Not All Occlusal Splints Are Created Equally

Ronald Klausz, RDT

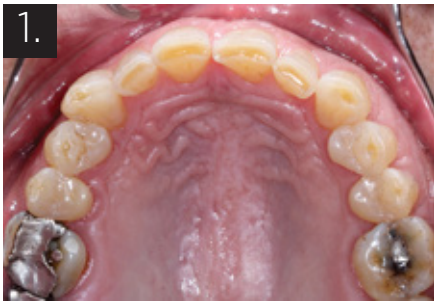
Splint therapy has become one of the most prevalent aspects of dentistry over the last number of years. Patients are presenting with multiple reasons for needing this type of dental intervention. From TMJ pain to severely wearing away the enamel of their natural teeth, the devastation and destruction that bruxing and clenching (parafunction) can cause is dramatic and poses long-term consequences **(Figs. 1 & 2)**. One of the major challenges is designing a splint that accurately captures the occlusal scheme, is not too bulky, protects the opposing dentition, and patients are able to adapt to and wear long term. Patient adaption and compliance is the major challenge and this article will explore how to overcome this.

Occlusal splints can be fabricated from a variety of materials depending on the causes and effects of the trauma, the patient's compliance, the dentist's preferences, as well as a myriad of other determinants.

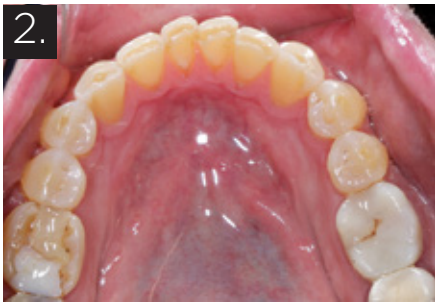
There are also an infinite number of designs that can be chosen from, to match the clinical needs, treatment outcomes and the philosophies of the dentist and patient.[1] This article will focus on the traditional flat plane occlusal splint made for either the maxillary or mandibular arch. This type of splint is one of the more common splints used to treat this wide variety of conditions.

Using today's modern prosthetic materials, we can ensure the fit, comfort, and longevity of custom fabricated appliances. The standard material, used for many years was hard, clear or tooth coloured acrylics (methyl mathacrylates). These materials had a number of shortcomings. The major shortcoming was due to polymerization shrinkage; the appliance would warp during curing and cause the appliance to rock intra-orally when placed on the teeth.[2] Due to the rigidity of the material, the splint needed to be kept short of the necessary undercuts to avoid fracture. To compensate for the lack of retention, ball clasps were incorporated into the splint. Ball clasps put excess pressure into inter-dental papilla and could cause long term damage.[3] A common patient complaint was excessive tightness in the anterior or posterior regions.

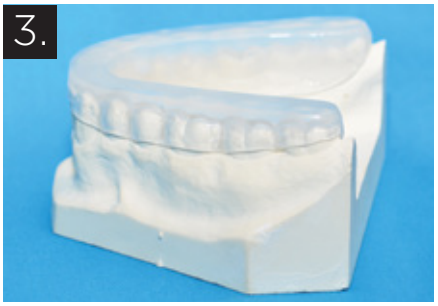
With the advancement of far more accurate Pressure Molded Technologies (PMT) such as Biocryl (Great Lakes Orthodontics), plastic bases can be fabricated that fit well, with less rigidity, onto casts of the teeth, capturing as much or as little undercut that is needed for retention. Onto these PMT bases, small amounts of hard acrylic can be cured, causing negligible distortion. This allows an accurate occlusal scheme to be created to match the patient's opposing dentition. Light cured composite such as Primosplint (Primotec USA), which has far less curing shrinkage than acrylics, can be bonded to



Heavily Worn Maxillary Dentition.

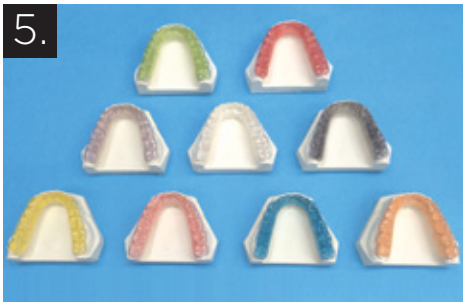


Heavily Worn Mandibular Dentition.

