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Effect of Different Dental Materials on the Surface Roughness of Acrylic Resin (A comparative in vitro study)

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Introduction

Acrylic resin pertaining to polymers of acrylic acid, methacrylate acid, as acrylic fiber. Any group of thermoplastic resin made by polymerizing ester chain of acrylic or methyl methacrylate acid [1,2,3].

Acrylic resin produce by dough molded technique are the most commonly used as a denture base material , Although Methyl methacrylate (acrylic resin) are available for dental use in polymer-monomer form [3,4] , and also as a (gel) [3,4,5]. The latter mode of presentation is not used as widely as the powder and liquid type, as its shelf life is of much shorter duration [4].

The natural and duration of the condition to which the mold is subjected during processing are described as the curing cycle, Since the mid 1940, most the acrylic denture bases have been fabricated by passing through 5 stages beginning with Sandy stage then Sticky stage , Dough stage is the third one which is the most important stage in which we can work and manipulate the mixture, then Rubber stage and finally Hard stage in which the acrylic become hard like stone that can be finished in order to reach to the polishing process to give the acrylic glassy appearance [6,7,8,] .

The finishing procedure of acrylic denture consist of making the denture free from sharpness and smooth [9,10,11], this process accomplished by stone bur and sand paper in order to make the acrylic denture reach to the final form before polishing [11,12,13].

The polishing procedure of the acrylic denture consist of making the denture glassy without changing its contour, To develop a high glass surface acrylic resin ,all scratches and rough area must be remove . A series of progressive finer abrasive is used to produce a lustrous surface on the denture [8,14,15,16].

This study used 2 different types of pumice to reach the lustrous surface of acrylic and also used the investment material as a polishing material and comparing among these three materials in their efficiency as a polishing material.

* Aim of Study: Determining &comparing the effect of 2 different types of pumice materials & Investment material as a polishing material on the surface roughness of acrylic resin.

*** Key Word: Acrylic Resin, investment material, pumices material.**

Materials & Methods

Samples Preparation

Thirty samples of base plate dental wax were used in this study, wax prepared (2cm length, 1.5cm width, and 5cm thickness), position inside the lower half of dental flask, then dental stone (Tuxj, China) mix according to manufactured instruction and poured in the lower half of the flask in which the level of the stone with the level of the base plate wax samples. After hardening of the dental stone it was coated with separating medium (Major, Italy) then the upper half positioned on the lower half and poured by dental stone.

After complete setting of stone , wax elimination was done by placing the flask in boiling water for 10 minute , then removed from the water and opened the flask, all excess wax was washed out with a stream of boiling water, then the mold washed again with boiling water . Then separating medium used to coat the surface of the mold.

Packing & Flasking

Clear hot cure acrylic (DMP , QD) powder and liquid was mixed according to the manufacture instruction, then left till reaching to dough stage(when the mixture separate from the wall of the container-ADA specification no 12 for denture base resin.

In the dough stage, the mixture was packed into the mold, covered with polyethylene sheet; the tow half of the flask was close together, flask assembly position into hydraulic press, pressure was applied incrementally to allow resin dough to flow evenly through out the mold.

The flask was opened, the over flow material and polyethylene separating sheet was removed. The tow half of the flask closed together, pressed metal to metal contact and held for 5 minute before clamping, then transfer to a thermostatically controlled water bath (W&H England), used the rapped cycle of curing (1 hour at 100 C°).

Finishing & Polishing

The thirty samples were finished by using stone bur to remove any feather edge and sharpness, and then smoothed by using sand paper in order to reach to the polishing procedure.

Thirty samples were polished by the same examiner, in order to standardized the pressure exert on each acrylic sample used a spring measuring balanced that positioned with the acrylic sample touching the rag wheel and fixed on a pressure of 1500gm, A new rag wheel (AN dent, china) was used for each sample, the rag wheel mounted on Dental lath (Italy) fixed on a standardized slow speed (1425 r.p.m.) for all samples.

Samples Grouping: samples were divided into 3 groups

Group A :10 samples polished by a new rag wheel for each sample, with Investment material 60mg (UAE), mixed with 1.3ml distilled water, for 1.30 min. under 1500gm pressure for each sample.

Group B: 10 samples polished by a new rag wheel for each sample, with pumice material 60 mg(Astm, Germany), mixed with 1.3ml distilled water, for 1.30min. under 1500gm pressure for each sample.

Group C: 10 samples polished by a new rag wheel for each sample, with pumice material 60 mg(MPJK, China), mixed with 1.3ml distilled water, for 1.30min. under 1500mg pressure for each sample.

*weight of polishing material controlled by using sensitive electronic measuring balance.

*quantity of distilled water controlled by using hypodermic syringe.

Surface Roughness

In order to determined the efficiency of each of these three materials to act as a polisher material for denture base acrylic used Surface roughness testing device (Talysurfa 4, Tylor Hobson) which consist of an electrical probe supplied with a horizontal magnifying lens of (4x → 100x) and vertical magnifying lens of (500x →100000x) , each sample positioned on the probe that had the ability to move (translate) to 1.1 mm to detect the amount of surface roughness which would appear as electronic measure for each sample.

