Obstructive Sleep Apnoea: Dental Implications & Treatment Strategies

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Abstract

The management and treatment of patients who suffer from snoring and obstructive sleep apnoea (OSA) have long since been addressed by medical and specialist dental publications and were recently highlighted by a number of mainstream dental articles. These articles inform of the medical implications of the problem and the medical and dental treatment options available, but provide little technical information on constructing these appliances. The article reviews the concepts, rationale and technical aspects of appliance design and discusses clinical and financial issues.

RATIONALE AND CONCEPTS OF APPLIANCE DESIGN

Snoring is a sign of partial upper airway obstruction during sleep. Snoring and OSA are caused by abnormal airway (base of tongue and soft palate) anatomy and altered respiratory control mechanisms.

Dental appliances may prevent snoring and OSA by modifying the position of the upper airway structures so as to enlarge and/or reduce collapsibility of the airway.[12345]

Both the superior airway space (between the soft palate and posterior nasopharynx)

and the posterior airway space (between the base of the tongue and posterior oropharynx) may be increased.[6] Three dimensional reconstructions of computed tomography and magnetic resonance imaging scans demonstrate significant increases in airway dimensions with the appliances.[78] The effectiveness of appliance therapy, however, depends on the severity of the sleeping disorder, the airway anatomy and whether the patient can tolerate the appliance. It is generally advocated for mild OSA and simple snoring (i.e. snoring in the absence of OSA) and moderate to severe OSA as an alternative to nasal continuous positive airway pressure (nCPAP) or craniofacial surgery.[9] The use of intra-oral appliances is simple, non-invasive, reversible and cost effective and may be the basis of definitive lifelong treatment.

Originally there were three concepts for a dental appliance to modify the airway, which could be used alone or in combination depending on where the airway obstruction occurred:

Soft palate lifting – the prosthesis lifts and/or stabilizes the soft palate, preventing vibration during sleep.

Tongue retention – tongue-retaining devices (TRDs) incorporate an anterior hollow bulb, which generates a negative pressure vacuum when the tongue is inserted. The tongue is held forward, away from the posterior pharyngeal wall, opening up the airway. Owing to muscle anatomy, this appliance simultaneously modifies the position of the mandible.

Mandibular repositioning – these appliances (MRAs) hold the mandible in an anteroinferior position, which, as a consequence of muscle attachment, indirectly brings the tongue forward, opening up the posterior airway (Figure 1). The repositioning may also stretch and reduce the collapsibility of the soft palate via its connection to the base of the tongue and increase the superior airway space.

The soft palate lifting design is not often used because of patient tolerance and the fact that tongue posture rather than soft palate position is considered to have a significant influence on the patency of the upper airway.[10] An example of this type of appliance is clearly shown in the paper by Clark and Nako1no.5 Whilst TRDs directly move the tongue to open the airway, patient tolerance is not satisfactory.

When appliances are indicated the consensus appears to be a type of MRA, which Johal and Battagel consider most suitable for obstructions at the level of the tongue.[2] However, there is considerable variation with respect to the vertical and horizontal planes of mandibular repositioning and the material used for construction.

MANDIBULAR REPOSITIONING CONSIDERATIONS

Appliances for the treatment of snoring and OSA have been described with different degrees of horizontal and vertical repositioning. The most common mandibular repositioning dimension quoted is 50–75% of maximal protrusion (approximately 5–7 mm) with minimal vertical opening.[11,12,15] The rationale for minimal opening is that, as the mandible opens, it rotates in an inferior and posterior direction. Concurrent posterior movement of the tongue and soft palate with wider opening may narrow the pharyngeal airway.7 An extensive review led by Ivanhoe found a variety of protrusive dimensions were associated with successful outcomes.[13] This, along with Lowe's text [14] suggests that most protrusive positions are effective.

MATERIAL CONSIDERATIONS

To date either poly-vinyl vacuum-formed thermoplastic materials (soft or stiff blanks depending on the Shore-hardness) or hard acrylic (predominantly heat cured) can be used. The choice of material often depends on appliance design and operator preference. To optimize retention for the vinyl appliances it is recommended that the flanges extend at least 3 mm past the gingival margin but, if softer vinyl is used, this depth should be increased.

OCCLUSAL COVERAGE

The designs in Table 1 have varying occlusal coverage but ideally complete occlusal coverage should be prescribed to prevent the potential of localized tooth over-eruption. Case reports of complications occurring when full coverage was not used are discussed below.

EDENTULOUS PATIENTS

Most appliances are made for dentate mouths but a technique for edentulous sufferers has been described.[15] If retention is a problem then a TRD may be an alternative option.

SOME DESIGNS OF MRAS (TABLE 1)

Appliances can be considered as either one- or two-piece designs. One-piece designs are not adjustable whilst the two piece appliances can be adjusted in the anteroposterior plane. They may also permit, as with the Herbst-type appliance, limited lateral movements for parafunctional patients.