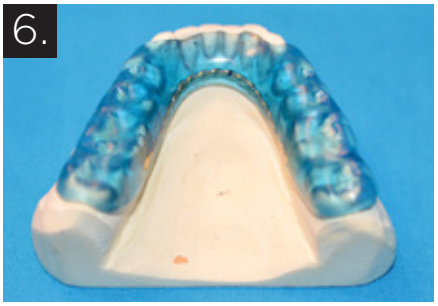


PMT and Composite Splint.

Thermoplastic/Hard Acrylic Combination.



Coloured Thermoplastics.



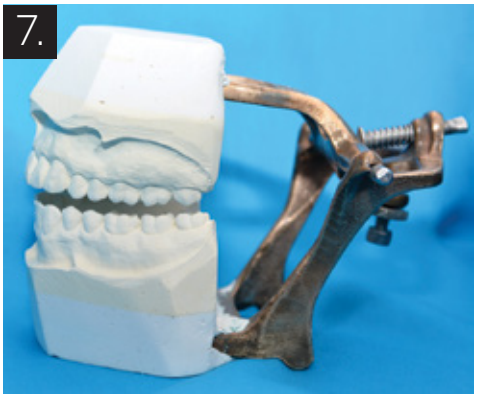
No Anterior Coverage Reinforced Splint.

the bases, eliminating the distortions caused by acrylic curing entirely **(Figure 3)**.[4] As well, chemical composition of composite resins tend to be far more biocompatible than methyl mathacrylates.[5]

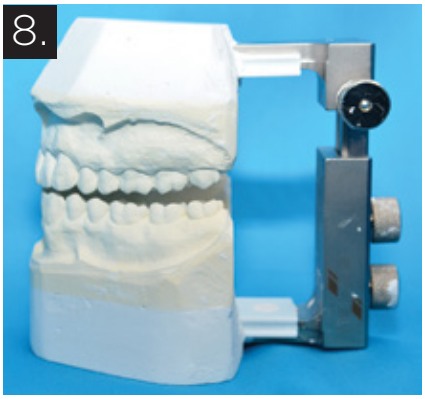
For even greater patient comfort, the development of thermoplastic materials, such as Clearsplint (Astron Dental), enables the clinician to prescribe appliances that can capture more hard tissue undercuts, thus being more retentive without the worry of breakage or the need for ball clasps. These materials are created by mixing a liquid monomer and powder polymer and curing under heat and pressure. Appliances that are fabricated from thermoplastic materials have the ability to flex when softened under warm water, or placed in the oral environment, and still retain their initial shape.[6] This allows these appliances to conform to the contours of the patient's teeth when inserted. One can modify the stiffness of the final appliance by altering the liquid/powder ratio to customize a splint to match the needs of a specific patient. Thermoplastics also act as a type of shock absorber, disseminating the excessive occlusal forces created during parafunction.[7]

Appliances can be left as all thermoplastic, or hard, clear acrylics such as Splint Acrylic Resin (Great Lakes Orthodontics) can be cured, under heat and pressure, to their occlusal surfaces **(Fig. 4)**. This hard acrylic layer will provide a more rigid and durable surface for the opposing dentition to occlude against. A more stable plane of occlusion should help relieve any TMJ related pain. With the combination thermoplastic base and hard acrylic occlusal, the patient is getting the best of both worlds: better fit and retention with the thermoplastic base material and occlusal stability, as the verticle dimension can be maintained over the long term, with the hard acrylic exterior.[8] These materials can be tinted in a variety of colours **(Fig. 5)** making the appliances easier to see and thus less likely to be accidentally lost. These colours also make them more fun and attractive to patients and thus can aid in compliance.

