Evaluation the effect of burning investment and black sand materials on the surface roughness of acrylic resin denture base

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المستخلص

الهدف: الهدف من هذه الدراسة هو تقييم تأثيرمادة الأكساء المحروق (investment) والرمل الاسود على الخشونه السطحية لمادة الاكريلك الحار

المنهجية: : تم تحضير ٦٠ عينة من مادة الاكريلك الحار ثم قسمت العينات الى ثلاث مجاميع: ٢٠ عينة(عينات قياسية) لمّعتْ بمادة الpumice والماءِ; ٢٠ عينة تم تلميعها باستخدام مادة الأكساء المحروق والماء و ٢٠ عينة لمعت بالرمل الاسود والماء. ان معدل الخشونة السطحية للعينات بعد عملية التلميع كانت قد حددت بواسطة جهاز فحص الخشونة بروفيلوميتر.

النتائج: أظهرت النتائج بوجود فرق معنوي عالي بين المجاميع الثلاثة.

التوصيات: يمكن الاستنتاج بان السطح الأنعم للعينات تم الحصول عليه بواسطة مادة الأكساء المحروق كَانَ أعلى جداً مِنْ مادتي الرمل الاسود وال pumice لذا مادة الأكساء المحروق يمكن ان تستعمل كمادة تلميع لمادة الاكريلك الحارالمستخدمة في صناعة قاعدة طقم الاسنان عوضا عن مادة ال pumice.

مفتاح الكلمات: الاكريلك الحارالمستخدمة في صناعة قاعدة طقم الاسنان، الخشونه السطحية، مادة التلميع

Abstract

Objective: The aim of this study was to evaluate the effect of pumice, burning investment material and black sand on the surface roughness of heat cure acrylic resin.

Methodology: Sixty specimens were prepared from pink heat cure acrylic resin, the specimens where grouped into; 20 specimens which polished with pumice and water (control group); 20 specimens which polished with investment material (after burning it) and water; and 20 specimens which polished with black sand and water. The average surface roughness of specimens after polishing procedure had been determined by profilometer (surface roughness tester).

Results: Through the application of ANOVA and LSD tests, the result of this study showed that there was a highly significant difference among the three groups at ($P<0.001$).

Recommendation: it may be concluded that the smoother surface of specimens gained by burning investment material was significantly higher than that of black sand and pumice materials. So that burning investment material can be used as a polishing material for heat cure acrylic resin denture base instead of pumice material.

Key words: heat cured denture base acrylic resin, surface roughness, polishing material

Introduction:

Acrylic plastic was the most widely used and accepted among all denture base materials and it was estimated that it represented 95% of the plastic used in prosthodontics [(1)]. Proper finishing and polishing for this material are important aspects of clinical restorative procedures, a rough surface on dental restoration may be uncomfortable and good oral hygiene maintenance become difficult because of food debris and plaque can easily cling to it [(2)] .Smooth surface offers little retention of food debris thus reducing the risk of plaque formation [(3)]. To develop a high gloss on heat acrylic resin, all scratches and rough areas must be removed [(4)]. A surface which is to be polished should show only fine scratches from a fine abrasive lightly applied. During abrasion, the direction of movement of abrasive particles over the surface should be changed constantly [(5)].

The preliminary polishing of acrylic resin is done with pumice mixed with water to the consistency of well- mixed plaster, which is applied to the denture with a black brush on the polishing motor with speed of (1.500) (r.p.m) [(6)].The pumice must be wet to minimize the generation of heat which will tend to warp non- metallic materials and to wear away the brush. Keep the work well covered with pumice and not allow the denture to be forced out of the hand by the motion of the brush [(7)].

Some authors used pumice and other polishing materials and studied their effect on the surface roughness of acrylic resin [(8)(9)].

The present study was under taken to evaluate the effect of burning investment material (which used as a polishing material) and blank sand on the surface roughness of heat cure denture base acrylic resin and comparing their effects with pumice polishing material.

