

Evaluation of surface roughness of two different heat-cure acrylic resins finished by different grits of sandpaper followed by polishing.

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Abstract

Aim: Effect of using different grits of sandpaper on two different heat cure acrylic resins followed by polishing.

Material and Methods: Two different commercially available heat-cure resin materials; DPI heat cure acrylic resin and Meliodent heat-cure acrylic resin were selected. For preparation of specimen (35 mm X 10 mm X 35 mm) of acrylic resin material, six specimensof equal dimensions were acrylized using pressure pot.A total of 24

specimens with 12 samples of each material were fabricated and divided into six groups. All specimens were finished by different grit of sand papers and polished by cloth wheel. Samples were tested for the surface roughness under perthometer.

Results: In both heat-cure acrylic resin materials (DPI &Meliodent), Group VI 3000 shows lowest Ra value 0.592for DPI and 0.721 for Meliodent shows smoothest surface among all groups.

Conclusion: Using different grits of sand paper show significant effect on the polished surface of acrylic resins.

Keywords: sand paper, Grit , Perthometer , Surface roughness, Heat-cure acrylic resin

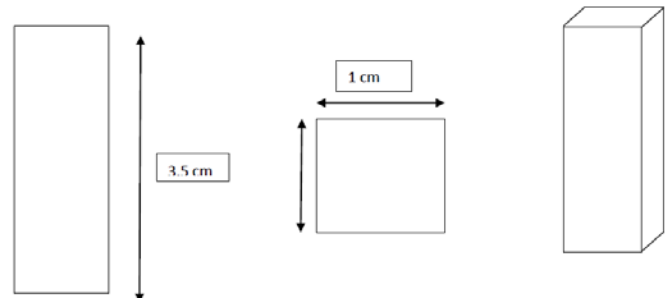
Introduction

One of the most important properties of successful dental prostheses is having a well-polished and smooth surface. The surfaces of dental prostheses must be as smooth as possible in order to achieve ideal esthetics and oral hygiene because roughness may facilitate microorganism adhesion even if the patient follows appropriate dental prosthesis hygiene. Streptococcus sanguis, Bacteroides gingivalis, and Candida albicans adhere in very high numbers to roughened acrylic resin versus smooth acrylic resin. 1 Polymethyl methacrylate is commonly used in prosthodontics since 1937 as denture base material. PMMA has inherent disadvantages such as polymerization shrinkage, allergies to the residual monomer, poor wear resistance, and low fracture and flexural strength. Therefore, alternative materials such as polyamide have been developed. 2 Surface roughness is an important factor as it directly or indirectly affects bacterial plaque retention, staining, oral health, and patient comfort. 3,4. The surface roughness of denture base acrylic resin depends on the processing technique with heat cure or cold cure and the type of polishing media used. 5 In current study, an attempt was made to evaluate the effect of using different grit of sand papers on two different denture materials. To evaluate the surface roughness, Ra value is chosen as the parameter with use of perthometer. 6 The polishing procedure involves gradual elimination of rough layers. This process may affect the physical properties of acrylic resin, such as surface hardness. Acrylic resin has been less frequently investigated for its surface roughness, effects of polishing,

bacterial adhesion, and plaque formation than other dental materials. 7

Materials and Method

Preparation of Acrylic specimen



Two Different commercially available heat-cure resin materials: DPI heat cure acrylic resin and Meliodent heat cure acrylic resin were selected. For preparation of specimen (35 mm X 10 mm X 35 mm) of acrylic resin material, six specimen of equal dimensions were acrylized using pressure pot. Each acrylic resin sample was prepared according to the manufacturer's instructions with respect to powder-liquid ratio, mixing, and packing. A standardized polymerization procedure was followed; The flasks were then left to cool at room temperature. After retrieving the heat cure acrylic blocks, all specimen were inspected for polymerisation defects like void formation with naked eye and dimensional changes were inspected by the ruler.

Minor flakes of excess material were removed carefully with the lab micro-motor and straight hand piece using the tungsten carbide burs. Then proceed for the finishing. All samples were specially finished with Grit No 60 to 3000 sand paper with mandrel on the dental lathe machine for 30 sec (using stop watch). All the sample were polished first with the pumice coated cloth wheel for 30 sec and again polished with the dry cloth wheel for another 30 sec.

Grouping of samples

A total of 24 samples were prepared. Twelve samples of each material were divided into six groups; each group consisting two samples of each material.