Figure 1

Table 1. A summary of dental appliances described for the treatment of snoring and obstructive sleep apnoea

Appliance name	Description	Type	Occlusal coverage
Adjustable Soft Palate Lifter	Lifts the soft palate and prevents vibration during sleep	One-piece	Full
Equaliser	Repositions the mandible anteriorly, equalizes intra- and extra-oral air pressure (via tubes) and elevates soft palate	One-piece	Full
Herbst	Repositions the mandible anteriorly, in open and closed position, withadjustable struts.	Two-piece	Full
Jasper Jumper	Repositions the mandible anteriorly	Two-piece	Full
Mandibular Repositioner	Repositions the mandible anteriorly (3–7 mm)	One-piece	Full
Nocturnal Airway Patency Appliance	Repositions the mandible anteriorly and inferiorly	One-piece	Full
Sleep and Nocturnal Obstructive Apnoea Reducer (SNOAR)	Repositions the mandible anteriorly (6–9 mm) and inferiorly (17 mm)	One-piece	Excludes anterior maxilla
Snore Guard	24 Repositions the mandible anteriorly (3 mm behind maximal protrusion) and inferiorly (7 mm)	One-piece	Excludes molars
Snoring Treatment Appliance	Repositions the mandible anteriorly	One-piece	Excludes molars
Tepper Oral Proprioceptive Stimulator	Modifies tongue position	One-piece	Not applicable
Tongue Locking Device	Preformed elastic appliance with a cavity that holds the tongue forward by self-created vacuum	One-piecel	Full
Tongue Positioner and Exerciser	Helps train the tongue to be in a more favourable position	One-piece	Full
Tongue Retaining Device	Holds the tongue anteriorly during sleep by negative pressure in a bulb	One-piece	Full
Therasnore	Lower fin prevents tongue and mandible dropping back	Two-piece	Full

One of the most accepted designs is the one-piece non-adjustable soft vinyl vacuum-formed MRA. (Fig 1) This involves fusing the thermoplastic material covering the maxillary and mandibular arches in the desired anteroinferior position. The occlusal position is established and recorded in vivo by a variety of methods including a wax-bite, silicone-bite or anterior jig with an interocclusal registration.[14] An optional anterior breathing hole can be placed to reassure those patients who mouth breathe but is not essential.

Figure 2

Figure 1. Conventional vinyl MRA (nonadjustable).

In the two-part Herbst-based IST (Intra- Oral Snoring Therapy) and Silensor appliances (Fig 2), the arches are connected by pivoting bars that can be altered in length to titrate the protrusive mandibular position for effectiveness and comfort. The occlusal registration for these two-part appliances is not as important because mandibular repositioning can be titrated from the intercuspal position.

Figure 3

Figure 2. The Silensor – an adjustable two-part

Although designed for orthodontic treatment, the Twin-Block functional appliance can be used as a MRA because its (two-piece adjustable) design allows adjustment of the mandibular position by removing or adding acrylic. These adjustments will be difficult, however, if modifications have been included in an attempt to prevent nocturnal mandibular opening .

Figure 4

Figure 2. IST Appliance – an adjustable two-part Herbst-type appliance.

It is crucial that full coverage is provided to prevent over-eruption and the technician knows that the appliance is for sleep breathing disorders rather than orthodontics.

The recently advertised Therasnore Zx has a different approach, in that the appliance engages only the maxillary dentition and relies on a lingual fin to induce protrusive mandibular repositioning and/or prevent the tongue and mandible from dropping backward during sleep.[16]It is two-part in design and adjustable via five slots of 1.5 mm increments .

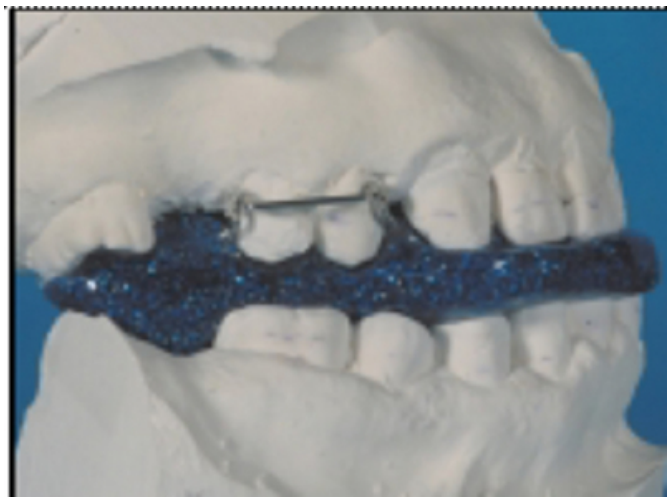
Figure 5

Figure 5. In vivo fitting of the Therasnore Zx appliance

It is believed that if a patient opens their mouth at night the appliance will not function. To counteract this locking, elastics are advocated for the two-part Herbst-type appliances and adequate retention of the dental arches is needed for the one-piece prostheses. However, one must question this theory as a rule. For example, the Therasnore Zx engages only the maxillary dentition and relies on the mandible being closed for the lingual fin to effect mandibular repositioning. The anterior repositioning splint (ARPS) described for temporomandibular disorders is similar to the mandibular repositioners in Table 1.[18] The ARPS either fits the maxillary dentition and relies on the mandible being closed or vice versa .

Figure 6

Figure 7. A one-piece heat-cured acrylic nonadjustable MRA (an ARPS).



PATIENT PERCEPTIONS, COMPLICATIONS AND FOLLOW UP

Patients may recall, when questioned, the thermoplastic designs, the appliance may loosen. The ideal design is probably the more rigid acrylic two-piece adjustable Herbst-type appliance but this design was not financially viable for the department.

Materials were sought to construct a one-piece MRA that would resist splitting.

SUMMARY

Aspects relating to the provision of appliances for snoring and OSA have been discussed

The clinician should decide on the most suitable design for the patient depending on factors such as diagnosis of sleep disorder, cost, parafunctional activity and occlusal registration. A formal medical assessment of the sleeping disorder is advocated before treating such patients.

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