Methodology:

Specimens grouping

Sixty specimens were prepared from pink heat cure acrylic resin (pan comp. Turkey), the specimens where grouped into; 20 specimens were polished with pumice (Ivoclar, Germany) and water as control group; 20 specimens were polished with investment material after burning it(phosphate bonded, Gilovest, German) and water; and 20 specimens were polished with black sand(Baghdad ,Al-kreeait) and water.

Specimens preparation:

Acrylic resin specimens (80 x 10 x 3.0mm) were prepared from metal pattern [(8)]. The lower portion of the dental flask was filled with dental stone mixed according to manufacturer instructions (31 ml /100gm); a layer of stone mix was placed on metal block to avoid trapping of air when inserting the metal block into the stone mix after coating with separating media. After stone was set, both the stone and metal patterns were coated with separating media. The upper half of the flask was then positioned on the top of lower portion and filled with stone. Stone was allowed to harden for 60 minutes before the flask was opened. The metal pattern was invested each time when the samples are to be prepared, the flask was then opened and metal patterns were removed from the mould carefully.

Pink heat cured acrylic resin was mixed according to manufacturers instructions (2.25gm/1ml). The acrylic resin dough was packed into the mould which had been treated with separating medium and covered with polyethylene sheet, the two halves of the flask were closed together and placed under the hydraulic press, and the pressure was slowly applied to allow even flow of the dough through out the mould space. The pressure was then released, the flask was opened and the over flowed material (flash) surrounding the mould space was removed with wax knife. A second trial closure was performed, the two halves of the flask were finally closed until an intimate contact had been established and left under the press (1500psi) for 5 minutes before clamping was done and then the flask was placed in a flask clamp maintaining undisturbed pressure during processing.

Curing was carried out by placing the clamped flask in a thermostatically controlled water bath and processed by heating at 74C° for 1.5 an hour and the temperature was then increased to the boiling point for half an hour (short curing cycle) according to ADA specification, No.12 (1999).After completing the curing, the flask was allowed to cool slowly at room temperature for 30minutes, followed by complete cooling of the flask with tap water for 15 minutes before deflasking, figure (1).

The acrylic plates were then removed from the flask and hand finished using progressively finer grades of silicon paper (grades 120 to 40µm) with continuous water cooling, each acrylic plate was cut into equal square plates with an acrylic separating disk to obtain the final measurement of 10x10x2.5 mm(length, width, thickness) [8] as shown in figure(2). All the tested specimens were conditioned in distilled water at 37Cº before they were tested according to ADA specification NO.12 (1999).

Figure (1): The flask

Figure (2): The acrylic plates

Polishing material groups:

The specimens tested by three types of polishing material; pumice, investment material after burning it and black sand.

In this study the pumice used was fine grade type and the investment material after burning it was get it after completed the casting procedure of crown & bridge in dental lab. The investment material was mixed according to the manufacture instruction. The burning temperature which is used for burning the investment material in this study was 950◦C, after burning the investment it was crushing and grinding it by using Retch. BB1 A device. As shown in figure (3).

Figure (3): Electrical grinding device

Then sifting grind burning investment from any impurities by using the sieve analysis device to get particle size (range ≤ 250 micron). As shown in figure (4).The process of sieving technique carried by making certain vibration, this vibration allowed some powder particles to pass through standard sieve (the mesh size was 250 micron), and the particles were greater than this, which will be not allowed to pass the powder (P<=250 µm ,will be passed and used in this study). This powder have a wide of distribution of powder particles size standard 250 µm, containing down to the size less than 250 µm , which is related to the characteristic behavior of burning investment and the efficiency of grinding unit as well as sieving unit .

Figure (4): Electrical sifting device

Accepted quantity of black sand about 100 gm put in glass beaker of 2L size then filled up to 1.6L with distilled water, then mixing the content for 15min using mechanical mixer as shown in figure (5) after that leaving the content to be settled over night with covering the open end with nylon cover in order to prevent the dust fall in which regard an impurities. Then pouring water from the beaker up to the level of water above the content about 1cm; this process was repeated by adding distilled water, mixing, setting and pouring for three times. The aim of this process is to minimize the haled and any other soluble material.