Table 1: Group

Group name	Grit No. Of sand paper	Number of Samples	
		DPI	Meliodent
Group I	60	2	2
Group II	120	2	2
Group III	600	2	2
Group IV	800	2	2
Group V	2000	2	2
Group VI	3000	2	2
Total No.		24	

Measurement technique

All 24 specimens were inspected by the same operator and finalised for test. All samples were tested for the surface roughness under Perthometer. **Perthometer** is a contact stylus surface texture measuring instrument that measures the surface topography of a sample using the areal and profile methods. Samples with roughness and features within the instrument range can be measured. The value were expressed as Ra in μm .



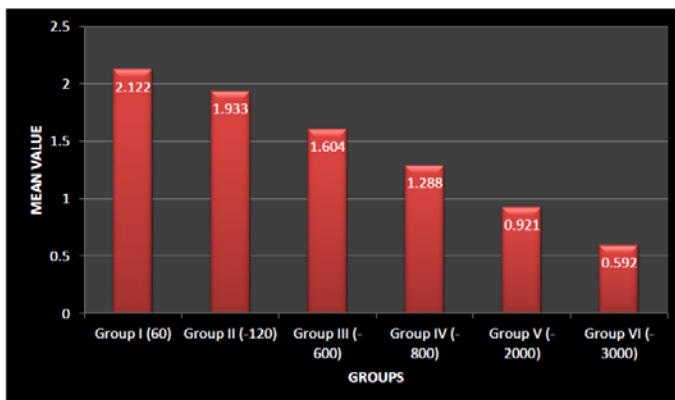
Figure 1: Perthometer

Results:

Table 2 : Ra values in μm

Group name with grit of sandpaper	DPI	DPI	Meliodent	Meliodent
Group I (60)	1.789	2.456	1.989	2.266
Group II(120)	1.879	1.987	2.143	1.977
Group III(600)	1.655	1.554	1.696	1.457
Group IV(800)	1.325	1.251	1.112	1.546
Group V(2000)	0.886	0.957	0.889	.912
Group VI(3000)	0.606	0.578	0.690	0.752

Graph 1: Mean score of DPI samples.



Graph 2: Mean score of Meliodent samples

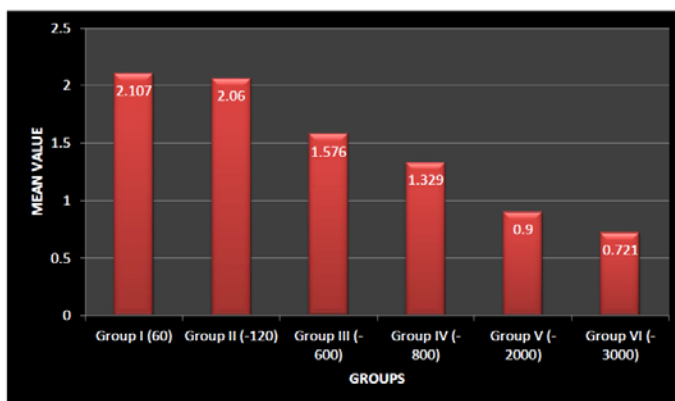


Table 3: Groups wise distribution of DPI

Groups	Mean	SD	F Value	P Value
Group I (60)	2.122	0.471	17.487	0.002 S
Group II (-120)	1.933	0.076		
Group III (-600)	1.604	0.071		
Group IV (-800)	1.288	0.052		
Group V (-2000)	0.921	0.050		
Group VI (-3000)	0.592	0.019		

Mean score was high in Group I (2.122 ± 0.471) followed by Group II (1.933 ± 0.076), Group III (1.604 ± 0.071), Group IV (1.288 ± 0.052), Group V (0.921 ± 0.050) and

Group VI (0.592 ± 0.019) respectively. Statistically, significant difference was present among all the groups in DPI (Table 4).

Table 4: Groups wise distribution of Meliodent

Groups	Mean	SD	F Value	P Value
Group I (60)	2.107	0.167	24.008	0.001 S
Group II (-120)	2.060	0.117		
Group III (-600)	1.576	0.168		
Group IV (-800)	1.329	0.306		
Group V (-2000)	0.900	0.016		
Group VI (-3000)	0.721	0.043		

Mean score was high in Group I (2.107 ± 0.167) followed by Group II (2.060 ± 0.117), Group III (1.576 ± 0.168), Group IV (1.329 ± 0.306), Group V (0.900 ± 0.016) and Group VI (0.5721 ± 0.043) respectively. Statistically significant difference was present among all the groups in Meliodent also (Table 5).

Discussion

This study aimed to comparatively evaluate the effect of using different grit of sandpaper on two different heat cure acrylic resins followed by polishing. The purposes of using different grit of sand papers are due to its clinical relevance as stated in the study by **Chalpathi Rao et al.** They evaluated the surface roughness of three heat-cured acrylic denture base resins with different conventional lathe polishing techniques on meliodent, DPI and Trevlon. Different grit of sand papers (80,100,120) were used for finishing in their study.

