

Research Article

Clinical Effectiveness of Using Aesthetic Fixed Prosthetic Appliances with Combined Occlusal Surface

Andrii Biben^{*}, Zinovii Ozhohan**Abstract**

The objective of the research was to evaluate the clinical effectiveness of using aesthetic fixed prosthetic appliances with combined occlusal surface.

Materials and methods. The study included 30 patients who were divided into 2 groups: Group I included 20 patients with combined occlusal surface of the crowns; Group II included 22 patients with ceramic occlusal surface of the crowns. The patients were observed 3, 6 and 12 months after prosthetic repair.

Results. 6 months after prosthetic repair, the occlusal contact surface area in Group I increased by 0.79%, while in Group II, it increased by 1.4%. 12 months after prosthetic repair, the occlusal contact surface area in Group I and Group II increased by 2.37% and 5%, respectively. The aforementioned data indicated that the occlusal contact surface area increased as the period of ceramic fixed prosthetic appliance wearing increased. When combining the occlusal surface in dental prostheses, the occlusal contact surface area increased approximately 2 times slower. The study demonstrated convincingly that crowns burnt on a zirconium dioxide frame were a better choice as compared to cast framework made of nickel-cobalt-chrome alloy. In case of cast frameworks, the indicators of crown margin discrepancy were worse than in case of milled frameworks - 15% versus 5%, respectively. In addition, one cast framework crown (5%) in Group II was remodeled and one crown (5%) was recemented.

Conclusions. Aesthetic fixed prosthetic appliances with combined occlusal surface demonstrated high functional and aesthetic characteristics. The use of the USHPS system showed a decisive advantage of milled frameworks and combined occlusal surface over traditional cast ceramic frameworks. The combination of high mechanical, strength and tribological properties of zirconium dioxide and high biological as well as aesthetic properties of ceramic materials helped reveal high clinical characteristics of aesthetic appliances with combined occlusal surface.

Keywords

prosthetic appliances, combined occlusal surface, zirconium dioxide, ceramics

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Problem statement and analysis of the recent research

Despite the many advantages of using ceramic materials, there are some disadvantages including their propensity for chipping as well as a high degree of the abrasion of the antagonistic teeth [1].

In prosthetic dentistry, zirconium dioxide has been used for manufacturing dental prostheses relatively recently. Zirconium dioxide has an obvious advantage over ceramic materials in its biological, physical and tribological properties. It has weak spots as well; it is mainly due to its low aesthetic characteristics.

However, when veneering zirconium dioxide framework with ceramics, aesthetic characteristics of such prosthetic appliances are even higher compared to traditional porcelain-fused-to-metal restorations [2], since metal-free ceramics shows the optical properties as those of natural teeth; translucency and opalescence are the major ones [3]. There is no doubt that metal-free ceramics is the choice of the future.

When veneering the occlusal surface of prosthetic appliances with ceramics - its disadvantages are observed - high abrasion of the antagonistic teeth as well as the probability of chipping. It leads to the increase in the occlusal surface area resulting in periodontal tissue overload, functional overloading of the masticatory muscles and their parafunction.

Therefore, we have proposed the design of a fixed prosthesis where the framework and interocclusal spaces between the antagonistic teeth were made of zirconium dioxide and all the other surfaces were veneered with ceramics. It provides a combination of positive characteristics of both construction materials. High aesthetic qualities of ceramics as well as its biological inertness combine with strength and tribological properties of zirconium dioxide.

The objective of the research was to evaluate the clinical

effectiveness of using aesthetic fixed prosthetic appliances with combined occlusal surface.

1. Materials and methods

The study included 30 patients who were divided into 2 groups. Group I included 20 patients with combined occlusal surface of the crowns. Group II included 22 patients with ceramic occlusal surface of the crowns.

The patients were observed 3, 6 and 12 months after prosthetic repair.

It should be noted that when making prosthetic appliances for the antagonistic teeth in all cases fixed prosthetic appliances with ceramic occlusal surface were used.

The state of the occlusal surface of prosthetic appliances was studied based on the data of physical examination, X-ray results and the determination of the occlusal contact surface area using 3Shape TRIOS Dental System.

