Occlusal Splints and Temporomandibular Disorders: Why, When, How?

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Abstract: **Occlusal splints are one form of treatment in the management of patients with a temporomandibular disorder. Appliances are often used in conjunction with other forms of treatment such as physiotherapy or medication. A variety of splints is described in the literature and the dentist must ensure that the splint prescribed is of a design that has a proven success rate for the specific diagnosis. General principles that apply to the provision of all splints are outlined in this paper.**

***Dent Update* 2001; 28: 194-199**

Clinical Relevance: **Occlusal splints are frequently prescribed in general dental practice for patients with a temporomandibular disorder. Thought should be given to the design of such splints and their perceived mode of action.**

The management of patients with temporomandibular disorders (TMD) is controversial and attracts suggestions from widely differing viewpoints. Such patients are, after all, suffering from a common musculoskeletal disorder like many others. The use of occlusal splints is, however, commonly accepted and occlusal splint therapy should be regarded as one of the readily accessible treatments for TMD available to general dental practitioners.

It is interesting to record that, in a specialist TMD clinic, where there is access to a wide range of investigative procedures and treatment options, the four most commonly employed treatments (used in over 90% of patients) are counselling, drug therapy, physiotherapy and splint therapy. These four treatments are precisely the same options that are available to dental surgeons in general practice.[1]

A combination of treatments may often be employed in the management of patients suffering from symptoms of a TMD. In the authors' experience there appear to be synergistic effects – with, for example, a combination of splint therapy, outpatient physiotherapy and muscle relaxant pharmacotherapy often producing a better result than any of the individual options used in isolation.

When considering the use of splints, however, the dentist should avoid the 'one aetiology, one diagnosis, one treatment' approach. A variety of different splints, often with apparently diametrically opposed modes of action, can be used to treat symptoms. Dentists aim to treat a patient's reaction to a set of circumstances and two people with apparently identical symptoms may need different treatment plans, depending on the apparent aetiology and individual circumstances. It is therefore inappropriate to provide one particular type of splint all of the time: this approach is narrow and demonstrates lack of awareness of the range of appliances available; in addition, it ignores other possible contributory factors.

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OCCLUSION AS A PREDICTOR OF SUCCESS

It is important to examine the patient's occlusion before treatment. First, it has been shown that the nature of the patient's occlusion is a valuable predictor of success of splint therapy in pain dysfunction syndrome.[2] Second, the dentist will need a record of the patient's occlusion before splint therapy as the occlusion could change during the treatment, with possible restorative or even medicolegal implications.

A record should be made of the pre-existing centric relation and centric occlusion. If there is not correlation, the position of the premature contact and the direction of the slide from centric relation to centric occlusion should be noted. Note should be made of the anterior guidance of the mandible and whether or not there are posterior interferences on the working or non-working side during lateral excursions.

The Pretreatment Record

It is essential that a record is made of the patient's occlusion before any form of splint therapy is undertaken in the management of a TMD: this

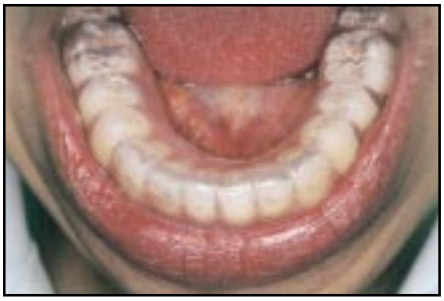

Figure 1. *Soft lower splint.*

provides a baseline against which any changes can be monitored. This is especially important if an occlusal splint is provided as part of an overall course of restorative treatment which has the potential to change the occlusion. Whether or not a conformative or reorganized approach is being undertaken,[3] careful pretreatment analysis of the occlusion is mandatory.

Keeping the Definitive Objective in Mind

There are four splints which are readily applicable to general dental practice:

- the soft vacuum-formed splint usually made on the lower arch;
- the localized occlusal interference splint;
- the anterior repositioning splint;
- the stabilization splint.

