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EFFECT OF SURFACE POLISHING AND GLAZING ON THE ROUGHNESS OF THE DENTAL ACRYLIC RESINS

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Abstract: *Rough surface of denture base promote adhesion of microorganisms and plaque formation, which can result in denture stomatitis. It is therefore important to know how different polishing systems affect surface roughness of denture base acrylic resins. The purpose of this study was to evaluate the effect of polishing technique and glazing on the roughness of the dental resins.*
Key words: *roughness, acrylics, polishing, glazing*

1. INTRODUCTION

Acrylic resin is used in dentistry for the fabrication of various dental prostheses. Prosthodontic appliances should have a smooth and highly polished surface to maintain comfort and health of oral tissues, and to prevent colonization of micro organisms and plaque accumulation (Craig et al., 2000; Zissis et al., 2000). The value reported as characteristic of smooth acrylic resin is 0.12µm. However, surface roughness (R_a) of polished acrylic resin may vary between 0.03 and 0.75 µm (Quirynen et al., 1990).

Denture plaque formation occurs as a result of adhesion of various microorganisms to the acrylic surface of dentures. Yeasts of the genus *Candida* are commonly present in plaque on denture bases but various other pathogens have been found to grow in denture plaque. Several authors have reported increased adhesion of both *Candida albicans* and *Streptococcus oralis* to rough acrylic resin surfaces. Candida adhesion was strongly affected by R_a (Pereira et al., 2007; Radford et al., 1999). According to some in vivo studies (Bollen et al., 1996) clinically acceptable roughness of hard surfaces in the oral environment after polishing should not exceed 0.2 µm. Results of several studies have indicated that surface roughness of acrylic resin polished with prophylactic pastes, various rubber polishers, abrasive stones, and pumices still exceeds the threshold at R_a of 0.2 µm (Yamauchi et al., 1990).

Dental technicians use effective techniques for polishing denture base acrylic resin. Some glazes have been used for sealing acrylic dentures. According to the manufacturers, a glaze would make the acrylic resin surface smoother, decreasing accumulation of residual food and plaque adhesion, and providing improved oral hygiene conditions (Sesma et al., 2005).

The objective of this study was to evaluate the effect of polishing technique and the glazing on the roughness of the dental resins.

2. MATERIAL AND METHOD

Three types of denture base acrylic resins were used:
1.Duracryl Plus/Spofa Dental (self curing resin)
2. Prothyl Hot/Zhermack (heat curing resin)
3. Vertex Soft/Vertex (resilient heat curing resin).

2.1 Preparation of the acrylic specimens

There were 20 specimens (50 × 25 × 3 mm) per each acrylic material. A 2-mm layer of base plate wax (Morsa**)** was flasked with dental stone to obtain a mold for acrylic resin specimens. Polymerization of acrylic resin materials was performed according to the manufacturer's instructions. Self curing resin was polymerized for 15 minutes at 40°C under a pressure of 3 $\times 10^5$ N/m^2. The flask with heat-curing resin was immersed in cold water under a pressure of 3×10^5 N/m^2, heated to 70°C. This temperature was maintained for 1 hour; then the flask was cooled in cold water.

2.2 Finishing and polishing of the acrylic resin specimens

After deflasking all specimens were finished with a tungsten carbide bur at 10,000 rpm. Prothyl Hot and Duracryl Plus specimens were divided in two half.

One half was polished using a conventional laboratory polishing method: coarse pumice, water and lathe bristle brush for 90 seconds at a rate of 1500 rpm and soft leather polishing wheel for 90 seconds at a rate of 3000 rpm.

The other half of specimens was glazed, after polishing, with Glaze^{TM}/Bosworth. Glaze^{TM} is a fast-setting, self-curing acrylic resin which bonds to other resin substrates and dries to a clear, hard surface with a high-gloss finish. According to the manufacturer, Glaze™ fills microscopic voids and reduces bacterial growth. Sets in 20 seconds.

Vertex Soft specimens were not polished because resilient materials for denture bases cannot be polished or glazed.

2.3 Surface roughness measurements

Surface roughness (R_a) of the acrylic resin specimens was measured by atomic force microscopy (AFM). For hard materials roughness measurements with traditional diamond stylus profilers are adequate. The smooth surfaces consist often of soft materials such as pure metals (aluminium, gold, copper, etc.) or polymers and lacquers. For roughness measurements on such surfaces diamond stylus profilers – which drive the profilometers - can not be used because they will scratch the surface and the measured value will be meaningless. With AFMs the interaction force between the probing tip and the sample is very small and the spatial resolution is high. Additionally, for bacterial colonization roughness at nanometric scales becomes important. For this reason, roughness measurement by AFM is justified.

3. RESULTS

AFM analysis showed that the surface roughness was influenced to the greatest extent by the finishing and polishing procedures and to a lesser extent by the acrylic resin material (Tab.1). The highest smoothness, a mean surface roughness significantly below the threshold R_a=0.2 µm level, was produced by conventional laboratory polishing techniques combined with glazing of the heat curing samples.

