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Wear Resistance of Acrylic Resin Teeth against Porcelain and Natural Teeth

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Abstract

***Statement of Problem*:** The effect of porcelain surface on the antagonist acrylic teeth has not been widely studied.
Objectives: This study aimed to investigate the effect of polished porcelain, glazed porcelain, and natural teeth (as the control group) on the acrylic resin teeth.
***Materials and Methods*:** In this experimental-laboratory study, a total of 60 specimens of glazed and polished porcelain, natural teeth, and acrylic resin teeth were prepared; in groups of 15 samples each. The denture teeth specimens were examined in terms of tooth wear against glazed or polished or enamel surfaces. After the abrasion test using the polishing machine, the wear of each sample was measured based on the weight lost by a digital scale. The wear surfaces of acrylic teeth were observed by SEM to evaluate the wear characteristic. The data were analyzed using Independent Sample t-test.
***Results*:** The glazed and polished porcelain teeth abraded the denture teeth significantly more than the natural teeth (P=0.001). Although there was not a significant difference between the glazed and polished porcelain (P=0.059), the polished porcelain caused less tooth wear than the glazed porcelain.
***Conclusions*:** According to the results of this study, glazed porcelain caused less tooth wear on denture teeth than both of the polished porcelain and natural teeth.

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Introduction

Porcelain is a substance in aesthetic dentistry which is used for rehabilitation of both anterior and posterior teeth. Porcelain restoration is polished and glazed after testing the marginal adaptation and the occlusal adjustment [1].

Porcelain polish is a method in which a smooth and glossy surface is made by using specific polishing rubbers [1]. Surfaces with a high level of polish, similar to reglaze, limit the accumulation of plaque, and prevent the periodontal health status from being damaged [2]. It is indicated that polishing does not decrease the physical properties [3] but polishing and glazing of the porcelain increases the strength of ceramics [4-9] through decreasing the depth and width of the cracks in the surface [4]. Inadequate glaze or polish will cause plaque retention and make the restoration prone to breakage. Sometimes during adjustment of the restoration, their glazed surface will be removed. In order to prevent post-adjustment problems, the clinical and laboratory standard has

been adjusted for porcelain surface and reglaze for many years [10].

Porcelain polish has more benefits than reglaze such as control over lustering, time and cost benefit for patient and dentist, and control ofcross-infection. In polishing, there is more control over lustering of different; e.g. more polish on cervical and less polish on the incisal area are possible. In reglaze, the entire crown is under the influence of temperature and it is impossible to control the area [11, 12]. Bessing and Wiktorssar [13] reported that surface roughness in the polished surface was less compared to auto-glazed one [14]. Laboratory studies have indicated that the wear of enamel by polished porcelain is less than glazed porcelain [10, 14]. Some other studies have shown that tooth wear during the chewing process by glazed and non-glazed porcelain is almost the same, but it is significantly less observable in the polished porcelain [14-16]. Klausner *et al*. [16] also concluded that polished and glazed surfaces have similar surface properties. According to Jagger *et al*. [10], the glaze on the porcelain surface is removed after a short period of time which has been confirmed by some other studies [15-18].

The abrasion rate of porcelain on the natural teeth has been investigated widely, while studies on the effect of natural teeth, polished porcelain, or glazed porcelain on acrylic resin teeth is lacking. The null hypothesis is that there is no difference between the effect of natural teeth, polished or glazed porcelain on denture teeth.

Materials and Methods

In this in vitro study, a total of 60 specimens were prepared in the form of glazed porcelain, polished porcelain (Vita- dur N, Vita, Germany) natural teeth and acrylic resin teeth (Ivoclar- Vivadent, Germany),each in a group of 15 samples and in standard sizes. The porcelain groups were prepared in 10×10 mm flat dimensions with 1mm thickness and were mounted in resin base with 30×30 mm dimension.

The enamel and acrylic teeth specimen were taken from the buccal surface of human permanent incisors, canines, and premolars. Intact teeth were sectioned with a water-cooled diamond wheel. Each enamel specimen was embedded in poly-methyl methacrylate dough and secured in position with auto-polymerizing acrylic resin. The enamel and acrylic plate specimens were abraded against silicon carbide paper to achieve an overall flat plate specimen that could be attached to the wear machine.

The porcelain specimens were fabricated according to manufacturer recommendations. Specimens in the polished porcelain group were polished using Shofupolishing kit (aluminum oxide, Dura-White Stones, RD-1, Shofu, Kyoto, Japan) and the glazed groups were glazed in a glaze furnace at 900ºC. The glazed porcelain, polished porcelain, and natural teeth samples were fixed vertically against the prepared acrylic resin teeth samples and then the wear test was performed with a load of 25 N at 50 cycles per minute for 30 minutes by using polishing machine (Remet, Hergon mp 300, Bologna, Italy). The abrasion rate of each sample was measured by a digital scalewith the accuracy of 0.001 gram according to the weight lost. For quantative analysis of the acrylic surfaces, the resin teeth surfaces were evaluated using SEM. The data were analyzed in SPSS version 16 using t-test. α=0.05 was considered as the significant level.

Results

The abrasion rate of all groups are presented in Table 1 and the damaged surfaces evaluated by SEM are shown in (Figure 1A, B, C). According to the results of this study, there was no significant difference (P=0.059) between the abrasion rate caused by the glazed (mean=0.112gr) and polished porcelains (mean=0.010gr). There was a significant difference between the natural teeth and glazed porcelain (P=0.001) or polished porcelain (P=0.001)with the lower wear rate for natural teeth (mean=0.004gr) .

