

The effect of disinfectant solutions on the surface topography of acrylic denture base materials

Munther N KAZANJI*
Nadia H AL-KAZAZ**

ABSTRACT

The aim of this study was to measure the effect of different immersion period up to (7) days of acrylic denture base materials (heat cure acrylic Vertex and QD, and cold cure acrylic Miky-red and QD) in three types of disinfectant solutions (0.525% Sodium hypochlorite, 0.2% Chlorhexidine and 2% acidic Glutaraldehyde) on the surface roughness.

One hundred eighty acrylic plates were prepared from a base plate wax of (20mm × 10mm × 2.5 ± 0.03 mm) dimension using a conventional denture processing technique. From each type of acrylic denture base materials, (45) acrylic plates were prepared, which were intern divided into three groups: (15) unpolished (inner-side) surface, (15) polished by conventional technique and (15) polished by a modified polished technique.

The surface roughness was measured by a prethometer.

The results, revealed that there was a significant difference at (1%) level between the materials used, solution used, types of polishing technique and the time of immersion. The cold cure acrylic denture base material type (Miky-red) showed the highest degree of the surface roughness. Photomicrograph microscopical study of the acrylic beads (mer-unit) showed the effect of the size of the beads on the surface roughness.

It was concluded that the modified polishing technique produces a smoother surface for the acrylic denture base materials, the solutions and duration of immersion up to seven days showed a statistical significant difference but practically they can be used for denture disinfecting.

Key Words: Disinfectants, denture base materials, surface topography.

الخلاصة

لابد من تقاليل خشونة سطح مواد قاعدة الطقم الاكريليكية للحصول على أقصى انسجام حيوي مع هذه المواد ، أستخدم في هذه الدراسة جهاز (Perthometer) وهو عبارة عن آلة مبرمجة لقياس طبيعة السطوح بدقة تصل إلى (0.1 μm) ، أستخدم هذا الجهاز لقياس تأثير فترة الغمر لمدة سبعة أيام في ثلاثة أنواع من المحاليل المطهرة (Sodium hypochlorite, 0.525%; Chlorhexidine, 0.2%; Glutaraldehyde, 2%) على خشونة سطح الصنفايح المصنوعة من مواد قاعدة الطقم الاكريليكية . [Heat cure acrylic (Vertex, QD); Cold cure acrylic (Miky-red, QD)]

*Munther Najeeb KAZANJI; BDS, MSc: Lecturer.

**Nadia Hassan AL - KAZAZ; BDS, MSc: Assistant Lecturer.

Department of Prosthetic Dentistry, College of Dentistry, University of Mosul, Mosul, IRAQ.

حضرت (١٨٠) صفيحة أكريليكية من صفيحة القاعدة الشمعية (١٨٠) صفيحة من كل نوع من مواد قاعدة الطقم الأكريليكية وقسمت إلى ثلاثة مجاميع (١٥) غير ملمعة السطح - جهة النسيج - ، (١٥) ملمعة السطح بواسطة الطريقة الاعتيادية، (١٥) ملمعة السطح بواسطة الطريقة المحورة. أظهر التحليل الإحصائي بأن هنالك فرق معنوي عند المستوى ١% بين قياسات المواد المستخدمة، المحاليل المستخدمة، طريقة التلميع وأوقات الغمر ، أظهرت مادة قاعدة الطقم الأكريليكية نوع المعالجة بالبرودة (Miky-red) أعلى درجة لخشونة السطح ، أظهرت الدراسة الصورية المايكروسكوبية (المجهريّة) لوحداث الأكريليك (مير) تأثير حجم هذه الوحدات على خشونة السطح. استنتج من هذه الدراسة بأن الطريقة المحورة للتلميع أنتجت أنعم سطح لمواد قاعدة الطقم الأكريليكية، بالرغم من أن نوع المحاليل وفترة الغمر إلى حد سبعة أيام أظهرت فرق معنوي عند تحليلها إحصائياً ولكن استخدام هذه المحاليل لتطوير الطقم يعتبر آمناً عملياً.

INTRODUCTION

Infection control to prevent cross-infection, becomes a topic that is still receiving attention from within the profession of dentistry, as well as from outside agencies, (1, 2).

Prosthetic patients are generally a high-risk group relative to their potential to transmit infectious diseases as well as acquire them (3) So routine infection control and disinfection protocols have been developed. Specifically, emphasis has been placed on the disinfecting of impressions, gypsum casts and even so the dental prostheses (4, 5, 6, 7).

Dentures of the patient represent a potential transmitter of microorganisms and infection to avoid contamination of dental office and dental technicians, it has been recommended that denture should be disinfected before and after receiving from laboratory (5). There, the old or even a new denture will undergo a series of preparation before the work is completed.

