The occlusal guard: a simplified technique for fabrication and equilibration

John Antonelli, DDS, MS  Timothe L. Hottel, DDS, MS, MBA  Sharon C. Siegel, DDS, MS  Robert Brandt, DDS, MS
Gladston Silva, DDS, DMD

Hard occlusal guards have been used effectively to treat myofacial pain originating from parafunctional activities. They can also protect the natural dentition when it opposes porcelain restorations, help to evaluate changes in occlusal vertical dimension during full mouth rehabilitation, minimize further tooth loss in patients with abfraction lesions, and redirect occlusal loads more favorably onto dental implant-supported prostheses. A simplified technique is described to fabricate a properly designed wax model of an occlusal guard that can be processed in acrylic in the same manner used to construct a complete denture.

The first step in this technique is to obtain a set of irreversible hydrocolloid (alginate) impressions that are free of voids. A snap removal from the mouth is recommended, as rocking upon removal causes distortion and tearing, and leads to an ill-fitting appliance. Pour impressions immediately into Resin Rock (Whip Mix Corporation). Resin Rock is ideal for producing accurate casts as it provides 2 major advantages: it is a resin-fortified die stone that is more abrasion-resistant than other gypsum products, and it exhibits less setting expansion (0.08%) than conventional model stones (setting expansion range 0.9% to 0.16%).

Use a facebow transfer to relate the maxillary cast to a semi-adjustable articulator. Arbitrary hand articulation and subsequent mounting of casts on an articulator should be avoided as they generally result in significant occlusal discrepancies and the need for additional chairside adjustments of the appliance at the delivery appointment. Chairside adjustments can be minimized further by making a CR bite record to mount the mandibular cast. To record CR, soften a piece of extra hard pink base plate wax (Beauty Pink Wax, Miltex, Inc.) and then cut to the shape of the maxillary arch. Place the softened wax over the maxillary teeth to index the wax (that is, record indentations of the cusps). Remove and chill the wax and then replace over the teeth and check for stability. Attach two thicknesses of green Aluwax (Aluwax Dental Products Co.) to the premolar-molar regions of the pink wax. Soften the Aluwax and place the indexed wax intraorally to record the

---

Materials and methods

Constructing a hard occlusal guard is relatively uncomplicated. This article describes a simple technique that uses few materials to process a wax model in acrylic according to the same technique used in the construction of complete dentures.

---

Received: March 15, 2012
Revised: August 2, 2012
Accepted: September 24, 2012
bite. Remove the wax record after approximately 45 seconds and chill in cold water prior to articulating the mandibular cast. Verify that the articulated casts conform identically to the patient’s CR bite. The next step is to outline in pencil on the maxillary cast the peripheral extent of the appliance. The lingual border should extend approximately 10 mm apical to the free gingival margins. For adequate retention of the guard, the labial border should terminate between the incisal and middle thirds of the anterior teeth; the border around posterior teeth may be slightly longer. Survey the maxillary cast to detect deep undercuts that could prevent seating of the appliance in the mouth; undercuts may be blocked out by applying stone or plaster directly to the cast. Block-out procedures may be omitted if undercuts or embrasures are minimal and subsequent interferences to seating the guard can be removed at the time of insertion.

With both casts on the articulator, eccentric guidance and the thickness of the guard are best developed by using an anterior guide pin in contact with the patient’s previously constructed custom incisal guidance table. If a custom guidance table is not available, then a mechanical incisal guidance table may be inserted on the articulator and set flat initially. Open the occlusal vertical dimension of the articulator by extending the incisal pin downward. An interocclusal space of approximately 1.5 to 2.0 mm should exist in the molar region of the casts; this should be approximately the same OVD as the one at which the wax CR record was made and should provide sufficient room for the anticipated thickness of the appliance. A pin extension of approximately 5.0 to 6.0 mm is in the range of opening for this purpose. Check the clearance between opposing casts during protrusive movement. If there is less than 1.5 mm clearance, then increase it by tilting the mechanical guidance table. Raise the wings of the mechanical guidance table until there is 1.5 to 2.0 mm of clearance in all lateral excursions. Next, soften 2 pieces of pink base plate wax (Henry Schein Dental) in hot water; avoid overheating as melted wax is difficult to manipulate. Superimpose the pieces and then fold lengthwise to produce a strip approximately 15 mm wide. Adapt the wax strip over the teeth of the maxillary cast and exert pressure to extend the edges up to the facial/buccal and palatal borders outlined previously (Fig. 1). Use a warm, sharp knife to cut wax that extends beyond the pencil lines.

