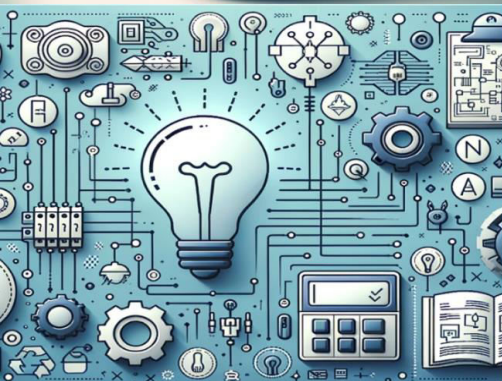


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Occlusal Splints-A Comprehensive Review

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ABSTRACT: Occlusal splints, also known as bite guards or dental splints, are removable devices commonly used in dental practice to manage various conditions related to the temporomandibular joint (TMJ), bruxism (teeth grinding), and other occlusal disorders. These splints are designed to protect the teeth, alleviate discomfort, and prevent further damage by providing a stable bite relationship. They work by redistributing the forces applied during chewing, reducing muscular tension, and facilitating proper jaw alignment. The therapeutic benefits of occlusal splints include the prevention of enamel wear, reduction of pain from temporomandibular disorders (TMD), and alleviation of headaches and facial pain. Additionally, splints can aid in reducing the occurrence of bruxism-related tooth fractures and improve overall dental health. Various types of occlusal splints, including hard, soft, and combination designs, cater to specific patient needs. Despite their proven effectiveness, the design, duration of wear, and potential side effects require careful clinical consideration to optimize outcomes.

I. INTRODUCTION

Occlusal splints, known as night guards, orthotics appliances, and oral appliances, are used frequently in dental practices. Occlusal splints come in a variety of forms, and each one can be used to treat different ailments. Occlusal splints help reduce muscular activity, decrease tension, and reduces the negative consequences of temporomandibular disorders (TMDs) and bruxism. TMDs can be treated with occlusal splint therapy, physiotherapy, patient education, or reassurance.¹ Occlusal splint therapy may be defined as “the art and science of establishing neuromuscular harmony in the masticatory system and creating a mechanical disadvantage for parafunctional forces with removable appliances”. It can treat individuals with TMD and bruxism for occlusal stabilization and to reduce dentition wear.²

II. CLASSIFICATION OF SPLINTS

According to Dawson P E:³

- Permissive splints
- Non -permissive splints
- Pseudo permissive splints

According to Okeson J P:⁴

- Muscle relaxation appliance/ stabilization appliance
- Anterior repositioning appliances/ orthopedic repositioning appliance

According to slavicek R:⁵

- Myopathic splints
- Decompression splint
- Compression splint



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- Verticalization splint
- Anterior repositioning splint

According to Alex willis:⁶

- Flat plane splint
- Anterior repositioning splint
- Canine protected splint

Occlusal splint working mechanism : ⁷

Different theories are explained on occlusal splint mechanism:

1. Occlusal disengagement theory
2. Restored vertical dimension theory
3. Maxillomandibular realignment theory
4. TMJ positioning theory
5. Cognitive awareness theory

Goals of occlusal splint therapy: ^{8,9}

1. To protect the TMJ discs from dysfunctional forces, which may lead to perforations or permanent displacements.
2. To improve jaw muscle function and to relieve associated pain by creating stable balanced occlusion.

Indications of occlusal splints:¹

- Patients with masticatory myalgia or TMJ arthralgia.
- Patients with myospasms or myositis.
- Patients with a history of trauma or inflammatory joint conditions and existing causes of parafunctional activity, such as bruxism.
- Patients with unstable occlusion.
- Patients with stress-related pain symptoms, such as tension headaches and neck pain of muscular origin.