Discussion

Resistance to abrasion is one of the most important physical properties of denture in complete or partial denture. The excessive abrasion may result in reduction of vertical height of occlusion, defective dental relation, and chewing system fatigue [19-20]. Among all artificial teeth, acrylic and ceramic teeth are more popular with more resistance to abrasion for

Table 1: Abrasion rate of acrylic resin teeth by glazed porcelain, polished porcelain, and natural teeth against acrylic resin teeth (N=45)

Variables	Abrasion Rate		P value
	Mean	SD	
Polished porcelain	0.010	0.020	0.059
Glazed teeth	0.112	0.075	
Glazed porcelain	0.112	0.020	0.001
Natural Teeth	0.004	0.002	
Polished porcelain	0.010	0.002	0.001
Natural teeth	0.004	0.075	

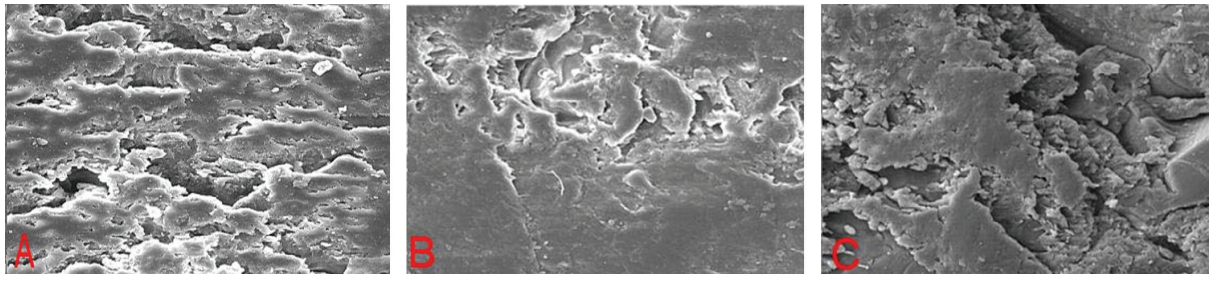

Figure 1: Acrylic resin abrasion against A) Polished porcelain, B) Enamel, C) Glazed porcelain

the ceramic teeth. Nevertheless, acrylic teeth make a better chemical bonding with denture base and create less fracture and crack into the denture base compared to the ceramic teeth [21].

The abrasion rate of natural and artificial teeth is affected by the surface roughness of the antagonist teeth. Finishing the surface of each dental prosthesis is important as it is a determining factor for patient's comfort, prosthesis longevity, and its beauty. Also, it reduces the surface energy, surface roughness, bacterial adhesion, and plaque retention [22-24]. The roughness of ceramic materials is affected surface hardness, size of material particles, and polishing method [25-27].

The abrasion resistance of the natural teeth against different types of restorative materials has been studied for many years. In most of these studies, the type of the applied material against the teeth enamel was a determinant factor in the abrasion rate of natural teeth [16-18, 23]. In the present study, the abrasion rate of the acrylic teeth against glazed porcelain, polished porcelain, and natural teeth was investigated.

The results of the present study revealed that the abrasion rate of the acrylic resin tooth by natural teeth had a significant difference compared to the glazed and polished porcelain. But there was no significant difference between the abrasion rates of acrylic teeth against polished porcelain and glazed porcelain. However, the abrasion rate caused by polished porcelain was less than that of glazed porcelain. In addition, the results indicated that the abrasion by natural teeth was significantly lower than porcelain materials. Therefore the null hypothesis was rejected.

Jagger *et al*. showed that the enamel abrasion during chewing against glazed porcelain and unglazed porcelain was relatively similar but this abrasion was remarkably less against the finished porcelain. The result of our study is in agreement with those of some other studies [15-18]. Elmaria *et al*. [22] in their study investigated the relationship between the abrasion of the enamel against gold and three types of ceramic in glazed and polished conditions; it was indicated that the polished gold and all ceramic types were less abrasive while the glazed IPS empress was more abrasive. In their study, all polished material made less abrasion on the enamel but the rate of this abrasion with regard to the applied materials and surface roughness was different. So the result of this study is in agreement with that of the present study.

In the study by Chazal *et al*. [21], the abrasion rate of resin and ceramic teeth against the enamel was investigated. It was shown that acrylic resin teeth had the least abrasion and ceramic teeth showed the most abrasion in the normal teeth. In addition, it is shown that acrylic resin teeth have less resistance against abrasion than ceramic and natural teeth.

In our study, acrylic resin teeth compared to ceramic had less abrasion against the tooth enamel. It was shown that abrasion resistance of acrylic resin tooth is affected by their antagonist materials. The least rate of acrylic abrasion is when two acrylic teeth are located in front of each other. In our study, the least rate of abrasion was when acrylic teeth were against the enamel. The reason of this discrepancy is that, in our study, the abrasion of these acrylic teeth against each other was not investigated.

One study investigated the relationship between enamel abrasion against zirconia (in 3 conditions of glazed, polished and polished before re-glazing) and porcelain veneer [28]. According to the results of this study, the least rate of enamel abrasion was against polished zirconia and the most abrasion was against veneered porcelain. In another study, it was demonstrated that during the abrasion process, the surface glaze is removed from the ceramic surface rapidly, and this causes the unpolished ceramic to be in contact with the tooth enamel [29]. As a result, polishing of ceramic before glazing decreases the rate of enamel abrasion. The results of this study are in accordance with those of our study.

The results of the current study were verified by SEM (Figure 1A, B, C).

Conclusions

The results of the present study revealed that the abrasion rate of acrylic resin tooth by natural teeth had a significant difference compared to the glazed and polished porcelain. But there was no significant difference between the abrasion rates of acrylic teeth against polished porcelain and glazed porcelain. However, the abrasion rate caused by polished porcelain was less than that of the glazed porcelain. In addition, the results indicated that the abrasion

by natural teeth was significantly lower than by the porcelain materials.

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Conflict of Interest: None declared.

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