Result

Statistical Analysis:

The suitable statistical methods were used in order to analyze and assess the results, they include the followings:

1- Descriptive statistics:

A) Statistical tables including observed frequencies with their percentages.

B) Summary statistic of the readings distribution (mean, SD, SEM, minimum & maximum).

C) Graphical presentation by (bar - charts)

2 – Inferential statistics:

These were used to accept or reject the statistical hypotheses, they include the followings:

(ANOVA) Analysis of variation test (t-test).

(LSD) lest Significant difference (t-test).

Discussion

Water bath method was used in this study and followed the method of (Craig and power, 2002) which showed the best, recent and easy method for curing acrylic resin denture base material.

According to the result obtained in table (1&2) although there were an increase in the surface roughness in both group B&C ,it showed that the pumice used with water in this study for polishing acrylic specimens gave a smooth surface ,this is agree with (Willson,1970).

According to the inferential statistic obtained from this study (table 3) showed a significant difference between group B&C although they were both polished with pumice material but in different company this significant difference may be due to variation in their composition of there 2 pumice that they may be due to the difference to the mineral content that increase the abrasive resistance of the pumice , Also during comparison between group A,B &C seeing that investment material act better than pumice as a polisher material this may be due to the particle size of the material that when the polisher material has smaller particle size it need more particle which mean increase in surface area which mean increase in wear which lead to increase in polishing mechanism and decrease in surface roughness , this is agree with (Philips,1992). , also it may be refer to the hardness of the material which was often used to give an indicator to resistance to abrasion ,that investment material act better than pumice due to the limited abrasion power of the pumice & because it was not very hard material which may abrade easily ,especially by water.

Conclusion

Investment materials act as a good polishing material for acrylic denture base material rather than pumice.

In order to have good polish surface denture base should choose the pumice that have the ability to match the polishing requirement.

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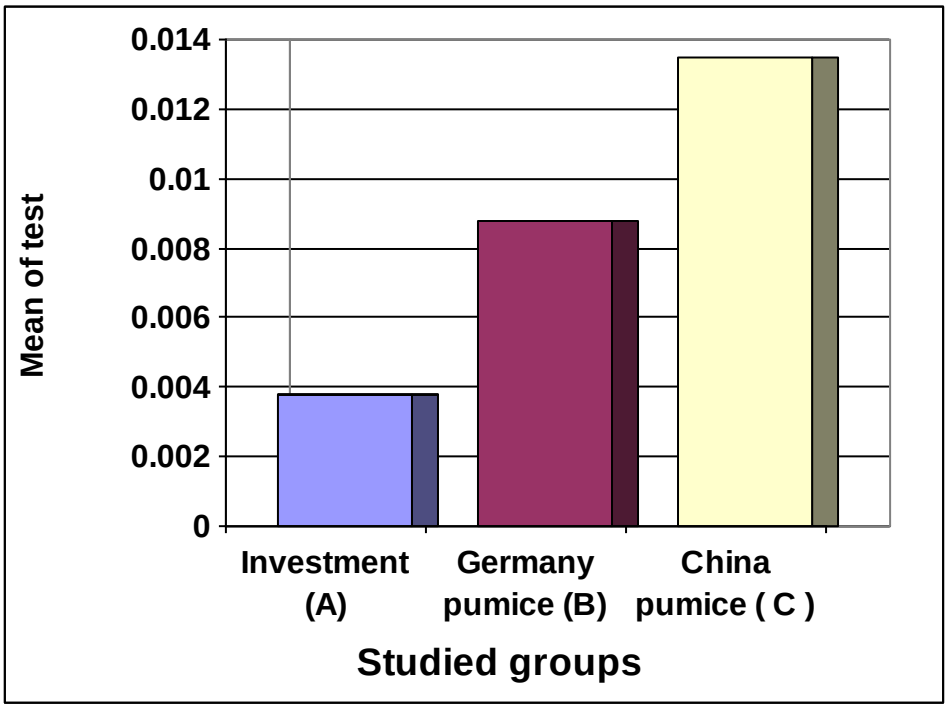

Figure (1): Mean distribution of test among studied groups.

Table (1): Mean distribution of test among studied groups.

Studied groups	No.	Mean	SD	SEM	Mini.	Maxi.
Investment (A)	10	0.0038	0.0012	0.00038	0.002	0.005
Germany pumice (B)	10	0.0088	0.0024	0.00078	0.002	0.010
China pumice (C)	10	0.0135	0.0073	0.00232	0.008	0.030
Total	30					

Table (2) The ANOVA test for test between and within studied groups.

ANOVA test	Sum of Squares	df	Mean Square	F	P-value	Sig.
Between Groups	0.00047	2	0.00023	11.433	0.00	Highly sig. (P<0.01)
Within Groups	0.00055	27	0.00002			
Total	0.00102	29				

Table (3): Mean distribution of test among studied groups.

Studied groups		LSD (f-test)	
		P-value	Sig.
A	B	0.020	Sig. (P<0.05)
	C	0.00	Highly Sig. (P<0.01)
B	C	0.028	Sig. (P<0.05)