It might be necessary to resoften the wax at this time. Replace the softened wax strip over the maxillary cast and close the articulator until the incisal pin contacts the guidance table; imprints of mandibular tooth surfaces should appear in the wax strip. Use a sharp blade to remove excess wax until only the indentations
of the functional (buccal) mandibular cusps remain. Next, use thin (19 µm) articulating ribbon (Exacta-Film, Ardent International, Inc.)—blue side facing the wax—in a Miller forceps to record all occlusal contacts by alternately closing and opening the maxillary member of the articulator. There should be even diameter blue CR marks on the surface of the wax strip for each functional cusp. Use a warm knife to flatten and smooth the wax until there are solid CR contacts bilaterally for every mandibular buccal cusp; retain solid CR marks for as many incisors as possible (Fig. 2). At this point, all contacts should be located in shallow wax depressions. After all occlusal contacts have been recorded, use a new piece of articulating ribbon to identify potential working and balancing side interferences. Release the centric lock on the articulator. Place the ribbon on the left side (red side facing wax) and close the articulator. Move the incisal pin to the right and left sides to register any laterotrusive (working) and mediotrusive (balancing) interferences, respectively. Repeat the procedure on the opposite side of the arch to detect and eliminate all posterior working and balancing interferences; do not eliminate the blue CR dots (Fig. 3). CR markings are essential contacts and are used to equilibrate the occlusal guard. Preserve only the blue CR marks in the incisor region. This step establishes incisal guidance in the occlusal guard. Protrusive movement should be guided predominantly by the mandibular canines. (Mandibular incisors may assist in protrusive movement; however, no single incisor should bear the load in anterior guidance.) Use a new piece of articulating ribbon to detect (in red) and eliminate all posterior interfering contacts that appear during protrusive movement; continue to preserve all posterior blue CR contacts. Shape and smooth the wax as you develop an anterior ramp and canine eminences (Fig. 5). They should be angled approximately 30 to 45 degrees to the occlusal plane and allow continuous and smooth contact during protrusive and laterotrusive excursions. A greater angulation could restrict anterior guidance and aggravate existing masticatory muscle pain. Smooth all wax surfaces.

The occlusal table should be at least half a cusp wider facially and lingually than the maxillary teeth being covered; it should extend anteriorly to provide incisal contact in full protrusive jaw position. Smooth all ridges and irregularities produced by centric closure and excursive movements so that wax extends almost to the deepest portions of the indented tracks made by the mandibular teeth. At this point, a commercial dental laboratory can invest and process the wax pattern with clear, heat-polymerizing acrylic resin in a manner similar to the way complete dentures are invested and processed.

**Intraoral delivery and equilibration of the processed occlusal guard**

The success of the therapy will depend on how accurately the occlusal guard is equilibrated and on the level of patient cooperation. There are a few steps to help ensure a favorable outcome. First, at the try-in appointment, deep interproximal embrasures and tooth surface irregularities are likely to interfere with complete seating of the guard. Soft disclosing wax can be melted into the intaglio surfaces of the guard to facilitate identification of binding areas. White Fit Checker (GC America, Inc.), a silicone disclosing material, may also be used to detect binding sites within the guard. A satisfactory fit is achieved when the intaglio surfaces are covered by a uniformly thin film (30 to 120 µm) of silicone material. Remove binding areas with a No. 8 carbide bur at slow speed. The appliance should fit comfortably and be adequately retentive without rocking; lip and tongue movements should not unseat the guard.

Another way to ensure a favorable outcome is to place the patient in a reclined position to simulate the sleeping posture, then use articulating ribbon intraorally over occluding surfaces of all opposing teeth to equilibrate the guard. Be aware that gravitational effects will likely cause a slight posterior repositioning of the mandible. Register all mandibular CR functional cusp tip and incisal edge contacts with the blue side of the ribbon facing acrylic. If contacts are detected predominantly on one side of the arch, then flatten areas of heavy or premature contacts until there are solid CR contacts bilaterally throughout the posterior areas of the occlusal guard (Fig. 6). Eliminate all premature contacts on the appliance outside the mouth. A pear-shaped laboratory acrylic finishing bur (Komet H77E-029, Komet USA LLC) is recommended to eliminate CR prematurities and deflective contacts in all mandibular excursions until each CR functional cusp has a relatively even diameter mark.

Identify anterior protrusive sliding contacts with the red side of the articulating ribbon. Then identify and eliminate posterior interfering contacts that occur during protrusion; preserve all blue CR dots. Establish broad, continuous curved contacts on the guard, guided...
by the mandibular canines and as many incisors as possible during protrusive movement. In canine guidance, movements must be smooth as posterior teeth are disoccluded.

Eliminate all posterior laterotrusive and mediotrusive contacts on both sides of the appliance without eliminating blue CR contacts (Fig. 7). Remove all eccentric contacts made by incisors so that the predominant laterotrusive marks are those of the mandibular canines. Occlusal equilibration should avoid selective spot grinding; instead, planar grinding is preferred to beneficial laterotrusive markings. After adjusting the guard in the upright position, raise the patient to the initial diagnosis must be questioned. Failure to abate, then the occlusion should be reevaluated. If symptoms persist, then the initial diagnosis must be questioned.

