A New Design for Mandibular Occlusal Splint

*Ahmad A. Mahmoud, *[1] Mahmoud K. AL-Omiri, [2] Osama Abu-Hammad, [3] Nadia Ereifej, [4] Yara Owis [5]*

Abstract

Objectives: The aim of this report is to describe the design and steps for construction of a new design of mandibular occlusal splint, which was designed in a manner that facilitated the engagement of the bilateral undercuts usually located on the lingual aspects of the lower posterior teeth and alveolar processes.

Materials and Methods: This occlusal splint was composed of two parts. The split design provided the flexibility needed to engage the deep bilateral undercuts located lingual to the mandibular posterior teeth and alveolar processes.

The parts of the two splint segments were connected with flexible connectors made from cast Ti-6Al-7Nb, an alloy characterized by its high flexibility (for the first part), and wrought Cobalt-Chromium wire (for the second part of the splint). These flexible connectors were expected to flex repeatedly each time the appliance was inserted or removed from its position without undergoing permanent deformation.

Significance: The described occlusal appliance had the following merits. Since it had the ability to engage the bilateral undercuts usually located lingual to the posterior segments of the mandibular arch, this could abolish the need for any necessary block out and eliminate the spaces between the appliance and the oral tissues. Such spaces can be annoying for some patients because of the noticeable borders or trapped food when the appliance is used for eating. An undercut engagement also added to the stability and retention of the appliance.

Keywords: Occlusal splint, Undercuts, Split design, Flexibility.

(J Med J 2012; Vol. 46 (1):33- 38)

Received	***Accepted***
July 26, 2011	*September 4, 2011*

Introduction

Occlusal splints are one form of the treatment modalities used for the management of patients with temporomandibular disorders. Appliances are often used in conjunction with other forms of treatment such as medications and physiotherapy.[1-2]

Occlusal splints can be fabricated either for the maxillary or the mandibular arches,[1, 3] and are classified into four groups according to their occlusal relationship with the opposing arch: [1-2]

- Soft vacuum formed splint
- Localized occlusal interference splint
- Anterior repositioning splint
- Stabilization splint

1. Assistant Professor, Department of Prosthodontics, Faculty of Dentistry, University of Jordan, Amman, Jordan.
2. Associate Professor, Head of Department of Prosthodontics, Faculty of Dentistry, University of Jordan, Amman, Jordan.
3. Professor, Department of Prosthodontics, Faculty of Dentistry, University of Jordan, Amman, Jordan.
4. Assistant Professor, Department of Prosthodontics, Faculty of Dentistry, University of Jordan, Amman, Jordan.
5. Lecturer, Department of Conservative Dentistry, Faculty of Dentistry, University of Jordan, Amman, Jordan.
**** Correspondence should be addressed to:***
Dr. Ahmad Abdel Aziz Mahmoud
P. O. Box: Amman 11942, Jordan
E-mail: anabtawime@yahoo.com

It is a perquisite for any prosthesis to have no interferences during its insertion. To achieve this, it's mandatory to locate and block out any undercut area to be covered by the prosthesis.[4] The same rule applies for occlusal splints.

Large bilateral undercuts are usually located lingual to posterior teeth and their corresponding alveolar processes in the lower arch.[4] Those undercuts are usually blocked out before the fabrication of the mandibular occlusal splints. This results in a space between the appliance and the oral tissues. Those spaces can reduce the stability of the appliance, and lead to noticeable borders, food trapping and an increase in the volume occupied by the appliance. All those factors can be detrimental to patients' comfort and may reduce their compliance and willingness to wear the appliance with negative consequences on the efficacy of appliance therapy.[1]

This report describes a new design for mandibular occlusal splint that deals with those potential problems.

Materials and Methods

Design description: Because of their three dimensional configuration, the teeth-covering parts of the occlusal splint are characterized by high stiffness which prevents deflection and mandates undercut block out.

The occlusal splint used in the current study is composed of two parts. By splitting the tooth-covering parts into two segments and using flexible connectors to replace the missing parts in each respective segment, the stiff design can be converted into a flexible one.