Using these materials, one can modify the design of the "standard" flat plane occlusal splints. These appliances were originally designed as a full coverage appliance with a flat occlusal table, occluding with every tooth in the opposing arch. Now, through correct material selection, the design can be altered to enhance the patient experience depending on the clinical needs that need to be addressed. Appliances can be fabricated with or without anterior tooth coverage, increasing air-flow and making it easier for the patient to breathe and communicate **(Fig. 6)**. This also eliminates the tightness and discomfort caused by lingually directed forces placed on the anterior teeth by appliances. For additional strength, during processing, lingual braided bars or mesh can be incorporated



Standard Articulator Mounting.



Hinge Fixator Mounting.

into the materials and designs. As well, the design can be altered to add anterior and/or cuspid guidance and the posterior occlusion can be left smooth or guiding grooves can be added.

There are a number of bite registration techniques that are utilized for the fabrication of oral appliances, such as Centric Occlusion Registrations, Centric Relation Registrations, Phonetic Bite Registrations, Aqualizer Muscle Directed Bite Registrations (Aqualizer from Jenmar Corporation) etc. Depending on the technique requested and the philosophy that is being followed, today's dental laboratories need to be able to mount the provided models, using the various bite registrations, on a variety of different types of articulators such as the Panadent Articulator (Panadent Corp), or the AccuLiner Articulator (Accu-Liner Products).

However, through discussions with various dental lab owners, it is evident that the vast majority of occlusal splints are being mounted using centric occlusion bite registrations on simple hinge axis articulators. Dental laboratories generally mount these models on standard hinge axis articulators and estimate the amount of vertical opening for the splint, based on the required amount of material thickness. These simple articulators have a more than two to one ratio of opening the anterior more than the posterior **(Fig. 7)**.[9] As well, they do not take into consideration the occlusal anatomy of the teeth or the skeletal anatomy of the patient.[10] Using this technique creates an appliance where the occlusion is very heavy in the posterior areas and open in the anterior. This forces the dentist to spend additional time grinding in the bite, starting in the posterior and working their way forward until more even occlusal markings are developed. This technique leaves the distal areas of the splint thin and compromised.[11]

In our laboratory, we have found a solution to this reoccurring problem. When provided with models and a centric occlusion bite registration, the models are mounted on special articulator/verticulator devices such as the Hinge Fixator (Scheu Dental Technology) **(Fig. 8)**. When determining the amount of space needed for the splint material, these types of devices allow the technician to take into consideration the translation of the mandible. As well, by carefully assessing the posterior tooth morphology, we can estimate the angle of the articular eminence and mimic the rotation of the mandible. By incorporating these two crucial aspects of jaw movement, we can simulate the amount of translation and rotation of the mandible using a formula, based on the concepts taken from The AccuLiner System, derived by Dr. James Carlson.[12] By following these teachings, the dental laboratory can closely match the patient's true vertical opening in the lab when designing the space that is required for the splint, thus reducing the amount of chair time it takes to calibrate the occlusion of the appliance. It requires more skill and knowledge by the technician in the lab to utilize this technique; however, the result can be very dramatic when it comes to the time spent in the office adjusting the occlusion into the appliance.

The simple occlusal splint has come a long way since first introduced to dentistry. Today's dentists and dental technologists are constantly striving to enhance the patient experience and reduce the devastating effects that bruxing and clenching are causing. At the same time, we are working to develop better materials, creating advanced designs, and engineering techniques that provide for less time fitting and dispensing these devices. **OH**

Oral Health welcomes this original article.

Disclosure: The author wishes to express that he has no financial interest in any of the products or devises mentioned in the article; however, Klausz Dental Laboratories is one of the Canadian distributors of The Aqualizer Temporary Splint.

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Ron Klausz, RDT, is owner of Klausz Dental Laboratories, located in Toronto, Ontario. He has written numerous articles on restorative and implant dentistry and has lectured in both Canada and the United States. He keeps with the family traditions of producing advanced, high quality restorations and appliances while developing unique client and patient care services. He has modernized his family run company, which is celebrating 50 years of serving the dental community, whose focus is still based on fulfilling client needs. "Working harder and smarter for your practice!" is their mantra.