The glass funnel and filter paper were used in the filtering process, figure (6). The process was done by pouring the suspension slowly, the clay was kept over filter paper and water with soluble content is thrown to the glass beaker through glass funnel. Then the clay was collected in dish and put it in oven for dryness at 100C for 2 hours[8] .The dry powder are milled for 1 hours and sieved by the same sieving technique that used for burning investment to get powder having particle size range ≤ 250µm.

Figure (5): Mechanical mixture

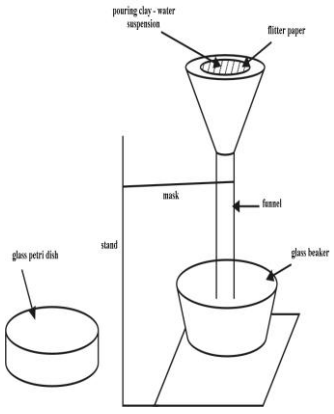

Figure (6): Filtration process

Polishing procedure:

The sample test was fixed in the dental lathe unit as shown in figure (7). The space between the sample and the brush was fixed 1-2mm. The speed of the dental lathe was fixed at low speed which was (1425 rpm) Time of polishing process for each specimen was 2 min. The amount of water added to each of these polishing materials (pumice, burning investment, and black sand) was 2ml measured by using plastic disposable syringe.

Figure (7): Acrylic specimen fixed on polishing dental lathe device

Surface roughness test:

After polishing procedure the surface roughness of each specimen was measured by using profilometer surface roughness device, figure (8). The profilometer was supplied with stylus (profilometer needle) made of diamond, the specimen's surface was fixed in a very flat position to the horizontal base of the profilometer by glue. The stylus was moved across the surface of the specimen in three different directions for a distance of 1.7 mm according to apparatus design, for each specimen two reading were recording and the mean value for each specimen was the average of the reading. The data was collected and subjected to statistical analysis.

Figure (8): surface roughness tester

Results:

The mean of surface roughness for each studied groups is listed in table (1).The mean of surface roughness for pumice (control group) was 2.315µm , and for burning investment was 0.73µm, while the mean of surface roughness of black sand was 1.330 µm , as shown in figure(9).

Also table (1) show the ANOVA test for surface roughness for all tested groups and it was found that there is a highly significant difference among tested groups at (P<0.001).

Table 1. Descriptive statistics and ANOVA test for surface roughness of studied groups

Studied groups	No.	Mean (µm)	Std. Dev.	Mini.	Maxi.	ANOVA Test P-value	Sig
pumice (control group)	20	2. 315	0. 281	0. 650	2.665	0.000	HS
Burning investment	20	0.733	0. 277	0. 313	1. 376		
Black sand	20	1. 330	0. 391	0. 384	1. 951		
Total	60						

No.=Number; Std. Dev. =Standard Deviation; Mini.=Minimum; Maxi.=Maximum; p-value= Level of probability at p=<0.001;Sig=Significance