A.S. Kagermeier-Callaway⁸ conducted study to compare the attachment of two typical strains of oral bacteria *Streptococcus oralis* and *Actinomyces viscosus* to four denture base materials. They concluded that Polishing had little effect on adherence. Denture base materials are not resistant against adherence and possible surface damage by oral bacteria. Therefore, thorough oral hygiene is important for denture wearers. **Milan Kuhar**⁹ compared the effects of 4 chairside polishing kits and 2

conventional laboratory techniques used for polishing 3 different acrylic denture base resins. Using contact profilometric measurement, the surface texture of 54 specimens per acrylic material was studied before and after cutting with a tungsten carbide bur, and during and after chairside polishing with 4 polishing kits, and after conventional polishing with 2 polishing systems (Universal Polishing Paste for Resins and Metals, Lesk Polishing Liquid). There were 9 specimens for each acrylic resin material and polishing method combination. Conventional lathe polishing with polishing paste served as the control. Mean average surface roughness (Ra) values of each specimen group were analyzed using a 2-way analysis of variance, the Scheffe' post-hoc test, and paired t test ($\alpha=0.05$) with the Bonferroni adjustment. After testing the polished acrylic resin surfaces were evaluated under a scanning electron microscope. It was concluded that Conventional laboratory polishing was found to produce the smoothest surface of denture base acrylic resin. Chairside silicone polishing kits produced a significantly smoother surface of acrylic resin than specimens polished with a tungsten carbide bur. The presence of large pores was characteristic for the autopolymerizing resin material. **Manal Rahma**¹⁰ et al. in 2008 assessed the influence of polishing techniques on pre-polymerized CAD\CAM acrylic resin denture bases. CAD\CAM denture base material should be considered as the material of choice for complete denture construction in the near future, especially for older dental patients with changed salivary functions, because of its wettability.

In present study, surface roughness on the heat-cure acrylic blocks was selected as critical factor for the oral hygiene and longevity of dental prosthesis. In literature, various polishing techniques show the better result for the dental prosthesis. In dental prosthesis like complete

denture, removable partial denture, temporary fixed partial denture, depressions and elevations present on the surface make finishing and polishing procedures challenging. To achieving better polishing a good finishing of prosthesis required. According to the glossary of prosthodontics terms finishing defined as “final coat or surface on; therefinement of form prior to polishing”. Many text books authors mentioned finishing and polishing together for lab procedure but they are different procedures. As finishing is first step it remove the excess material after polymerising the prosthesis with various burs, diamond disc and abrasive like sand papers.

One of the main objective this study is evaluation of surface roughness of specimen finished by different grit number of sand paper for DPI and Meliodent material. Statistically, significant difference was present among all the groups in DPI as well as Meliodent. The Ra values of both were same. However, after the use of 3000 grit sandpaper, DPI showed less surface roughness than Meliodent. **Hasan Gungor**¹¹ and **Onwubu**¹² support this study that more the finer materials are use for finishing and polishing more smooth surface will form.

T.D. Morgan & M. Wilson¹³ in 2000 investigated the effects of surface roughness and type of denture acrylic on biofilm formation by *Streptococcus oralis* in a constant depth film fermentor. They stated that choosing an appropriate type of smooth acrylic could lead to reduced biofilm formation in vivo which contradicts use of armamentarium as in current study.

There are no statistical significance found between two different heat-cure materials but statistical significance was found among result of different groups.

The study, of course, is not without limitations. The acrylic blocks used for finishing and polishing are made up of flat surface where in dental prosthesis like complete denture depressions and elevations are found on the

surface which might affect the polishing technique and surface roughness. The Ra values in result table showing increase in surface fineness with increase in grit number but it is not yet evaluated that till what extent polishing surface is needed for good oral hygiene.

Conclusion

Within the limitation of the study the following conclusions can be made:-

1) In both heat-cure acrylic resins materials (DPI & Meliodent) Group VI3000 Shows lowest Ra value 0.592 for DPI and 0.721 for meliodent shows smoothest surface among all groups.

2) Mean score was high in Group I (2.122 ± 0.471) followed by Group II (1.933 ± 0.076), Group III (1.604 ± 0.071), Group IV (1.288 ± 0.052), Group V (0.921 ± 0.050) and Group VI (0.592 ± 0.019) respectively. Statistically, significant difference was present among all the groups in DPI.

3) Mean score was high in Group I (2.107 ± 0.167) followed by Group II (2.060 ± 0.117), Group III (1.576 ± 0.168), Group IV (1.329 ± 0.306), Group V (0.900 ± 0.016) and Group VI (0.5721 ± 0.043) respectively. Statistically, significant difference was present among all the groups in Meliodent.

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