Many materials and instruments used in dentistry cannot be subjected to high heat. So, chemical agents must be used to sterilize or disinfect them (4), such as (5.25%) sodium hypochlorite solution as a surface disinfectant (8). Glutaraldehyde in (2%) solution (5), and chlorhexidine solution as a denture disinfecting agents (7).

It is essential that the solution used for disinfection of the denture affect neither the accuracy nor the surface texture of the denture materials (9).

The aims of the study designed to measure the effect of disinfectant solutions, polishing technique, and immersion period on the surface roughness of denture base materials.

MATERIALS AND METHODS

The tested materials used in this study are listed in table (1: a & b).

Table (1 a): Acrylic denture base materials and auxiliary materials

Product	Type	Manufacture	Class	Batch No.
Vertex	Regular heat cure denture acrylic	Dentimex B.V.	Cl.I powder and liquid pink-	GH 294 po1 GH 273 Lo3
Quayle-Dental	Denture base material QD-heat cure denture acrylic	QUAYLE DENTAL LTD	Cl.I powder and liquid light-pink color	BS 2487 BS 2487
Miky-RED	Extra fast self-curing acrylic	NISSIN DENTAL Products INC	Cl.II powder and liquid pink color	PPEM PGP
Quayle-Dental	Rapid repair material cold cure denture acrylic	QUAYLE DENTAL LTD	Cl.II powder and liquid pink color	BS 2487 BS 2487
Toughened-Pink	Modelling Wax	QUAYLE DENTAL LTD	Universal	022788
ZETA ZEIENOR	Gypsum	INDUSTRIA ZINGADI S.Y.I.	Cl. III stone	15067
GUARANTEED P.D. product	P.D. Separating film for Acrylic Resin	PRODUITS DENTAIRE S.A. VEVEY (SUISSE)	Pink color	806317
GRADE fine	Pumic	Whipmix CORPORATION	Cl. 125	03549

Table (1 b): Disinfectant solutions

Product	Type	Manufacture	Class	Batch No.
Bleach Regular	Sodium Hypochlorite (5.25%)	CHEM LAB PRODUCTS INC		415902071
Glutaraldehyde (2%) in Water	Glutaraldehyde (2%)	Switzerland		49629
Hibitane Concentrate (5%)	Chlorhexidine Gluconate (5%) w/v	ZENECA limited		1932366

One hundred eighty wax plates were prepared to a uniform dimension of (20mm X 10mm X 2.5 ± 0.03mm). These plates were divided into three groups:
Group A: The outer surface of the wax plates were smoothed with a piece of nylon – clothes (polished M*)⁽¹⁰⁾.

*Modified polishing technique.

Group B: The outer surface of the wax plates were flaked in stone as it is (Polished C**).

Group C: The inner surfaces of the wax plates were flaked, as it is (non-polished).

The samples were prepared following conventional denture processing.

The acrylic plate of group A (polished M) were finished using a sand-paper grade zero, polished using a wet-slurry pumice and muslin buffing wheel band on A lathe polishing machine. Then a watery wet muslin buffing wheel used to re-polished the surface of the samples followed by a Tri-poli with a dry muslin buffing wheel⁽¹⁰⁾.

The acrylic plate of group B (polished C) polished by conventional method⁽¹¹⁾, while the acrylic plates of group C were remains as it is.

All acrylic samples were stored in distilled water at $(37 \pm 1C^0)$ in an incubator for conditioning (the heat cure samples stored for 7-days while the cold cure samples for 14 days)⁽¹²⁾.

The measurement of surface topography of acrylic plates were obtained as following:

A piece of an autoclave tape of (7.5) mm width was fixed on one end of the plate. Then the center of the plate was determined as a line on the tape. This line will be made a right angle with the cyclometer that was adjusted previously on the frame of the perthometer machine, therefore the sample can be repositioned. The measurement was done by adjusting the needle of the perthometer to start the recording from the end of the tape in the center of acrylic plate for a distance of (4.8 mm) (figures 1 and 2). The surface roughness (Ra, Rz) values of the tested plates were measured by a perthometer with (0.1 mm) level of accuracy.

Olympus photomicrograph microscope (BH₂, Japan) at X400 was used to examine the surface of acrylic plates.

The mean and standard deviation were calculated statistically. These means were compared by using Duncan's Multiple Range Test.