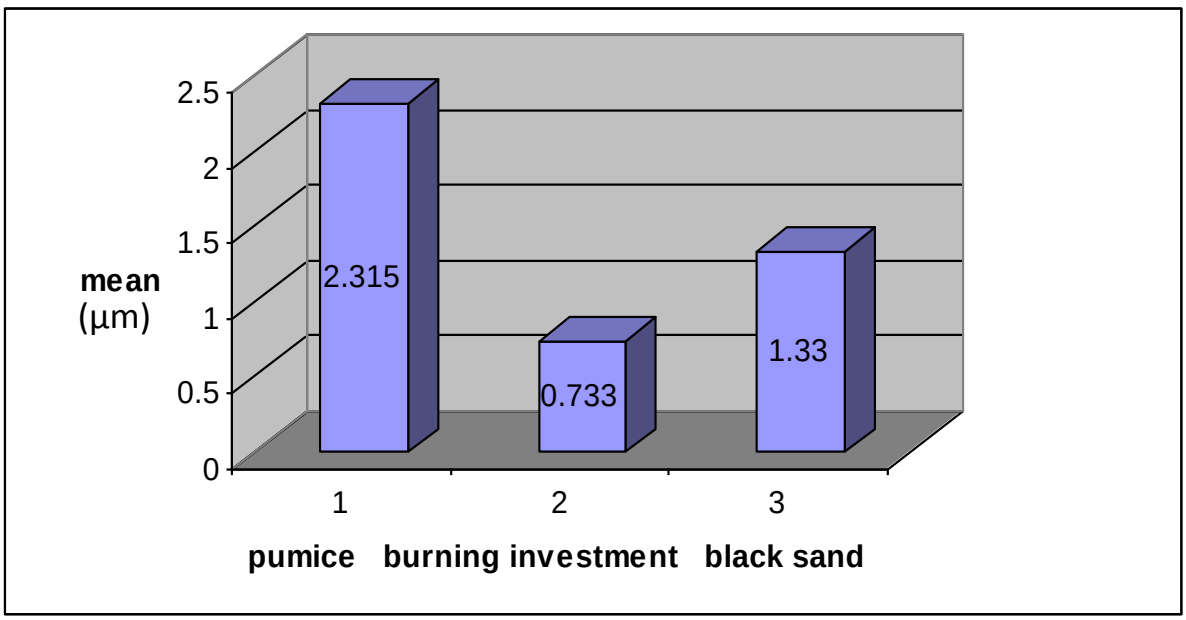

Figure (9): Graphical representation of means of surface roughness of studied groups by bar charts

The LSD test is shown in table (2) which indicated there was a highly significant difference (P<0.001) between each studied groups.

Table 2. LSD test for studied groups

Studied Groups		LSD (f-test)	
		P-value	Sig.
Control	Burning investment	0.000	HS (P<0.001)
	Black sand	0.000	HS (P<0.001)
Burning investment	Black sand	0.000	HS (P<0.001)

P-value= Level of probability at p=<0.001;Sig=Significance

Discussions:

Polishing process is an important to remove excess material and to smooth roughened surface [10]. A rough surface on dental restoration may be uncomfortable and good oral hygiene maintenance become difficult because of food debris and plaque can easily cling to it [2] .Pumice was the most common fine abrasive used in dentistry, and pumice used as an agent for polishing acrylic sample which was considered a useful polishing agent [11]. The finishing and polishing of denture base material was done by using brushes with pumice slurry and it has been used as a control group [12].

An investment material after burning it and black sand were used as abrasive material to evaluate their effect on the acrylic resin specimens as an alternative to conventional pumice.

The results of this study showed that there was a different in the mean value of the surface roughness of the pumice (control group), burning investment and black sand materials. On the other hand, statically illustrated that there was a highly significant difference (P< 0.001) among the three groups; the burning investment which has been used as a polishing material showed a decrease in the mean value of the surface roughness of the acrylic resin specimens (0.733 µm) and this could be explained on the basis that investment material content a high percentage of SiO_2 (65.4%) in their composition than pumice (50.3 %) and black sand (55.8%) materials. While black sand material showed less mean value (1.330 µm) and decrease in the surface roughness than pumice (2.315 µm) and this is in agreement with Al-Majeed [8] who showed that the black sand materials had a decrease in the surface roughness, and it was concluded that the smoother surface of acrylic samples gained by black sand more than pumice material and this may be due to difference in their minerals content of the materials (SiO_2,Fe_2O_3, Al_2O_3, and TiO_2) While this result disagreement with Mohammed [9] who concluded that smoother surface of the acrylic resin gained by pumice more than other abrasive material, and this may be due to the variation in their properties of the materials that have been used as a polishing material .

However, there were no further studies in the English and Iraqi literatures concerned this work, by using burning investment material as a polishing material.

Recommendations:

1. Effect of porcelanite and burning investment materials on the surface roughness of heat cure acrylic denture base resin.
2. Effect of Aluminum oxide on the surface roughness of heat cures acrylic denture base resin.

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