

Influence of Polyethylene Plate Thickness upon the Attrition of Dental Occlusal Appliances

ANGELA CODRUTA PODARIU¹, ATENA GALUSCAN¹, DANIELA JUMANCA^{1*}

¹“Victor Babes” University of Medicine and Pharmacy Timisoara, Faculty of Dentistry Medicine, Department I, 14A Tudor Vladimirescu Str., 300173, Timisoara, Romania

This workpaper presents the assessment of the interaction between the dimension of glycol-modified polyethylene terephthalate (PETG) and the attrition of occlusal appliances by determining the degree and area of attrition of dental mouth guards made of PETG plates of different sizes: 0.8mm, 1mm, 1.2mm, 1.5mm, 2mm, 2.2 mm thick. The samples were made by thermoformed using the Erkoform device and inserted into the oral cavity subjects. The evaluation was made 2 weeks, 4 weeks and 6 weeks later. For evaluation it was used coloured occlusal spray. The best results were obtained with the 2 mm thick, but in our study the occlusal appliances with 1,2 mm had good results too.

Keywords: occlusal appliances, glycol-modified polyethylene terephthalate (PETG), thermoformed

Bruxism is a disorder in which teeth are ground, gnashed or clenched. In bruxism, the subject may unconsciously get his teeth clenched together during the day, or clenched or ground them at night (sleep bruxism). Some consider sleep bruxism as a sleep-related movement disorder. People who clench or grind their teeth (brux) during night are more likely to have other sleep disorders too, such as snoring and sleep apnea (pauses in breathing), which disrupts their sleep session. Mild cases of bruxism may not need any treatment. On the other hand, in some patients bruxism can occur frequently and severely enough to lead to damaged teeth, headaches, jaw disorders and other issues. Because certain subjects may have sleep bruxism still be unaware of their unpleasant condition until sooner or later complications develop, it's important for them to acknowledge the specific signs and symptoms of bruxism and to seek regular dental care (Mayo Clinic staff). A palliative treatment of bruxism is the usage of the mouth guards to protect the dental arches from breaking or dulling. They are made in the dental laboratory in collaboration with the dentist.

Neuroleptics can be used as adjuvants but they bring many side effects. The herbal pills (tablets) are also used because they are obtained out of certain soothing natural extracts with no side effects such as valerian, chamomile, sunflower. Mouth guards that are used for patients with bruxism may be manufactured of various materials: urethane oligomers, free of methyl, ethyl, propyl or butyl monomers, polymethyl methacrylates (PMMA), but the residual monomer (methyl methacrylate MMA) can cause irritant or allergic reactions [2], glycol-modified polyethylene terephthalate (PETG). Glycol-modified polyethylene terephthalate is a thermoplastic polymer, with an excellent high-impact and chemical resistance, simultaneously with flexural strength. Glycol-modified polyethylene terephthalate is obtained from polyethylene terephthalate (PET) by copolymerization. Cyclohexane dimethanol (CHDM) is added to the PET backbone in place of ethylene glycol. The resulting copolymer has a lower melting temperature and is a useful material for thermoforming applications which requires complex shapes. Glycol-modified polyethylene terephthalate is used in many fields, including medicals, electronics, automobiles [4].

Experimental part

Materials and methods

In the present study we included a total of 40 subjects with ages between 20-65 years. Of these 12 women and 28 men. We divided them into 3 groups: 20-30 years, 30-40 years, 40-65 years. They were given occlusal appliance manufactured of PETG of various thicknesses: 0.8mm, 1mm, 1.2mm, 1.5mm, 2mm, 2.2 mm, one of each thickness. The subjects had been taken impressions of either lower or superior arches (fig.1)

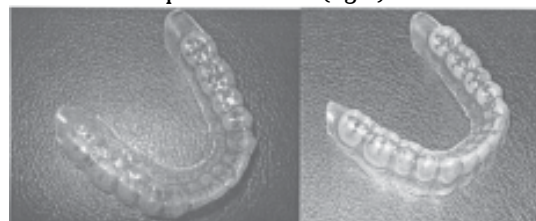


Fig.1. a,b Occlusal appliance

The mouth guards were made with the device Erkoform. The subjects wore their manufactured mouth guards every night. The operating principle of this type of device is based on thermo vacuum forming (fig.2).

Erkoform can also be used to obtain models of molded crowns, models of metal components of the fixed restorations, individual impression trays used in movable prosthetics, immobilization splints, orthodontic appliances especially for contention rails, bleaching and protection mouth guards. After using the mouth guard for 6 weeks, we identified in subjects the differences between attrition/wear areas, as well as the functionality and resistance of the mouth guards made of plates with the above mentioned different thicknesses.

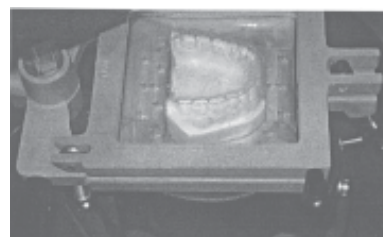


Fig.2 Erkoform device

* email: djumanca@clicknet.ro



Fig.3. Occlusions Spray Green (Marcadent, Germany) Highlighting areas of high wear appropriate occlusal areas of high voltage was achieved by spraying with Occlusions Spray Green (Marcadent, Germany).(fig.3)

Results and discussions

The results of the study have revealed that the younger subjects show pronounced wear areas compared to the older ones. In men, these areas are much better identified than in women. Regarding the size of PETG plates, we can state that the most efficient but lowest wear/attrition are the 2-mm thick (fig. 4, 5, 6). However, observing the other plates, we have found that the plates of 1.2 mm in thickness had a quite satisfactory behavior, but not as good as the 2-mm thick though.

