3D Printed Retainer in Case of Bruxism

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Abstract

After the orthodontic treatment patients need an approach for preserving the outcome. Orthodontically treated "old" patients often also exhibit parafunctions. Thermo-vacuum molding technology for the retainers' fabrication is widely used today. 3D printing technology is highly popularized, but it is still poorly researched in Orthodontics.

The purpose of this article is to demonstrate the opportunities of digital design in orthodontic retainer fabrication and its application in dental practice in cases of bruxism.

After orthodontic treatment on a bruxist patient was made a retainer by 3D printing. The alginate impressions were poured out of dental stone class III. They were scanned with inEos X5 laboratory scanner (Dentsply Sirona). The digital design was made by Sirona inLab software (Dentsply Sirona). For 3D printing was used Form 2 SLA printer (Formlabs) and post-polymerisation processing, with material Dental LT Clear (Formlabs Inc., USA) - a photopolymer biocompatible resin.

The 3D printed retainer has precise adaptation to the tooth surfaces. The resulting retainer was 1.2 mm thick, but in a balanced occlusion with a lower jaw. It began to resemble a stabilization splint for the treatment of bruxism, but with a reduced thickness.

3D printed retainer is better decision in cases of bruxism. Mechanical properties are more appropriate than thermo-vacuum retainer and they can be used longer.

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Introduction

After the orthodontic treatment patients need an approach for preserving the outcome. Retainers are the devices, which purpose is to fix the result. They can be removable or fixed [1, 2]. Thermo-vacuum molding technology for the retainers' fabrication is widely used today. Its easy technology, high aesthetics, and any adjustment in the patient mouth make them preferable for dentists 3. Its main problems are relatively fast wear (about 1 year), easy deformation, tearing and perforation [4, 5]. Acrylic retainers (Hawley retainers) are more durable, but their production requires a complicated laboratory protocol and they are used only in rare cases [6].

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Bruxism is a common parafunction among people who live under stress. Bruxism can occur during the day or at night. Daily bruxism is more conscious and patients often "calm down" by clenching or pressing their teeth. They seek help before the onset of clinical symptoms (muscle tension, pain in the TMJ, abrasion of tooth surfaces) and consciously seek to eliminate the habit [7, 8]. Patients often find out about nocturnal bruxism from the dentist after sharing the accompanying symptoms and in the presence of clinical manifestations (abraded tooth surfaces, exostoses, linea alba on the inside part of the cheek) [7, 9]. Bruxism is seen in sensitive children who are prone to anxiety, but also after dental treatment (in cases of multiple caries with decreased vertical dimension of occlusion) or general illness [10, 11].

The most common treatment for bruxism is splints[12]. Main types of splints according to Okeson are two (stabilization and repositioning splint) [13], four additional according to Moin (pivot splint, soft splint, anterior bite splint, posterior bite splint) [14], Bumann adds variants without specific design, but expressive function (relation splint, decompression splint, verticalization splint) [15].

For the usage of modern digital technologies it is necessary to transform the information from the patient's mouth to a digital model. This is obtained in two main ways - by direct scanning of the oral cavity using an intraoral scanner, or by taking a classic impression, pouring the model and this model to be scanned using a laboratory scanner [16]. Digital design software has many options for creating objects mainly in prosthetic dentistry - crowns, bridges, removable dentures, surgical guides, splints and more. It allows precise design, good adaptation and quality of a final product [17]. The resulting virtual objects can be completed by additive manufacturing (3D printing) or CAD / CAM milling. In additive manufacturing, the material is applied in layers, softened by a different physical source (heat, laser, directed light) [18, 19]. In CAD / CAM technology the object is cut from a monolot block with different chemical nature - PMMA, resin, zirconia and others [20].

3D printing technology is highly popularized, but it is still poorly researched in Orthodontics. It is mainly used for printing models on which thermo-vacuum foil is adapted [21, 22]. The digital creation of retainers is not widespread and requires further research [23].

The purpose of this article is to demonstrate the opportunities of digital design in orthodontic retainer fabrication and its application in dental practice in cases of bruxism.

Materials and methods

After orthodontic treatment on a bruxist patient was made a retainer by 3D printing. The alginate impressions were poured out of dental stone class III. They were scanned with *inEos X5* laboratory scanner (Dentsply Sirona), figure 1.