Rugh[4] supported the use of a variety of splints. He suggested that many designs of splint have been shown to reduce parafunction and emphasized that practitioners should not disregard the use of any individual splint because its method of action is not precisely understood.

SOFT BITE GUARD

This is the most commonly prescribed splint (Figure 1). It is quick to fabricate and can be provided as 'emergency treatment' for a patient who presents with an acute TMD. This splint is more readily tolerated in the lower arch than the upper arch as there is no satisfactory way of thinning the margins of the splint while keeping good retention. This means that if the splint is made on the upper arch, the patient is subjected to a thick ridge of polyvinyl in the palate which often makes the splint difficult to tolerate.

The only record needed is a lower alginate impression as the splint is not made to a specific occlusal prescription but, while cheap and easy to fabricate, cannot be readily adjusted. It should be stressed to the patient that, in approximately 10% of cases, these appliances will make the symptoms worse. This is especially true in patients who are 'dedicated bruxists' as they are so aware of having something compressible in the mouth they actually increase the activity rather than decrease it.

These appliances are usually worn only at night and, if they are to be successful, will produce some symptomatic relief within 6 weeks. They should be replaced after 4–6 months as they lose their resilience with the passage of time.

The appliance is generally made out of 2 mm polyvinyl. If a thinner splint is required, the laboratory can be instructed to overheat the material before vacuum forming, and if a selectively thicker appliance is required (for instance in a patient with an anterior open bite) then layers can be added in certain areas (i.e. anteriorly) to ensure even occlusal contact.

LOCALIZED OCCLUSAL INTERFERENCE SPLINT

Schulte[5] described the use of an 'interceptor splint', which is alternatively known as the Localized Occlusal Interference Splint. The use of this splint may be indicated in a patient who shows active signs of bruxism, such as cheek ridging and tongue scalloping (Figure 2a). It can be used whether or not the patient has signs and symptoms of a TMD and can thus be regarded as a 'habit breaker'.

Construction of this appliance involves taking upper and lower alginate impressions and recording the patient's centric occlusion. The splint comprises a palatal plate retained by Adams clasps or ball-end clasps around the area of the first molar or second premolar and bears ball-ended wires anteriorly (Figure 2b). The ball at the end of these wires is usually fitted against the mesial marginal ridge of the first premolar or against the cingulum of the maxillary canine so that the tip of the cusps of either the mandibular canines or the mandibular first premolars occlude against it. This prevents all other teeth from touching during closure in centric occlusion. It thus deliberately increases the load on the proprioceptive fibres of the periodontal membranes of four teeth. The hypothesis is that in this way parafunctioning, especially clenching, is discouraged. It is important that the ball-end interference wire is not placed against the surface of the lateral incisors as the root area is not substantial enough on these teeth.

These splints are especially effective in patients who parafunction (either bruxing or clenching) in centric occlusion. Their use is not successful

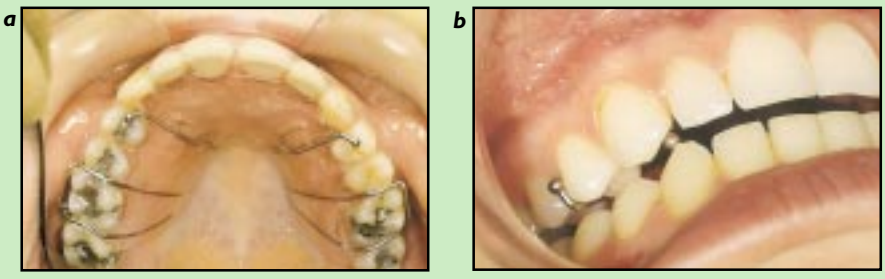

Figure 2. (a) *Localized occlusal interference splint.* ***(b)*** *Close up of ball-end interference wire.*