Functions of occlusal splints:²

Properly fabricated splints have at least 6 functions, including the following:

- (1) to relax the muscles
- (2) to allow the condyle to seat in CR
- (3) to provide diagnostic information
- (4) to protect teeth and associated structures from bruxism
- (5) to mitigate periodontal ligament proprioception
- (6) to reduce cellular hypoxia levels

III. CONCEPT BEHIND SPLINT DESIGNS¹⁰

Permissive splint:

1. Anterior midpoint contact permissive splint: Complete seating of joint by removing occlusal interference. When elevator muscles contract on closure it allows freedom of for full seating of mandibular condyle.

Examples: B splints, Bite planes, Lucia jig, NTI, Leaf gauge, kois deprogrammer.¹¹

2. Full contact permissive splint: Uniform contacts are achieved on all teeth when joints are fully seated by the elevator muscles. Dawson's bimanual manipulation technique is used to the guide the joints in centric relation.

Examples: Stabilization splints.¹¹

Directive splints: It is used when the condyles are needed to be placed in a specific position. The main purpose is to position or align the condyle-disc relationship.



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Materials used for fabrication of occlusal splints:¹²

- Poly(methyl methacrylate) (PMMA)-self cure & heat cure
- Thermoplastic materials: usually made of polyvinyl acetate.
- 3D-printable materials
- Polycarbonate
- Polyetheretherketone (PEEK)
- Urethane dimethacrylate
- Polyamides

IV. TYPES OF SPLINTS-IN DETAIL

Anterior bite plane:

The anterior bite plane is a hard acrylic appliance worn over the maxillary teeth that provides contact with only the mandibular anterior teeth and no posterior teeth in occlusion. It is usually flat & parallel to the occlusal plane. Anterior jig, Lucia jig, Hawley bite plane, anterior deprogrammer and Sved plate are the types of anterior bite planes. These must be used only for short periods under close monitoring.¹¹

Indications:¹⁰

- Acute disturbance in occlusion
- parafunctional activity such as bruxism.

Mechanism of action:¹¹

It is primarily intended to disengage the posterior teeth about 2-3 mm to establish a neuro-muscular reconditioning and thus eliminate their influence on the function or dysfunction of the masticatory system. Thereby aiding the relaxation of the muscles (the lateral pterygoid) and encourage the readaptation of condyle to the rest position.

Limitations:¹³

If the appliance is worn continuously for more than 3-4 weeks, the unopposed mandibular teeth might supra-erupt, resulting in an anterior open bite and may add to a TMJ overload without the posterior contacts.



Anterior bite plane

Lucia Jig:¹¹

Lucia jig is a neuromuscular deprogramming device. It is a type of modification of anterior bite plane placed between the maxillary and mandibular incisors.

Indications:

- In full mouth rehabilitation cases to establish centric relation by eliminating any type of occlusal contacts.
- In cases where muscle relaxation is required to make jaw manipulation easier.
- Muscular hyperactivity.

Mechanism of action:

It acts by de-programing the proprioceptive patterns of habitual contact between teeth (engram) changing the mandibular closure pattern and allowing the condyles to seat in the most superior position.



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Limitations:

- Because of the small size, possibility of aspiration of the appliance.
- Mobility of anterior teeth.
- Occlusal changes if used unmonitored for a long time.



Lucia jig

B splint:¹⁰

The B-Splint is used for rapid harmonization of occluso-muscular disorders and comprises of an upper and lower appliance. Supra-eruption of posterior teeth is prevented by fully covering them which will also aid in its retention. There is no posterior contact because of lower splint having a flat bite plane along the anterior central incisal region and upper having a ramp.

Indication:

It allows the condyle to seat during clench and will eliminate lateral pterygoid resistance to masseter and temporalis muscles.



B-splint

NTI-Nociceptive Trigeminal Inhibition Tension Suppression System:¹¹

The NTI-tss device is a modified anterior bite plane which is narrower than the regular bite plane. It covers only two maxillary (or mandibular) central incisors. This is also known as "miniature anterior bite appliance". Duration to be worn is about 6 to 8 weeks.

