occlusal appliances and management of TMD. *Actual Odontostomatol* 255: 243-253.
6. Kuzmanovic PJ, Dodic S, Lazic V, Trajkovic G, Milic N, et al. (2017) Occlusal stabilization splint for patients with temporomandibular disorders: meta-analysis of short and long term effects. *PLoS ONE* 12(2): e0171296.
7. Amin A, Meshramkar R, Lekha K (2016) Comparative evaluation of clinical performance of different kind of occlusal splint in management of myofascial pain. *J Indian Prosthodont Soc* 16(2): 176-181.
8. Ramalingam S, Saravana Priyan GL (2022) Occlusal splint therapy in TMD pain management: a review. *J Global Oral Health* 5(2): 102-106.
9. Dipika LD, Rajeev S, Gaurang M (2019) Splints: decoded. *IOSR J Dent Med Scien* 18(5): 11-19.
10. Niha N, Kannan S (2020) An overview on the effect of occlusal splint therapy on muscle function. *Europ J Mol Clinic Med* 07(8): 1760-1762.

11. Karakis D, Dogan A, Bek B (2014) Evaluation of the effect of two different occlusal splints on maximum occlusal force in patients with sleep bruxism: a pilot study. *J Adv Prosthodont* 6(2): 103-108.
12. Ré JP, Perez C, Darmouni L, Carlier JF, Orthlieb JD (2009) The occlusal splint therapy. *J Stomat Occ Med* 2: 1-5.
13. (2017) The Glossary of Prosthodontic Terms: Ninth Edition. *J Prosthet Dent* 117(5S): 1-105.
14. Dylina TJ (2001) A common-sense approach to splint therapy. *J Prosthet Dent* 86: 539-545.
15. Srivastava R, Jyoti B, Devi P (2013) Oral splint for temporomandibular joint disorders with revolutionary fluid system. *Dent Res J* 10(3): 307-313.
16. Alqutaibi AY, Aboalrejal AN (2015) Types of occlusal splint in management of temporomandibular disorders (TMD). *J Arthritis* 4(4): 176.
17. Dhannawat P, Shrivastav S, Ranjit K, Banerjee S (2020) Different types of occlusal splint used in management of temporomandibular joint disorders—a review. *Europ J Molecul Clinic Med* 7(7): 1787-1794.
18. Elsaih EA, Mowafey B, Ata F, Salem AS (2022) Treatment protocol for temporomandibular joint derangement using an anterior repositioning splint with modification (one-year prospective study). *Egypt Dent J* 68(1): 853-873.
19. Kashiwagi K, Noguchi T, Fukuda K (2021) Effects of soft occlusal appliance therapy for patients with masticatory muscle pain. *J Dent Anesth Pain Med* 21(1): 71-80.
20. Al-Moraissi EA, Farea R, Qasem KA, Al-Wadeai MS, Al-Sabahi ME, et al. (2020) Effectiveness of occlusal splint therapy in the management of temporomandibular disorders: network meta-analysis of randomized controlled trials. *Int J Oral Maxillofac Surg* 49(8): 1042-1056.
21. Sabbagh H, Sabbagh A, Heppner A, Auer C, Wichelhaus A, etc. (2022) Patients' perceptions on temporomandibular disorder treatment with hydrostatic oral splints - a pilot study. *British Dent J Open* 8: 4.