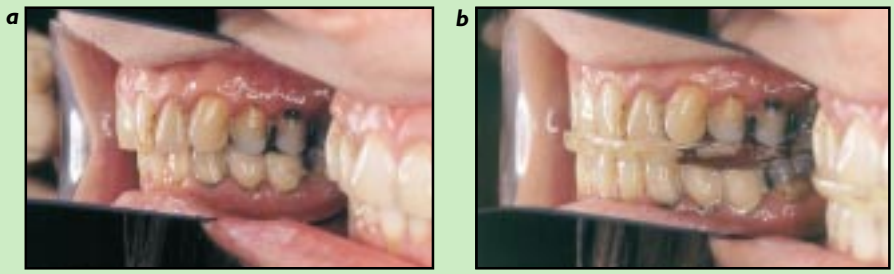

Figure 3. ***(a)*** *Mirror view of incisor relationship without anterior repositioning splint.* ***(b)*** *Mirror view of incisor relationship with anterior repositioning splint in place.*

for patients who parafunction in extreme excursive positions.

These splints are simple to construct and patients report them to be comfortable to wear. They can be used primarily at night but also on other occasions when patients are aware of parafunctioning, such as when driving. In the authors' experience, these splints do not result in wear of the teeth occluding against the splint, primarily because their use stops the parafunctional habit. Nevertheless, the patient must be carefully monitored.

ANTERIOR REPOSITIONING SPLINT

The construction and insertion of this splint has been described by Clark.[6] This is the splint of choice for the treatment of a patient suffering from disc displacement with reduction (clicking). It is a full-coverage splint constructed on the lower arch and guides the mandible downwards and forwards into a protruded position (Figure 3).

A click arises because of anterior – or, more usually, anteromedial – intra-articular disc displacement. The diagnostic test before provision of this splint is to determine whether the click disappears when the patient is asked to open from, and close into, a protrusive mandibular position. In a patient with a Class I skeletal relationship this position is usually incisal edge to edge, although there is no hard and fast rule. However, if there is an increased overjet (Class II, division 1), there may be no need to advance the mandible this far for the disc displacement to be reduced. By such anterior repositioning the click should be eliminated because, while the mandible is anteriorly positioned, the head of the condyle moves downwards and forwards and, when in this position, is thus temporarily restored to a normal relationship with the displaced intra-articular disc.

The aim of providing an anterior repositioning splint is to maintain the mandible in a temporary therapeutic position in which the click is eliminated and thereby allowing the disc to reposition. It is important during fitting of the appliance that the upper teeth fit closely into the indentations prepared for them by the technician, otherwise uncontrolled tooth movement could occur.

These splints are retained either by relining at the chairside with autopolymerizing cold cure acrylic or by using clasps. The patient should be instructed to wear the splint all the time, including when eating, because the success rate is significantly reduced if it is not used on this basis.[7] However, the patient should stop wearing the splint if he/she experience jaw locking or if any portion of the splint breaks away – if this happens, continued wear could allow for uncontrolled tooth movement. Appropriate dietary advice must be given, such as avoiding eating foods such as crusty bread and meat, adhering to a diet containing items such as fish, soups, pasta and other easily chewed foods, in order to reduce the load on the articulatory system.

While the dentist should be conscious about a previous history of locking, this is not an absolute contraindication to prescription of such an appliance as long as the patient is more comfortable on opening from a protrusive position than his/her habitual position and provided that the click disappears. Some patients will find this protruded position easy to attain, whereas others will find it quite uncomfortable. In those who find it uncomfortable, the disc is probably being dragged forwards when the mandible is being protruded; provision of such a splint in these clinical circumstances is best avoided.

The records needed are an upper and lower alginate impression and a protrusive mandibular bite record in a 'post-click' position.