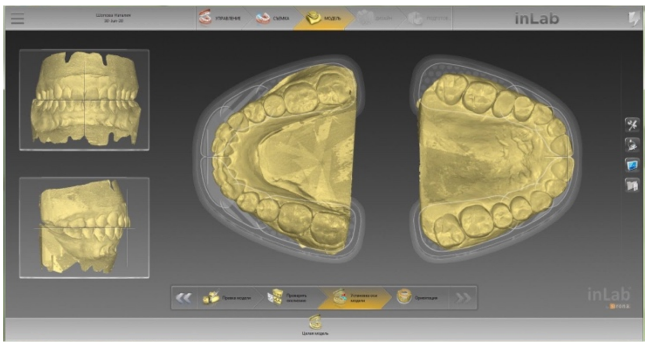

Figure 1. Scanned models and their view in *Sirona inLab* software.

The digital design was made by *Sirona inLab* software (Dentsply Sirona). The boundaries of the retainer were 1 mm to the cervical part on the vestibular surface, to the cervical part on the palatal surface, except the frontal area where an extension was made. The thickness of the retainer was 1.2 mm, figure 2.

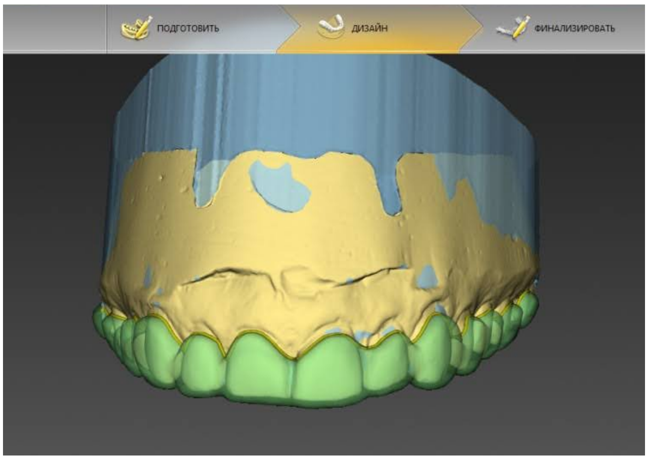

Figure 2. Digital design of the retainer (Sirona inLab).

For 3D printing was used ***Form 2 SLA printer*** (Formlabs) and post-polymerisation processing, with material ***Dental LT Clear*** (Formlabs Inc., USA) - a photopolymer biocompatible resin.

Results

After cleaning and disinfection, the retainer was placed in the patient mount. To check the adaptation to teeth, it was made a silicon test with C-type of silicon, low viscosity. Retainer stayed very stable, with symmetrical internal contact, figure 3.

Figure 3. Silicon test for teeth adaptation.

Except retentive function, this retainer should have and bruxism splint function. Due to this, it should have balanced occlusion, which is not mandatory for typical retainers. To check the static occlusion (open and close) we used red articulation paper 40 microns. For the dynamic occlusion (side movements) we used blue articulation paper 40 microns, figures 4 and 5.

Figure 4. Static occlusal contacts.

Figure 5. Dynamic occlusal contacts.

Figure 6. Retainer in the patient mount.

Discussion

There are very precise contacts between teeth and the internal surface of the appliance. These symmetrical internal contacts mean that the retainer won't change the teeth position during its wearing [1]. Retainers require almost all-day wear, except during meals. Bruxism splints are worn mainly during sleep. 3D printed retainer is a better decision in cases of bruxism. Mechanical properties are more appropriate than thermo-vacuum retainer and they can be used longer [4-6].

The demonstrated retainer resembled a stabilization splint for bruxism, but with a reduced thickness. The optimal thickness of the splint is from 3 to 5 mm, which is too much for a retainer. Therefore, we preferred to keep the thickness for the retainer 1.2 mm, but to design a balanced occlusion [4, 12].

Conclusions

3D printing technology can be applied for retainers' production because the thickness can be different according to the case, has very good adaptation to the surfaces, mechanical properties are bigger than thermo-vacuum foils.

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Declaration of Interest

The authors declare no conflict of interest.

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