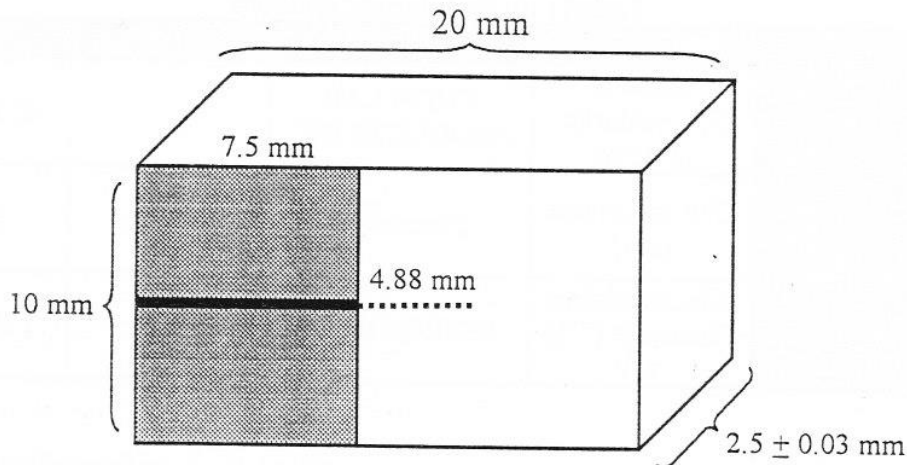


Figure (1): Schematic drawing of test plate

** Conventional polishing technique.

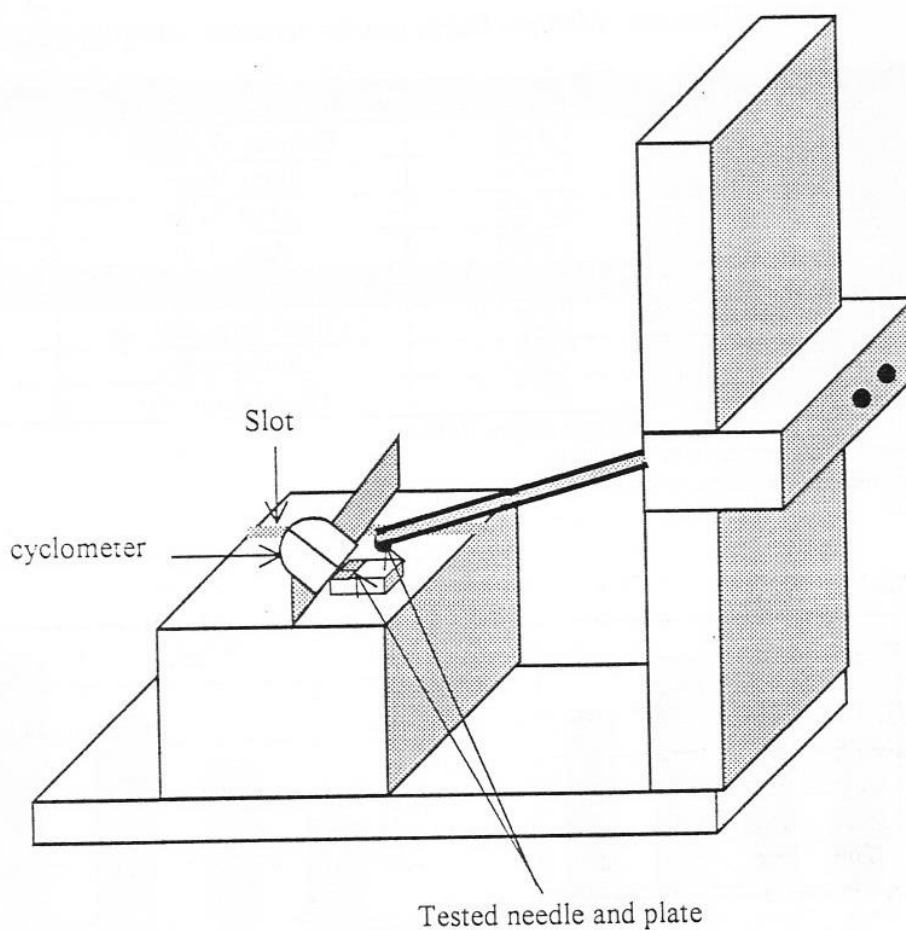


Figure (2): Schematic drawing of the tested machine

RESULTS AND DISCUSSION

The results are listed in table (2) and explained in figure (3: a, b, c and d) which included:

Figure (3a) showed that the Miky-red cold cure acrylic material has a high level of Ra value (surface roughness) due to fact that the bead size of this material are large^(13, 14, 15, 16).

Figure (3b) showed that the polished M has the less degree of Ra value^(11, 17).

While Figure (3c and d) showed that the duration of immersion up to (7) days in Glutaraldehyde solution gave the less degree of Ra value^(9, 18).