If the patient does experience locking, he/she should remove the splint until the next review. It is unlikely that the appliance itself would cause the locking: it probably would

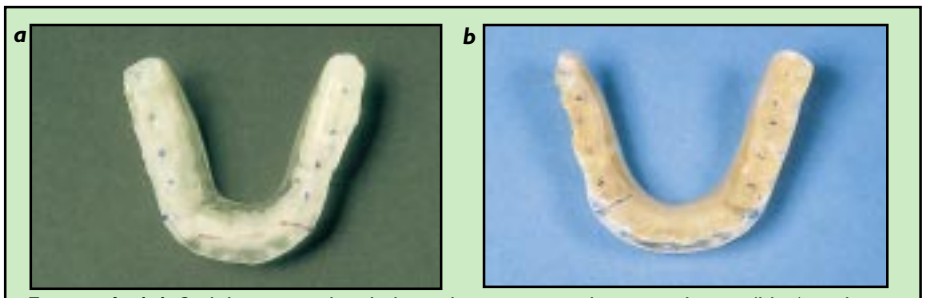

Figure 4. ***(a)*** *Stabilization splint balanced to centric relation occlusion (blue) with anterior guidance on anterior teeth (red).* ***(b)*** *Same splint 4 months later, after repeated adjustments with centric relation occlusion and anterior guidance maintained.*

have occurred in any case in a patient with an unstable disc. 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 when the time without the splint is increased slowly.

STABILIZATION SPLINT

This appliance (Figure 4) is made for patients with symptoms of pain dysfunction syndrome (facial arthromyalgia), where it is deemed that occlusal interferences or a discrepancy between centric occlusion and centric relation are aetiological factors. It may also be used as an aid to determine centric relation. This splint has several synonyms (Tanner appliance, Fox appliance, Michigan splint, centric relation appliance). The stabilization splint is a hard acrylic full coverage splint fitted to either the upper or lower jaw. It is usually made in the arch with the most teeth missing but consideration should be given to the patient's skeletal and dental arch form. As the term 'stabilization splint' suggests, the aim of the splint is to stabilize the mandible against the maxilla. 'Stabilize' suggests a provision of a balanced centric occlusion, but this simplifies its mode of action as it refers only to the static occlusion. A stabilization splint should be designed to provide an ideal occlusion in both the static and dynamic situations. The ideal occlusion is described by Ash and Ramfjord:[8]

1. The teeth are in contact in centric relation, which is considered to be the end point of the terminal hinge axis.
2. Centric occlusion is very slightly in front of centric relation but in the same sagittal and horizontal planes.
3. There should be an unrestricted glide from centric relation to centric occlusion.
4. There should be smooth gliding eccentric movements.
5. There should be no non-working-side interferences during lateral and protrusive excursions.

The aim, therefore, of a stabilization splint is to provide the patient with a static occlusion in which the maximum number of occlusal contacts are made simultaneously and with equal force between the opposing teeth and the splint. Ideally, this occlusion should be provided in centric relation as it is in this jaw relationship that the musculature is likely to be at its least strained and most stable. The dynamic occlusion provided by the splint should be a shallow and smooth guidance against the opposing canines and the central incisors. There should be immediate and lasting posterior disclusion.

The construction and fitting of this splint is a time-consuming process, involving impressions of the upper and lower teeth, a facebow record and a centric relation jaw registration. These appliances may take up to one hour to fit and balance and, once fitted, must be repeatedly adjusted until a stable mandibular position is attained. The appliance should be worn at night as there is no evidence to show that daytime wear alone improves its success rate.[9]

The cost of providing such an appliance under the terms of the National Health Service should be addressed. This is not an appliance that can be provided without the previously described records, and this is difficult to achieve under the remuneration provided by the NHS. It is to be hoped that the authorities will encourage good splint therapy by setting appropriate fees.

Provision of a heat-cured acrylic 'bite-raising appliance' is not appropriate for a patient with a TMD. If a hard acrylic appliance is provided without a centric relation jaw record and facebow registration, it merely adds a 'veneer' to the patient's existing teeth. As the mandible closes in terminal hinge axis, such an appliance can only accentuate (rather than improve) the patient's natural occlusal discrepancies. To achieve the objectives of a truly balanced stabilization splint – a removable ideal occlusion – is very demanding of both operator and patient.