Figure (1) shows the first segment which contains the acrylic parts that cover the six anterior teeth and the last molar on each side. This segment has a metal framework cast in Ti-6Al-7Nb alloy which is characterized by its high flexibility and resistance to permanent deformation. [5] By deflecting, the metal connectors allow easy engagement of the undercuts located lingual to the posterior alveolar processes and the most posterior molars. Engaging those undercuts provides the stability and retention needed for this segment (Fig. 2).

Figure (3) shows the second segment fitted on top of the first one. This segment is composed of the acrylic parts that cover the remaining posterior teeth; two double Akers' clasp assemblies and a wrought wire connecting the parts on both sides of the dental arch (Figs. 4, 5). Engaging the undercuts lingual to the posterior teeth provides the stability and retention needed for this segment.

Fig. (1): The first segment of the occlusal appliance fitted on the master model.

Fig. (2): Deflection of the connector of the first segment. The flexibility of the Ti-6Al-7Nb alloy was used to advantage here.

Fig. (3): The second segment of the occlusal appliance fitted on top of the first one on the master model.

Fig. (4): The wrought wire major connector and its engagement to the double Akers' clasps on both parts.

Fig. (5): The two segments of the appliance off the model.

Fig. (6): Secondary impression taken with addition silicone using a special tray.

Fig. (7): The occlusal appliance fitted inside the patient mouth.

Technique

1. After thorough medical and dental history and examination were obtained, primary impressions were made for both the upper and the lower arches using Alginate (Aroma fine dust free III; GC, Tokyo, Japan) in stock trays. The impressions were then poured with dental stone (Fujirock EP; GC).
2. One layer of baseplate wax was applied to the lower primary model to act as a spacer. The spacer was removed on four spaced locations occlusally to create stoppers then a special tray was constructed from autopolymerizing acrylic material (Ostron; GC) taking into consideration to have the maximum extension into the functional sulci and vestibules.
3. After checking and adjusting the extensions of the tray intraorally, tray adhesive (VPS tray adhesive; GC) was applied to the tray and a secondary impression was made for the lower arch using regular body silicone impression material (Monophase Examix NDS; GC) (Fig.6).
4. The secondary impression was poured with type IV dental stone (Fujirock EP; GC) taking care not to destroy the impression so that multiple pouring could be performed to produce as many master models as needed though out the construction steps of the occlusal splint.
5. Undercuts on the master cast were located and blocked out by plaster of Paris using the dental surveyor. Then a 2mm thick vacuum-formed sheet was pressed on the mandibular cast. [6-7] After cooling, the sheet material was removed off the cast carefully, trimmed and finished with suitable burs.
6. The vacuum formed occlusal splint was tried inside the patient's mouth. After confirming its full seating, autopolymerizing acrylic resin material (COE Ortho-Resin II; GC) was added to the anterior segment and the patient was guided to close in centric relation. The reproducibility of the relation was confirmed and the protrusive and lateral anterior guidance was adjusted. Autopolymerizing acrylic resin material was added then to the posterior segments and the occlusion was adjusted to have a uniform contact at centric relation and

posterior separation at eccentric positions.[1, 8]