Indications:

- Sleep bruxism
- Temporomandibular disorders (TMDs)
- Tension-type headaches, and migraine which is triggered by hyperactivity of the trigeminal nerve causing migraine like events. So it is used always while sleeping.

Mechanism of action :

NTI splint has a "disoccluding element" which contacts the two mandibular central incisors upon closure. The NTI-tts splints primarily function to relax the muscles involved in bruxing by reducing nociceptive stimulation.



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Limitations:

- Because of the small size, possibility of aspiration of the appliance.
- Mobility of anterior teeth.
- Occlusal changes if used unmonitored for a long time.



NTI-TSS

Kois deprogrammer:¹⁰

It is a palatal coverage maxillary acrylic device with a flat plane lingual to the anterior teeth. It helps as a diagnostic tool so as to determine if the mandible is to be placed anterior or posterior direction to reach centric relation from maximum intercuspation.

Indications:

It is used as a diagnostic tool to determine if the mandible needs to move in the anterior or posterior position.



Kois Deprogrammer

Stabilisation splint:^{8,10,11}

synonyms -Tanner appliance, Fox appliance, Michigan splint, centric relation appliance, superior repositioning splint.

Indications:

- Masticatory myalgia and TMJ arthralgia, especially if the pain is worse upon awakening.
- Muscle hyperactivity.
- Myospasms or myositis.
- Trauma or inflammatory joint disorder.
- Parafunctional activity.

Mechanism of action:

The aim to provide the patient with a stable occlusion in which the maximum number of simultaneous occlusal contacts are made with equal force between the opposing teeth. This also allows an adaptation of the temporomandibular joint apparatus by increasing the vertical dimension, occlusal stability and aids in self repositioning of the condyle in the glenoid fossa. An adjustment of the splint is needed periodically so that the masticatory muscles relax until a consistent jaw relationship is achieved.



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Limitations:

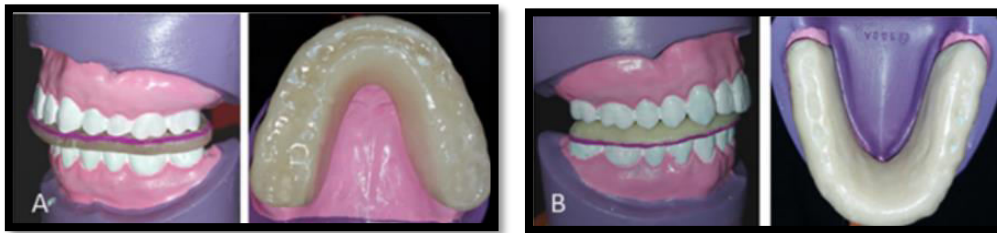
As these splints do not prevent tooth clenching due to the contact of lower teeth, may aggravate the condition in few patients.

Commonly used stabilisation splints are:

1. Michigan's splint/gnathologic splint/flat plane splint - fabricated on maxillary arch.
2. Tanner's splint-fabricated on mandibular arch.

The main features which separate the Michigan splint (Geering & Lang, 1978) from other stabilization splints are: ¹⁴

- Always adjusted to centric relation.
- Freedom in centric zone: 0-5-1-0 mm on a flat surface.
- Cuspid rise starts about 1 mm from freedom in centric.
- No incisal guidance from centric occlusion.
- Allows the condyles to seek optimal position.
- Can be used for indefinite time without change in occlusal relations of the teeth



Michigan's splint

Tanner's splint

Anterior repositioning splint:

The construction and insertion of this splint has been described by Clark.¹⁵

Indications:^{16,17}

- Disc derangement without reduction disorders
- Patients with joint sounds (single/reciprocal click)
- Inflammatory disorders

This is the splint of choice for the treatment of a patient suffering from disc displacement with reduction (clicking).

Mechanism of action:^{8,10,11}

By maintaining the mandible in a temporary therapeutic position where the click is eliminated and thereby allowing the disc to reposition. To achieve a maximum success rate these splints should be worn on a 24-hour-a-day basis for 3 months, followed by a careful, controlled, gradual weaning off period.