GENERAL CONSIDERATIONS

There are several general considerations that should be remembered in relation to splint treatment of any kind.

All Splints have some Common Modes of Action

- All splints will decrease occlusal forces.
- All splints will have a placebo effect (cognitive awareness effect).
- All splints will alter occlusal contacts.

Define Your Objectives

What is the splint being provided for? Define the objectives with your patient before you start treatment. In the context of management of temporomandibular disorders, occlusal splints can be used for the treatment of facial pain, muscle pain, temporomandibular pain, joint sounds and to stabilize the mandibular position. It is important that these treatment objectives are discussed and the splint appropriate to the diagnosis is designed with this in mind at the onset of treatment.

Do not use Partial-coverage Splints

Any partial-coverage splint allows for uncontrolled tooth movement. All splints should be full coverage, especially if designed for wear on a 24-hour basis.

Coordinate Treatment with Diagnosis

If the diagnosis changes then so should the treatment. For example, treatment for a condition such as disc displacement with reduction (clicking) with an anterior repositioning splint would be

not only inappropriate for a patient who subsequently develops disc displacement without reduction (locking) but may be detrimental. There is no splint that can treat a patient who is locked. So-called 'pivot appliances' cannot work without applying extraoral traction anterior to the fulcrum.

Follow Medicolegal Guidelines

From a medicolegal point of view, as well as a treatment point of view, the occlusion must be examined and recorded before any splint treatment. In addition, no permanent alterations to the occlusion should be made before a period of successful splint therapy. There are very few exceptions to this rule.

'Second Phase' Treatments are Unnecessary

Even with the use of repositioning appliances, it is not necessary to perform a 'second phase of treatment'. The aim is to reduce the patient's symptoms below the threshold level whereby they function with the same occlusion, muscles and joints (articulatory system) that they had before the onset of symptoms. Permanent alterations to the occlusion are, in the overwhelming majority of patients, not indicated. In a recent clinical trial, 91% of patients who wore an anterior repositioning splint for the successful treatment of disc displacement with reduction maintained their initial improvement at 3-year follow-up. An identical percentage of patients who suffered from symptoms of pain dysfunction syndrome also maintained their initial improvement at 3-year follow-up following treatment with a stabilization splint.[10]

Improvement may not be Linear

When considering treatment with a stabilization splint, the improvement in the patient's symptoms may not be linear. There may well be periods when the symptoms appear to have returned – this generally indicates that the splint is no longer in balance as the mandible may have moved position and further refining is required.

Give Clear Advice on Oral Hygiene

Give your patient dietary and oral hygiene advice, especially if they are wearing a splint on a 24 hours a day basis, such as an anterior repositioning splint. All splints should be cleaned with a toothbrush and toothpaste and do not require soaking in any particular cleansing agent. Indeed, such agents may denature some splints.

Refer Patients with Headache to a Neurologist

Some splints are advocated by dentists as beneficial in the treatment of patients with headache. It should be remembered that headache is a symptom, not a disease, and that the correct person to make a diagnosis of the cause of headache is a neurologist – not a dentist. The dentist should not take on this responsibility unless a definitive diagnosis of pain dysfunction syndrome has been made.

CONCLUSION

This paper is designed to give the dental practitioner an overview of splint treatment in the management of temporomandibular disorders. It is impossible to be definitive or prescriptive unless the TMD diagnosis has been made and it is not the remit of this paper to cover such diagnosis.

The overall benefits of splint therapy should not be underestimated – a major benefit is that if splint therapy is unsuccessful then the splint can be discarded, leaving the practitioner safe in the knowledge that no irreversible changes to the patient's natural dentition, which could subsequently compromise or exacerbate their symptoms, have been made. If splint therapy is successful, the patient can retain the splint to use on an 'as needed' basis, reassured that they will never do themselves any harm by wearing the splint, even on a temporary basis, should the symptoms recur.

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