7. The patient used the occlusal splint for two months. During this period, the occlusion was adjusted and the efficacy of splint therapy was confirmed.
8. Mandibular master cast was duplicated using silicone duplication material (Wirosil; Bego, Bremen, Germany) and poured with magnesia-based investment material (Selevest DM&D; Selec, Japan). The framework of the two segments of the occlusal splint was waxed up on the refractory model, sprues were connected, investment completed, wax eliminated with the manufacturer-recommended heat cycle and the framework was cast with Ti-6Al-7Nb (T-alloy Tough; GC) alloy under an argon gas atmosphere (Tricast super R; Selec). After divestment, the framework was retrieved and fitted on the master model.
9. The adjusted vacuum formed occlusal splint was placed on the master model. The occlusal surface was boxed and poured with dental stone to produce an occlusal index. The lower master model was split mounted and the occlusal index was mounted against the lower master model on a simple hinge articulator. Another lower member of the simple hinge articulator was used to mount a second master model against the occlusal index. The first master model was used afterwards to construct the acrylic part of the first segment of the occlusal splint while the second master model was used to construct the acrylic part of the second segment.
10. The acrylic part covering the anterior teeth and the third molars was waxed up against the occlusal index, invested and after wax elimination, heat cure clear acrylic (Perma-Cryl clear; GC) was packed and cured.[9]
11. The first segment was retrieved, and placed on the second master model. Full seating was confirmed and the occlusion was adjusted against the occlusal index. Aluminum foil was swaged to cover the acrylic surfaces making contact with the second segment's acrylic part.
12. A 1mm Co-Cr wire was bent to conform to its seat on the cast connector of the first segment and to pass through the prepared holes on the bilateral double Akers' clasp assemblies. The double Akers' clasps were designed to engage lingual undercuts on each respective second premolar and first molar. Engaging the bilateral lingual undercuts was allowed by deflection of the wrought wire major connector.
13. After seating the framework of the second segment on the second master model, the acrylic part of the second segment was waxed up against the first segment and the opposing occlusal index, invested, and heat-cured acrylic was packed and cured after wax elimination.
14. After divestment, the second master model was returned to the articulator and the occlusion was verified. The occlusal splint was removed afterwards, the two segments separated and the occlusal splint was finished and polished.
15. Finally, the two segments of the occlusal splint were fitted inside the patient's mouth and the occlusion was verified (Fig.7).

Discussion

The flexible design of the split occlusal appliance had the ability to deflect and engage the lingual undercuts located posteriorly. There was no need to block those undercuts and their engagement contributed to the stability and retention of the appliance. It should be noted, however, that the construction steps were longer and the fees were higher than the conventional vacuum-formed appliances.

Usually, it is preferable to construct the occlusal appliance for the maxillary arch. [1] However; mandibular appliances were reported to have less interferences with speech and to be more aesthetic,[1, 3] which make them ultimately more preferable than maxillary appliances for some patients, especially when daytime wearing of the appliance is needed.[1, 10] The extra time and fees may be justifiable in cases where long time wear of the appliance is needed for those patients who seem unable to use a maxillary appliance.

Conclusion

This study described, in detail, the rationale behind the new design and the construction steps. The new design can be added to the armamentarium of the dentist when handling temporomandibular disorders.

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وصف التصميم وخطوات العمل لإنجاز جبيرة اطباقية للفك السفلي

احمد محمود ،محمود العميري، أسامه أبو حماد، ناديه عريفج، يارا عويس

كلية طب الأسنان، الجامعة الأردنية، عمان، الأردن

الملخص

الأهداف: يهدف البحث الى وصف التصميم وخطوات العمل لانجاز جبيرة اطباقية للفك السفلي ذي تصميم جديد. الجهاز مصمم بحيث يسمح بالدخول في الغؤور الموجودة عادة على كلا الجانبين على الجهة اللسانية لعظم الفك.

المواد وخطوات العمل: الجبيرة الاطباقية مكونة من جزأين. فصل الجبيرة الى جزأين يعطيها المرونة اللازمة للسماح لها بالدخول في الغؤور الموجودة عادة على كلا الجانبين على الجهة اللسانية لعظم الفك.

مكونات كل من الجزأين الموجودة على كلا الجانبين تتصل عن طريق رابطتين مرنتين مصنوعة الاولى من سبيكة تيتانيوم ذات مرونة عالية والثانية من سلك جاهز مصنوع من مادة كوبالت–كروم. المرونة العالية تتيح لكل جزء الانثناء بشكل متكرر حين لبس الجبيرة او نزعها من دون التعرض الى تغير دائم في الشكل.

الاهمية: يتمتع التصميم الجديد للجبيرة بالمزايا التالية: امكانية الانثناء والدخول في الغؤور تلغي الحاجة لسد الغؤور وبالتالي تمكننا من تجنب وجود فراغات بين الجبيرة والانسجة المبطنة للفم. هذا من شأنه تجنب عدم الارتياح المصاحب للفراغات وتجمع بقايا الطعام فيها. بالاضافة لذلك الدخول في الغؤور يزيد من ثبات الجبيرة خلال الاستعمال.

الكلمات الدالة: الجبيرة الاطباقية، تصميم الجبيرة، المرونة.