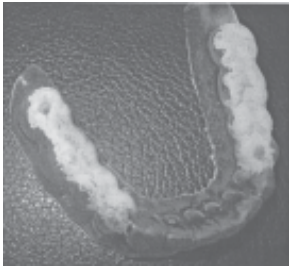


Fig.4 Occlusal appliance with occlusions spray green

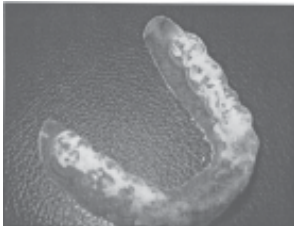


Fig. 5. Occlusal appliance with occlusions spray green after 4 weeks

Even at a thickness bigger than 2 mm, mean 2.2 mm and more, we can say that the high wear areas are relatively diffuse compared to other trays of different thicknesses, which means that after this, the thickness is seriously affected by overgrowth of DVO occlusion while wearing the tray and high intercuspitation position is variable and inaccurate.

In literature we found that bruxism was higher in men than in women — 43 percent vs. 31 percent. Caucasians had the highest rate of bruxism compared to other ethnic groups — 35 percent vs. 19 percent in Hispanics. African-Americans have the highest prevalence of GERD — 40 percent vs. 31 percent in the Hispanic population and 34 percent in Caucasians. Overall, no correlation was observed between the presence of self-reported GERD and bruxism.[1]

New researches have found that nearly 1 in 4 patients with OSA suffers from nighttime teeth grinding. This seems to be especially more prevalent in men and in Caucasians compared with other ethnic groups.[1]

The both obstructive sleep apnea and sleep bruxism are two conditions commonly related to certain arousal events.

A number of oral manifestations may follow an apneic event, such as teeth grinding, snoring, mumbles and gasps, Houston, TX. “Men are more likely to have severe sleep apnea than women. This phenomena might be due to the fact that men have more arousal responses, which explains the higher prevalence of teeth grinding in men. Besides, there are more symptoms of sleep apnea in men than in women, such as snoring, loud grunting, and witnessed apneas.” Other factors like anxiety and caffeine use might



Fig.6. Occlusal appliance with occlusions spray green after 6 weeks

help explain the relationship between sleep apnea and teeth grinding (University of Medicine and Pharmacy).

The polymethyl methacrylates (PMMA) persisted for many years as the usual materials of choice for occlusal appliances. In this case we found a lot of interesting articles about PMMA and the residual monomer[9]. Unfortunately, the residual monomer (methyl methacrylate MMA) can cause a lot of irritant or allergic reactions [5]. To compensate this, manufacturers have released advanced materials, such as those based on glycol-modified polyethylene terephthalate (PETG)[4]. Some other materials are used for occlusal appliances, but a lot of risks exists, including some allergic chemical elements like Ni, Cr, etc.[11]

According to the literature men have a higher rate of bruxism, therefore in our study we searched to introduce more men as subjects. Regarding attrition/wear areas of the mouth guards, we can discuss about a more accurate attrition/wear in men than in women and a pronounced difference between the printing of these areas in men even from the first week of using their trays/mouth guards.

Conclusions

The optimal thick for the occlusal appliances made by PETG is 2mm. A bigger size of the occlusal appliances affect the occlusion and a smaller one is inefficient. The PETG is a good material for the occlusal appliances from all points of view.

References

- 1.AMERICAN COLLEGE OF CHEST PHYSICIANS. “Teeth Grinding Linked To Sleep Apnea; Bruxism Prevalent In Caucasians With Sleep Disorders.” ScienceDaily. ScienceDaily, 5 November 2009. <www.sciencedaily.com/releases/2009/11/091102171213.htm>.
2. LUNG, C.Y.K., DARVELL, B.W., Dental Materials, 21, nr. 12, 2005, p.1119-1128
3. OKSENBERG A, ARONS E.: “Sleep bruxism related to obstructive sleep apnea: the effect of continuous positive airway pressure”. Sleep Medicine 3 (6): 513-5. , noiembrie 2002
4. MARCAUTEANU,C., STOICA, E.T., BORTUN, C., NEGRUTIU, M.L., SINESCU, C., TUDOR, A., Rev. Chim. (Bucharest), **65**, no.6, 2014, p.734.
5. HUYNH, M. Journal of the Canadian Dental Association, October 2007.
6. GIRAKI, M. Head and Face Medicine, March 5, 2010.
7. BARRON, R. Journal of the Canadian Dental Association, February 2003
8. SHYAM SUBRAMANIAN, MD, FCCP, Baylor College of Medicine, August 2008
9. ARDELEAN, A., RUSU, I.C., BRATU, D.C., BORTUN, C.M., Mat.Plast, **50**, no. 2, 2013, p.93
10. COUNCIL DIRECTIVE 67/548/EEC, Annex 1: Index of dangerous substances for which harmonized classification and labelling have been agreed at community level, 29th Adaptation to technical progress. Off J Eur Union L 2004: 152: 30/04/2004 (available from http://ecb.jrc.it/DOCUMENTS/Classification-Labeling/DIRECTIVE_67-548-EEC/ANNEX_1_OF_DIRECTIVE_67-548-EEC/Annex_I_of_Directive_67548EEC.doc).
- 11.RUSU, L.C., Rev. Chim. (Bucharest), **64**, no.1,2013,p.102

Manuscript received: 20.02.2014