Inform the patient that wearing the guard will likely cause an increase in salivation, which can last for as long as 2 weeks. Speech will likely be affected initially but will return to normal in 2 to 3 days.

**Maintenance of the occlusal guard**

Instruct the patient to brush the guard thoroughly after it is removed from the mouth; a soft toothbrush is recommended to remove food debris. After a guard is washed and is not going to be placed immediately back in the mouth, the patient should immerse the guard in water to avoid warping. To reduce biomass levels, the guard should be soaked in sodium hypochlorite, or denture cleansers containing sodium hypochlorite, for no longer than 10 minutes. During maintenance care visits—every 4 to 6 months is recommended—examine the guard for previously undetected or newly developed wear facets; re-equilibrate if necessary or remake if occlusal wear results in perforation. Oral hygiene instructions must be reinforced during maintenance care visits.

**Discussion**

The greatest harm to the teeth and supporting structures occurs during parafunction, not during normal function. Bruxers and clenchers may report the symptoms of myofacial pain associated with clenching and bruxing. Clark et al found that 82.2% exhibited attrition of enamel on 3 or more teeth; 41.7% of the subjects exhibited wear of both enamel and dentin. As many as 90% of nocturnal bruxers have reported clenching. Bruxing or clenching is the first indication for treatment with an occlusal guard. Bruxers and clenchers may report the following symptoms: (1) tightness of the masticatory muscles upon awakening (diurnal bruxing and clenching can also

Fig. 8. Side view of acrylic guard in mouth. Note posterior teeth are clearly disoccluded from the guard during canine guided movement.
produce this sensation) and (2) myofacial pain. During normal chewing, the loads applied to teeth are small, ranging from 2.25 lbs. to 4.5 lbs. Typically humans can only place approximately 25 lbs. of pressure on a central incisor, gradually increasing as one moves posteriorly to approximately 125 lbs. at the premolars and 200 lbs. at the molars.12 Bruxing and clenching have been found to have increasing effects on bite force.11 To add to these increased loads, total tooth contact time for bruxers was found to range from 30 minutes to 3 hours in a 24-hour period; total tooth contact time for nonbruxers was approximately 17.5 minutes.13,14 Myofacial pain is related to prolonged jaw closing muscle hyperactivity. Patients who exhibit greater levels of nocturnal electromyographic (EMG) activity are more likely to have signs and symptoms of jaw dysfunction (i.e., restricted range of mandibular movement, muscle pain on palpation, temporomandibular joint pain on palpation, and pain during mandibular border movements).12

Manns et al examined EMG activity when the masseter muscles clench in various situations.15 Their study first measured muscle activity when patients clenched only on natural teeth and then compared muscle activity when the same patients clenched on an occlusal guard. The authors observed an increase in muscle activity when patients clenched on a guard. When the design of the guard was altered to permit only the 6 anterior teeth to contact, muscle activity decreased by 40%. When the premolars and the incisors were permitted to contact, they observed a 20% decrease in maximum bite force. Maximum muscle activity was recorded when only the molars were in contact. A properly designed occlusal guard manages these forces by loading the temporomandibular joints with all teeth touching simultaneously.15 The authors concluded that muscle activity—and joint health—is dependent on the most posterior tooth contacts and anterior guidance functions to prevent posterior tooth contact. Therefore, reduction of posterior tooth contact will reduce muscle activity.15

In an earlier study, Manns et al undertook to determine how excursive contacts affect muscle activity.16 Electromyographic activity in patients displaying canine guidance was compared to those with group function. The authors discovered that in laterotrusive and mediotrusive movements, the masseter and temporalis muscles work half as much in canine guidance as in group function. This was attributed to decreased contacts among posterior teeth during canine guidance—it is not the contact of the canines that decreases EMG activity of the elevator muscles, but the elimination of posterior contacts.16 The case was presented for designing canine guidance in occlusal guards for patients with myofacial pain. When this objective is achieved, then the temporalis and masseter muscles release their contractions and are unable to exert a magnitude of harmful force when posterior interferences are present.9 A second indication for the need to provide an occlusal guard is the increasing use of porcelain in dental restorations. Porcelain is more abrasive to opposing natural enamel than metal; its destructive capacity is well-known.17 When porcelain surfaces are adjusted to the extent that the glaze is removed and the underlying opaque porcelain is exposed, the opaque porcelain poses a greater danger than the body porcelain for the destruction of opposing enamel and restorations during function.17 Also, while porcelain is strongest under compression, it is weakest under the tensile and shear forces that occur during excursive mandibular movements. Invisible microcracks exist on the surface of porcelain.17 Tensile stresses on porcelain serve as a wedge to concentrate the stress, enlarge the cracks, and eventually promote crack propagation through the body of the porcelain. Parafunctional activity is also responsible for loosening prostheses.18 It is recommended to provide an occlusal guard for all patients with porcelain reconstructions to preserve the natural dentition and to protect porcelain restorations when they oppose one another.