There was no significant difference in mean average surface roughness (R_a) between glazed and non/glazed self curing resin specimens, yet a significant difference in surface roughness was found between self curing and heat-curing resins.

Material	Type of resin	Polishing method	R_a(nm)
Prothyl hot-	heat curing resin	conventional laboratory polishing method	12.26
Prothyl hot	heat curing resin	conventional laboratory polishing method **Glaze**	5.33
Duracryl Plus	self curing resin	conventional laboratory polishing method	13.95
Duracryl Plus	self curing resin	conventional laboratory polishing method **Glaze**	13.11
Vertex- Soft	resilient heat curing resin	conventional laboratory polishing method -	121.63

Tab.1. R_a values recorded for acrylic samples

The mean value of R_a for resilient resin (Vertex Soft) was the highest from all samples in this experiment. Neverthless, the values recorded were lower than the threshold R_a (0.2 µm) found in the literature.

The 3D topography could reveal the lack of homogeneity of the sample surface which is closely related to previous processing technique (Fig.1-5).

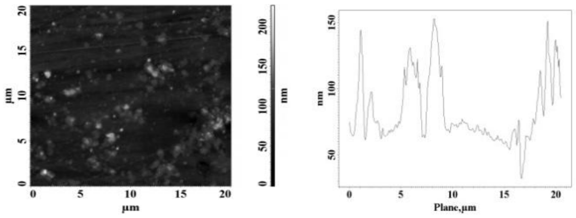

Fig.1. Image and 2D profile of unglazed Prothyl Hot sample for 20 µm

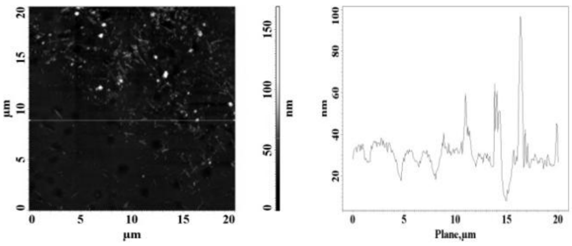

Fig.2. Image and 2D profile of glazed Prothyl Hot sample for 20 µm

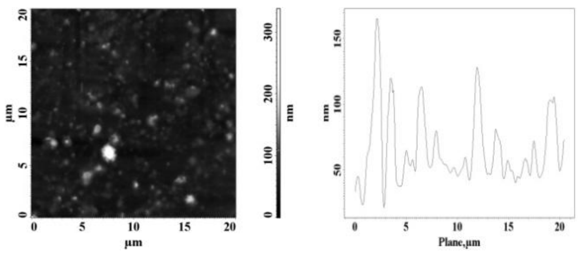

Fig.3. Image and 2D profile of unglazed Duracryl Plus sample for 20 µm

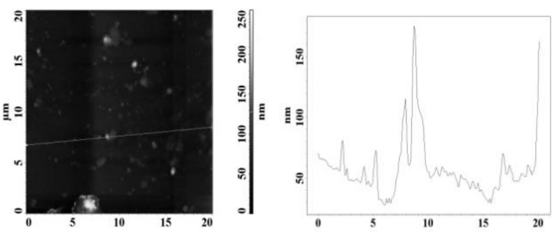

Fig.4. Image and 2D profile of glazed Duracryl Plus sample for 20 µm

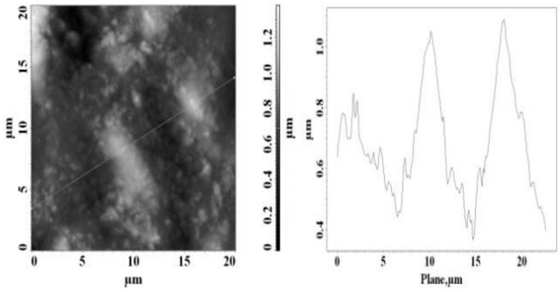

Fig.5. Image and 2D profile of Vertex Soft sample for 20 µm

The acrylic dentures are very often adjusted in the dental office during the clinical adaptation. Increased roughness of their surfaces after corrective grinding should be reduced by repolishing. Chairside polishing (in a dental practice) with silicone polishing systems is the method of choice when conventional laboratory polishing is not available. Our future research will be conducted to compare the effectiveness of the laboratory and chairside polishing methods.

4. CONCLUSION

Within the limitations of this study, the following conclusions were drawn:

1. Conventional lathe polishing method used in dental laboratory produced a surface roughness below the threshold R_a=0.2 µm, meaning that this is an effective and reliable technique for polishing denture base acrylic resin
2. Finished and polished specimens of self curing resin had a higher mean average surface roughness than heat curing resin after the same surface treatment.
3. Superior surface smoothness was produced by conventional lathe polishing completed by glazing.

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