Table (2) Duncan's Multiple Range test for variables with (Ra) value

Materials	Mean μm	Time	Mean μm
Heat cure (vertex)	1.6166 ^C	Control (0) Mint.	1.8834 ^C
Heat cure (QD)	1.6353 ^C	First Time	1.9348 ^{BC}
Cold cure (Miky-Red)	2.5768 ^A	After 24 hr	1.9739 ^{BA}
Cold cure (QD)	1.9908 ^B	After 1 w	2.0273 ^A
Technique of polishing	Mean μm	Type of solution	Mean μm
Polished M	1.2231 ^C	Sodium-hypochlorite	1.9942 ^A
Polished C	1.9842 ^B	Chlorhexidine	1.9568 ^{BA}
Non polished	2.6573 ^A	Glutaraldehyde	1.9136 ^B

Means with the same letter are not significantly different.

M: Modification technique of polishing.

C: Conventional technique of polishing.

hr: hour w: week

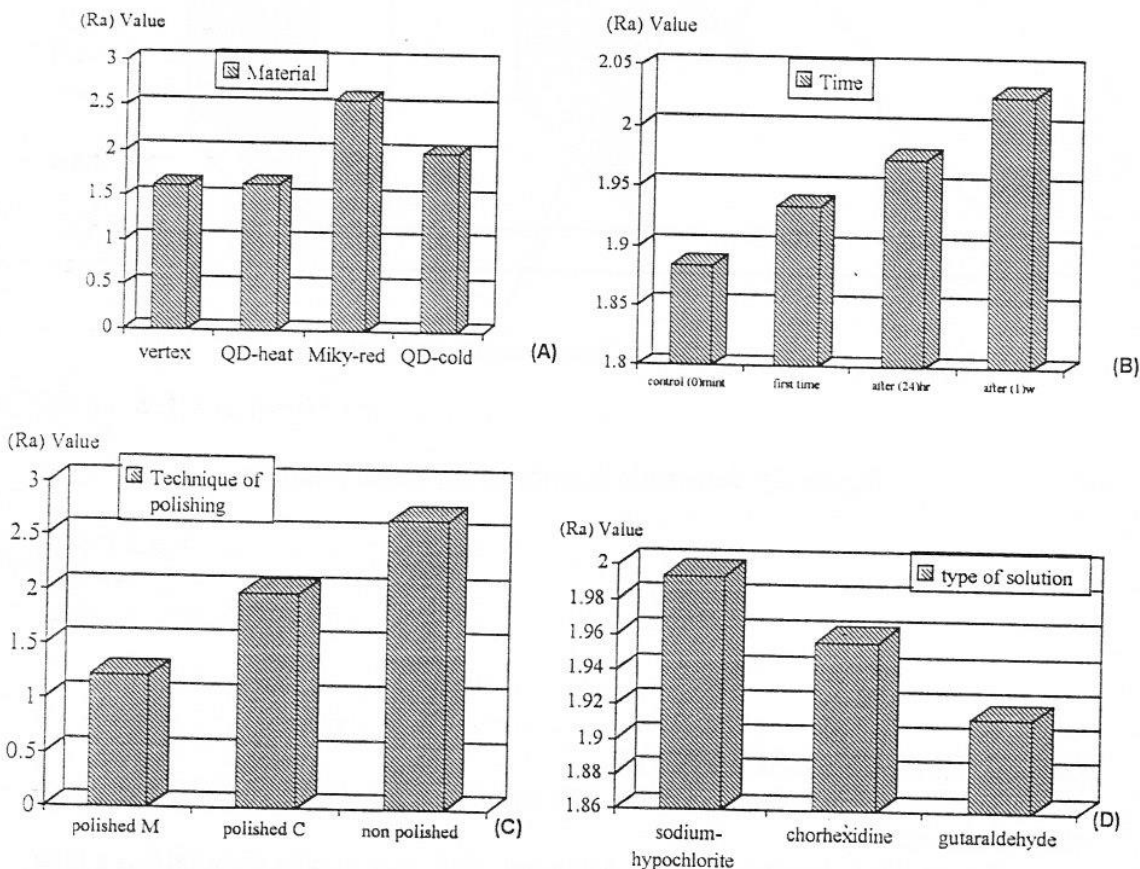


Figure (3): The relation of (Ra) values with:

- A. Materials.
- B. Time.
- C. Polishing technique
- D. Disinfectant solutions..

CONCLUSION

It was concluded that the smaller bead size of acrylic denture base materials that polished by a modification technique after curing have a less degree of surface roughness of acrylic plate even if such plate immersed in any type of disinfected solution (Chlorhexidine, Sodium – Hypochlorite or Glutaraldehyde) in a duration up to (7) days.

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