A third indication for an occlusal guard is prior to full mouth rehabilitation, when the OVD will be re-established and the teeth will be restored with full or partial coverage crowns. An occlusal guard is a non-invasive way to assess a patient’s tolerance to the restored OVD while preventing further loss of tooth structure. A maxillary appliance is provided after all restorative treatment is completed. After all definitive restorations are placed, a new appliance is constructed to protect the restorations and natural tooth structure, and to decrease myofacial pain when there is evidence of parafunctional activity. The fourth indication for an occlusal guard is the presence of tooth abfraction lesions.19 Abfractions are noncarious, V-shaped hard tissue lesions located at the cemento-enamel junction. Evidence suggests that abfractions are produced when occlusal loads applied outside the long axis during lateral excursions causes teeth to flex.20 Abfraction lesions are seen in bruxers and clenchers as they commonly apply large eccentric occlusal loads to their teeth. The efficacy of direct occlusal equilibration in these cases is still controversial, and the elimination of occlusal interferences will not necessarily eliminate bruxing or clenching habits. Providing an occlusal guard for patients with abfractions is considered a reasonable protective measure.19

A fifth possible indication for use of occlusal guards is in patients with dental implants. Lobbezoo et al acknowledged a lack of evidence implicating parafunctional activity as contributing to overloading implants or their superstructures; however, they credited occlusal guards with being able to redirect occlusal loads to the long axis of implant-supported crowns.21 Maxillary occlusal guards can also be used to eliminate occlusal loading of maxillary or mandibular implant-supported restorations. As implants do not extrude in the absence of opposing contacts, occlusal loads on maxillary implant-supported restorations may be eliminated by hollow grinding the intaglio surfaces of maxillary guards covering the implants. When mandibular implants are present, the occlusal surfaces of maxillary guards opposing implants can be relieved to eliminate occlusal loads.18

Soft occlusal guards are not recommended because they tend to produce an increase in masseter muscle activity during maximum clenching activity; hard occlusal guards decrease EMG activity in both masseter and temporalis muscles. When al-Quran & Lyons tested hard appliances, the decrease in activity was more pronounced in the temporalis muscles.2 Okeson reported that soft occlusal guards do not significantly decrease nocturnal bruxism.3 In his study, 80% of the participants experienced a
25% decrease in nocturnal muscle activity with a hard occlusal guard, whereas 70% of the participants who wore a soft guard experienced a 25% increase in nocturnal muscle activity. Soft appliances were shown to increase nocturnal muscle activity in patients who were initially asymptomatic; therefore they are contraindicated for use in symptomatic patients.23,24

Conclusion
While Christensen estimated that at least one third of patients in general practice need an occlusal guard, Dao & Lavigne cautioned against over-reliance on reports about the efficacy of occlusal guards as a therapy for reduction of myofacial pain and bruxism.23,24 Their data suggests that occlusion might not be the cause of bruxism, and the decrease in myofacial pain might not be the result of treatment with an occlusal guard but, rather due to a placebo effect. However, the authors recommended using a hard occlusal appliance as a diagnostic tool to rule out pathology prior to fabricating definitive restorations.24 Kreiner et al acknowledged that the efficacy of behavioral modification and occlusal appliance therapy might be equal; however, they conceded that when there is a need to protect the natural dentition from attrition, or symptoms of myofacial pain and parafunctional activity exist, prescribing an occlusal guard is a rational treatment.25

Author information
Dr. Antonelli is a professor and director, Fixed Prosthodontics Courses, Prosthodontics, College of Dental Medicine, Nova Southeastern University, Fort Lauderdale, Florida, and an adjunct professor, Department of Prosthodontics, College of Dentistry, University of Tennessee, Memphis. Dr. Siegel is a professor and chair, Prosthodontics, College of Dental Medicine, Nova Southeastern University, Fort Lauderdale, Florida, where Dr. Silva is a resident in the Implant Fellowship Program. Dr. Hottel is a dean and professor, Department of Prosthodontics, College of Dentistry, University of Tennessee, Memphis, where Dr. Brandt is a professor and director, AEGD Program at Lutheran Medical/Dental Center.

References

Manufacturers
Henry Schein Dental, Melville, NY 800.372.4346, www.henryschein.com
Komet USA LLC, Rock Hill, SC 888.566.3887, www.kometusa.com
Whip Mix Corporation, Louisville, KY 800.626.5651, whipmix.com