At follow-up visits, acrylic is ground by 1 mm every 4–6 weeks from the posterior areas to clear the occlusal aspect of the mandibular molars and premolars, thereby encouraging vertical eruption of these teeth, settling occlusion and re-establishing the position.

Limitations:

There could be permanent and irreversible occlusal changes on long term use.



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Anterior repositioning splint

Others:

Soft splint/resilient splint:^{11,18}

Mathews recommends the use of soft splints.

Indications:

- In reducing symptoms of temporomandibular disorders (joint dysfunction and myalgia).
- Protective device for persons likely to receive trauma to their dental arches (athletic splint)
- To prevent bruxism and clenching
- For relief of extremely sensitive posterior teeth due to chronic or repeated sinusitis.

Mechanism of action:

The soft splint is an appliance fabricated from resilient material and usually adapted to the maxillary teeth. Treatment goals are to achieve even and simultaneous contact with the opposing teeth. It is quick to fabricate and can be provided as „emergency treatment“ for a patient who presents with an acute TMD. It will produce symptomatic relief within 6 weeks.

Limitations:

They should be replaced after 4 – 6 months as they lose their resilience with the passage of time. The soft splints are less likely to cause significant occlusal changes that are sometimes noted with hard occlusal splint. They have low density and amorphous structure, therefore they are compressed or worn before the masticatory muscles are stretched or physiologic limits.



Soft splint/resilient splint

Hydrostatic splint / Aqualizer:^{19,20}

In addition to treating malocclusion and relieving TMJ discomfort and TMD symptoms, it uses water to regulate biting pressure.

When the hydrostatic cell is placed between the arches, the stomatognathic system undergoes a series of reorganizations, and the fluid distribution inside the cell naturally corrects occlusal disharmonies. Occlusal forces to every tooth contacting the cell there by becomes systematically equalized and axially oriented. Occlusal forces that normally arise individually as the result of many maxillary and mandibular tooth contacts now are created as a whole within the hydrostatic cell, and distributed to each tooth that contacts the cell.



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The hydrostatic appliance should be worn 24 hours and removed only while eating, for a period ranging from several weeks to years.



Acqualizer/Hydrostatic splint

Pivoting appliance:²¹

It is a hard acrylic device that covers one arch and usually provides a single posterior contact in each quadrant. 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.

Indications

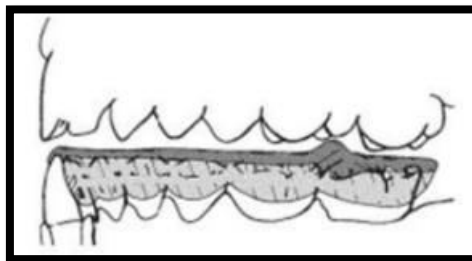
To decrease intraarticular pressure and thus unload the articular surfaces of the joint. In treatment of symptoms related to osteoarthritis of the TMJs, acute unilateral disc dislocation without reduction.

Mechanism of action

The proposed principle is that the condyles are pulled downwards upon clenching on the pivot, which causes a mandibular torque with an upward direction, also this torque is smaller than one that would be caused by a more anterior pivot, thereby relieving traumatic load and giving the disk freedom to reassume a normal position. The contact in these splints is usually on most posterior tooth.

Limitations

May cause occlusal changes as a posterior open bite in pivot area.



Pivoting appliance

V. CONCLUSION

Occlusal splint therapy has been used for many years in the diagnosis and treatment of various temporomandibular disorders. If TMDs left untreated it can lead to worsening of its symptoms which can extend beyond the jaws. Variety of designs are described in the literature. There are different types of splints that are used to treat different conditions. A thorough examination and differential diagnosis is necessary to know the decision regarding the appropriate role of splint therapy for each problem. The goal of this article was to make dentists aware of importance of splints in managing temporomandibular disorders (TMDs) using simple therapy.



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