We have used 3Shape TRIOS® 3D scanner to determine the occlusal contact surface area since at this stage computer occlusiography provides the most accurate results. We have not used any other computer methods as they are difficult to use in contrast to 3Shape TRIOS [4]. The accuracy of 3Shape TRIOS® 3D scanner is proven to be one of the highest [5] and the margin of error does not exceed 7 μm . Therefore, we consider the use of this scanner to be justified.

To determine the occlusal contact surface area, we have used the following method. At first, the upper jaw was scanned using 3Shape TRIOS® 3D scanner in the TRIOS Cart configuration, and then, the lower one was scanned. Next, dentitions in occlusion were scanned. The occlusal surface area was thereafter determined using computer software of 3Shape TRIOS Dental System.

The authors [6] stated that in patients with intact teeth the mean occlusal contact surface area of the 36th tooth is 7.044 mm^2 and the mean occlusal contact surface area of the 46th tooth is 7.62 mm^2 , respectively.

In addition, the state of the artificial crowns was evaluated using the USHPS system (the Ryge criteria) [7]. The criteria such as the patients' subjective impressions, decementation and prosthesis replacement were added.

The results were statistically processed using Student-Fisher's t distribution; the results were considered statistically significant at $p < 0.05$.

2. Results

The determination of the occlusal contact surface area using 3Shape TRIOS® 3D scanner provided the following results: 6 months after prosthetic repair, the occlusal contact surface area in Group I increased by 0.79%, while in Group II, it increased by 1.4%. 12 months after prosthetic repair, the occlusal contact surface area in Group I and Group II increased by 2.37% and 5%, respectively (Table 1).

The aforementioned data indicated that the occlusal contact surface area increased as the period of ceramic fixed

Table 1. Occlusal contact surface area of the 36th tooth

Group	Time period after prosthetic repair	Occlusal contact surface area
I	3 months	7.57±0.14 mm^2
I	6 months	7.63±0.15 mm^2
I	12 months	7.75±0.18 mm^2
II	3 months	7.79±0.15 mm^2
II	6 months	7.90±0.18 mm^2
II	12 months	8.18±0.19 mm^2

prosthetic appliance wearing increased. When combining the occlusal surface in dental prostheses, the occlusal contact surface area increased approximately 2 times slower.

This fact is explained by several factors. Zirconium dioxide contains almost no surface pores, i.e. it is non-aggressive. Even when interacting with ceramics it significantly improves tribological properties of zirconium dioxide/ceramics in comparison with ceramics/ceramics. Ceramics contains surface pores which negatively affect its tribological properties. Glazing and polishing smooth the surface structure of ceramics only for a short period of time [8]. Therefore, the glazed layer disappears as the prosthetic appliance wearing period increases resulting in the deterioration of tribological properties of ceramics/ceramics due to the increase in surface porosity.

The study demonstrated convincingly that crowns burnt on a zirconium dioxide frame were a better choice as compared to cast framework made of nickel-cobalt-chrome alloy. In case of cast frameworks, the indicators of crown margin discrepancy were worse than in case of milled frameworks - 15% versus 5%, respectively. In addition, one cast framework crown (5%) in Group II was remodeled and one crown (5%) was recemented.

In both groups, there were no changes in the approximal contact area.

The patients' subjective impressions were higher in Group I. Patients of Group I reported more satisfaction with their prosthesis (functional and aesthetic). It should be noted that there is no need in occlusal contact grinding when working with dental prostheses with combined occlusal surface as the form of the occlusal surface is modelled using computer program and milled with a high accuracy. It eliminates the possibility of supracontact presence. When veneering cast frameworks by dental technicians it is very difficult to provide the absence of supracontacts which is associated with many factors, human factor in particular.

3. Conclusions

Aesthetic fixed prosthetic appliances with combined occlusal surface demonstrated high functional and aesthetic characteristics. The use of the USHPS system showed a decisive advantage of milled frameworks and combined occlusal surface over traditional cast ceramic frameworks. The combination

of high mechanical, strength and tribological properties of zirconium dioxide and high biological as well as aesthetic properties of ceramic materials helped reveal high clinical characteristics of aesthetic appliances with combined occlusal surface.

4. Prospects for further research

The study indicated the need for further investigation of clinical effectiveness of using prosthetic appliances with combined occlusal surface to provide higher quality of prosthetic care.

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