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

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Nadia H AL-KAZZAZ**

ABSTRACT

The aim of this study was to measure the effect of different immersion periods 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 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

لا بد من تقليل خشونة سطح المواد المصنوعة من الطبقات الأكريليكية للحصول على أقصى

التسامح حيني مع هذه المواد، استخدام في هذه الدراسة جهاز عبارة عن آلية مبرمجة لقياس طبيعة المقطع بدقة تصل إلى (0.1 μm) ، استخدم هذا الجهاز لقياس تأثير فترة العصر لمدة سبعة أيام في ثلاثة أنواع من المحاليل المطهرة على خشونة سطح المواد المصنوعة من مواد قاعدة الطبقات الأكريليكية . [Heat cure acrylic (Vertex, QD); Cold cure acrylic (Miky-red, QD)]

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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)

Prosthodontic 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 (4). 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 (5), 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 (1a): Acrylic denture base materials and auxiliary materials

<table>
<thead>
<tr>
<th>Product</th>
<th>Type</th>
<th>Manufacture</th>
<th>Class</th>
<th>Batch No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertex</td>
<td>Regular heat cure denture acrylic</td>
<td>Dentimex B.V.</td>
<td>Cl.I powder and liquid pink-</td>
<td>GH 294 p01</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>GH 273 Lo3</td>
</tr>
<tr>
<td>Quayle-Dental</td>
<td>Denture base material QD-heat cure denture acrylic</td>
<td>QUAYLE DENTAL LTD</td>
<td>Cl.I powder and liquid light-pink color</td>
<td>BS 2487</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BS 2487</td>
</tr>
<tr>
<td>Miky-RED</td>
<td>Extra fast self-curing acrylic</td>
<td>NISSIN DENTAL Products INC</td>
<td>Cl.II powder and liquid pink color</td>
<td>PPEM PGP</td>
</tr>
<tr>
<td>Quayle-Dental</td>
<td>Rapid repair material cold cure denture acrylic</td>
<td>QUAYLE DENTAL LTD</td>
<td>Cl.II powder and liquid pink color</td>
<td>BS 2487</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>BS 2487</td>
</tr>
<tr>
<td>Toughened-Pink</td>
<td>Modelling Wax</td>
<td>QUAYLE DENTAL LTD</td>
<td>Universal</td>
<td>022788</td>
</tr>
<tr>
<td>ZETA ZEUSOR</td>
<td>Gypsum</td>
<td>INDUSTRIA ZINGADI S.Y.I.</td>
<td>Cl. III stone</td>
<td>15067</td>
</tr>
<tr>
<td>GUARANT EED P.D. product</td>
<td>P.D. Separating film for Acrylic Resin</td>
<td>PRODUITS DENTAIRES S.A. VEVEY (SUISSE)</td>
<td>Pink color</td>
<td>806317</td>
</tr>
<tr>
<td>GRADE fine</td>
<td>Pumic</td>
<td>Whipmix CORPORATION</td>
<td>Cl. 125</td>
<td>03549</td>
</tr>
</tbody>
</table>

Table (1b): Disinfectant solutions

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

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*)

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*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 wetery 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 ± 1°C) 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, there fore 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.

** Conventional polishing technique.
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

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

Means with the same letter are not significantly different.
M: Modification technique of polishing.
C: Conventional technique of polishing.
h: 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.

REFERENCES


