

## Research Article

# Clinical Aspects of Combination of Ceramic and Acrylic Occlusal Surfaces

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**Abstract**

**Objective:** of the research was to develop and substantiate the methods of constructing the occlusal surfaces when manufacturing aesthetic fixed restorations through the combination of different materials.

**Materials and methods:** The study included 65 patients with ceramic and acrylic occlusal surfaces of aesthetic fixed dental prostheses. Group I included 21 patients with a combination of ceramic and acrylic occlusal surfaces. Group II included 22 patients with a combination of ceramic occlusal surfaces. Group III included 22 patients with a combination of acrylic occlusal surfaces. The patients were observed 3, 6 and 12 months after prosthetic repair.

**Results:** The greatest increase in the occlusal contact surface area of fixed restorations was observed in Group I, that is, when combining dental prostheses with ceramic and acrylic occlusal surfaces. Considering uneven abrasion of the occlusal surfaces, we do not recommend to combine different materials when veneering the occlusal surface of the antagonistic teeth.

**Keywords**

prosthetic appliances; occlusal surfaces; acrylic resin; ceramics

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## Problem statement and analysis of the recent research

At the current stage of its development prosthetic dentistry uses a wide range of construction materials - both modern and those that have been known for a long time [1].

The combination of modern as well as traditional techniques and materials allows using many variants of prosthetic appliances in the oral cavity; however, the number of complications including ceramic chipping and the occlusal surface abrasion increases and, consequently, aesthetic, functional and anatomic values of the prostheses reduce [2]. It is due to the combination of prosthetic appliances being different from each other in construction materials, design as well as the methods of manufacturing – metal, acrylic, combined ceramic (low-temperature ceramics, high-temperature ceramics, feldspathic ceramics, alumina-based ceramics) and metal-free prosthetic appliances [2], which is contrary to basic principles of tribology.

A high degree of the aggression of ceramics towards the antagonistic teeth as well as a low abrasion resistance of acrylic resin remains the problem being difficult to solve. This fact is explained by several factors: ceramics possesses higher hardness; in addition, it consists of fine particles of different sizes which increase its surface roughness; the presence of surface and subsurface porosity is typical for ceramics.

The combination of various materials when constructing the occlusal surfaces always negatively affects the durability of the prostheses due to their different physical and chemical

properties [2].

All these factors indicate the need for developing the methods of the combination of aesthetic dental prostheses made of different construction materials in the oral cavity.

The objective of the research was to develop and substantiate the methods of constructing the occlusal surfaces when manufacturing aesthetic fixed restorations through the combination of different materials.

## 1. Materials and methods

The study included 65 patients with ceramic and acrylic occlusal surfaces of aesthetic fixed dental prostheses.

Group I included 21 patients with a combination of ceramic and acrylic occlusal surfaces.

Group II included 22 patients with a combination of ceramic occlusal surfaces. Group III included 22 patients with a combination of acrylic occlusal surfaces

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

The state of the occlusal surface of prosthetic appliances was studied based on the data of physical examination, X-ray results and 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 [3]. The accuracy of 3Shape TRIOS® 3D scanner is

proven to be one of the highest [4] and the margin of error does not exceed 7 mcm. 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. Then, the occlusal surface area was determined using computer software of 3Shape TRIOS Dental System.

The authors [5] stated that in patients with intact teeth the mean occlusal contact surface area of the 36th tooth is 7.044 mm<sup>2</sup> and the mean occlusal contact surface area of the 46th tooth is 7.62 mm<sup>2</sup>, respectively.

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

## 2. Results and Discussion

The determination of the occlusal contact surface area using 3Shape TRIOS® 3D scanner provided the following results:

The occlusal contact surface area 12 months after prosthetic repair was the largest in Group I (8.85±0.18 mm<sup>2</sup>). It was due to physical and mechanical properties of ceramics, i.e. its aggression as well as a low hardness of acrylic resin resulting in low abrasion resistance. In addition, in our opinion, low chemical resistance of acrylic resin to adverse effects in the oral cavity as well as a higher surface roughness resulting in an increased abrasion played a certain role. In Group I, the abrasion occurred very unevenly. Ceramic occlusive surfaces tended to be less abraded. The occlusal contact surface area increased due to acrylic occlusal surfaces which negatively affected the prosthesis height and periodontal tissue overload.

In Group II, both occlusal surfaces were made of ceramics the hardness of which as well as the abrasion resistance is higher; consequently, 12 month after prosthetic repair, the occlusal contact surface area in Group II was 8.38±0.17 mm<sup>2</sup>.

The increase in the occlusal contact surface area in Group III (8.67±0.21 mm<sup>2</sup>) is explained by the fact that despite low hardness and abrasion resistance, acrylic occlusive surfaces tend to be not so much abraded as in the interaction of identical materials the abrasion coefficient equals to 1 ensuring even abrasion over the entire occlusal surface.

In our opinion, the difference between the obtained data on the occlusal contact surface area and those obtained by the authors is explained by the fact that the method of determining the surface area differed from that used by the authors. The fact that they observed young persons with intact teeth should be considered as well.

The increase in the occlusal contact surface area of fixed restorations 12 months after prosthetic repair as compared to that 3 months after prosthetic repair was 9.93% in Group I, 5.4% in Group II and 7.03% in Group III.

The greatest increase in the occlusal contact surface area of fixed restorations was observed in Group I, that is, when

combining dental prostheses with ceramic and acrylic occlusal surfaces. Considering uneven abrasion of the occlusal surfaces, we do not recommend to combine different materials when veneering the occlusal surface of the antagonistic teeth.

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

Group	Time period after prosthetic repair	Occlusal contact surface area
I	3 months	8.05±0.15 mm <sup>2</sup>
I	6 months	8.25±0.19 mm <sup>2</sup>
I	12 months	8.85±0.18 mm <sup>2</sup>
II	3 months	7.95±0.24 mm <sup>2</sup>
II	6 months	8.04±0.22 mm <sup>2</sup>
II	12 months	8.38±0.17 mm <sup>2</sup>
III	3 months	8.1±0.2 mm <sup>2</sup>
III	6 months	8.21±0.19 mm <sup>2</sup>
III	12 months	8.67±0.21 mm <sup>2</sup>

## 3. Conclusions

This study demonstrated the important role of the correct combination of materials when veneering the occlusal surfaces. Physical and chemical properties of materials, namely the abrasion resistance play a significant role in the long-term denture functioning.

The smallest increase in the occlusal contact surface area was observed in Group II when combining ceramic occlusal surfaces. It was due to a good abrasion resistance of ceramics as compared to acrylic resin as well as the presence of the glazed layer which prevents the premature abrasion of the occlusal surfaces of the antagonistic teeth due to lower surface roughness.

The combination of acrylic resin and ceramics when constructing the occlusal surfaces of fixed restorations in Group I demonstrated the highest rate of the increase in the occlusal contact surface area – 9.93%. It was due to a low hardness of acrylic resin and its high surface roughness. In addition, there was observed an uneven abrasion of the occlusal surfaces resulting in periodontal tissue overload, thereby negatively affecting denture functioning.

## 4. Prospects for further research

The study indicated the need for further investigation of clinical features of combining different materials when constructing the occlusal surfaces of the antagonistic teeth to provide the highest quality of prosthetic care.

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