The effect of different disinfectant solutions on the surface roughness of heat cure acrylic resin in comparison to visible light cure acrylic resin denture base

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ABSTRACT
Background: A new denture should be disinfected before delivery to the patient before and after adjustment procedures (4). Also, denture should be disinfected used may have harmful effect on the plastic or metal component of the denture (2), so the dentist must be able to recommend a denture cleanser that is effective, non-detrimental to denture material and safe for patient use (3,4,5). The aim of this study was to compare the effect of chlorhexidine and sodium hypochlorite as a disinfectant solutions on the surface roughness of different denture base material.

Materials and methods: Sixty specimens were made from two different denture base materials. Twenty specimen of hot cured acrylic denture base which divided into two subgroups. And twenty specimen of light cured acrylic denture base which divided into two subgroups. Then each material was immersed in 0.2% chlorhexidine and 0.525% sodium hypochlorite for 48 hours at (37°C) before being tested (ADA no.12,1999) (6). And then each specimen was measured by surface roughness test by using (profilometer device) to show the effect of each solution on the denture base roughness. In comparison to twenty specimen immersed in distilled water as control group of hot cured acrylic and light cured acrylic.

Results: The mean values of roughness change were analyzed and showed the specimens polymerized by water bath presented a smaller differences in roughness, while the largest difference in roughness were observed in specimens polymerized by light cure system. T-test for three disinfectant solutions were showed non significant difference among distilled water and chlorhexidine and sodium hypochlorite for both water bath and light curing method. The t-test between water bath and light cure were showed a significant difference in surface roughness when different solution has been used.

Conclusion: The result of this study indicated that the roughness of acrylic materials was not affected by immersion in any disinfectant solution this is due to the effect of glutaraldehyde base disinfectants (alkaline, phenol buffered) on surface morphology of denture base resin (7) and also the disinfectant solution was able to reduce the pathogenicity and colorization of micro organism present on the surface of the material, so the acrylic surface remain smooth and polished (8).

Keywords: Surface roughness, chlorhexidine, sodium hypochlorite, hot cured acrylic, light cured acrylic. (J Bagh Coll Dentistry 2011;23(4):31-35).

INTRODUCTION
Oral hygiene remains important even when some or all teeth have been replaced with removable denture (4). Cleaners and cleaning methods used may have harmful effect on the plastic or metal component of the denture (2). Acrylic plastic have been the most widely used and accepted among all denture base materials and it was estimated than they represent 95% of the plastics in prosthodontics (9,10). The roughness of materials might affect plaque formation or inhibit its removal, so it could therefore be assumed that abrasive denture cleaners creating suitable surface on the denture resin for plaque to accumulate and rest (11,12). The method of sterilization by immersing dentures leaves the surface roughness of the denture resin unchanged and therefore possibly less susceptible to plaque accumulation (13).

Ruel et al (14) showed that correctly cured resin was not whitened by alkaline peroxide denture cleaner when it was used as recommended by manufacturer.

Also he found that soaking in hot water or hot sodium hypochlorite solution caused severe whitening and affected the flexural strength of acrylic resin. The hardness and modulus of elasticity were significantly reduced when chlorhexidine acetate was incorporated with acrylic resin (15).

The autopolymerized heat and light cured acrylic resin demonstrated insignificant color shift with short and long term immersion in disinfection solution (16). While Buchalla et al (17) found that the resin based restoration material undergoes measurable changes in color due to day light exposure and increased changes occurred under the influence of water storage and also storage specimens showed a tendency to higher color differences than the dry storage specimens.

MATERIALS AND METHOD
Sixty specimens in a dimension of (60 mmx10mmx2.5mm+0.1mm) length, width and thickness according to ADA specification no.12, 1999. Were made from two different denture base materials, and then each material divided into three groups according to disinfectant solution each group consist from (20) specimens.
1. The first group (control group) consists from (20) specimens and then divided into two subgroups, each one consists from (10) specimens. The first one were made from heat cured acrylic and the other one were made from light cured acrylic, and then the two subgroups immersed in distilled water for (48) hours at (37°C) before being tested (ADA N0.12.1999) to be used as a control group in comparison with other groups immersed in different disinfectant solutions.

2. The second group consists from (20) specimens were constructed from heat activated polymethyl methacrylate (pyrax I50 9001:2000 certified company, England). Mixing of heat activated polymethyl methacrylate done according to the manufacturers instructions follow the ration 3:1 the dough stage was packing to the model which was filled the lower portion of the denture flask with freshly mixed dental stone (w/p ratio is 25 g/100gm) then the metal block was coated with the separating medium and placed over the stone mixture, after the stone was set the metal patterns were coated with separating media then the upper half of the flask was positioned on the top of the lower portion and filled with stone (the stone was allowed to be harden before the flask was opened). When stone was hardened the metal patterns were removed to be ready for packing with acrylic dough and then flasked under pressure 10 Ibs for 5 minutes. A short curing cycle used, the temperature brought to 74°C for 90 minutes, and then the temperature was raised to 100°C for additional 30 minutes, and then the flask allowed to cool slowly at room temperature for 30 minutes then immersed in water for 15 minutes after that the acrylic patterns were removed from the mould (figure 2).

3. The third group consists from (20) specimens was constructed from visible light cure material (palatray XL-Heraeus kulzer GMbH and co.KG, Germany).

The VLC was closely adapted by fingers to the model after painting the periphery with separating medium which is done from three layers of glass the first layer will be straight below the second layer which is contain a hole in the middle with a dimension (65mmx10mmx2.5mm+0.1mm) length, width and thickness (ADA N0.12.1999). And then the third layer also will be straight and all the three layers have four screw to make the sample fit, and then placed inside the polymerizing device (YETI dental. preci NT shuttle II preci NTshuttle IV) the curing cycle chosen way 470 nm wave length for 10 minutes (figure 3).

All the samples finished and polished by removing all flashes of acrylic with an acrylic bur, then the pink stone bur were used to get a smooth surface of the samples and followed by sandpaper of medium grit to remove any remaining small scratches then the polishing was done with bristle lathe brush (white stiff 360) and pumice by using lathe polishing machine. A glassy surface was obtained with wool brush and polishing soap on dental lathe using low speed (1500 rpm) and the specimens were continuously coated with water to avoid over heating, and then 2nd and 3rd group specimens divided into two subgroups each group consists from (10) specimens, the first one immersed in 0.2% chlorhexidine and the other one immersed in 0.525% sodium hypochlorite (20.5 ml of 6.4% sodium hypochlorite in 229.8 ml deionized water) for 48 hours at 37°C before being tested (ADA no.12,1999) figure(4).

The measurement, was done by using profilometer device (surface roughness test), was used in order to study the effect of the denture disinfectant solutions on the microgemetry of the test surface. In comparison with control group immersed in distilled water for both heat cured acrylic and light cured acrylic denture base materials (figure 5).

RESULTS

The assessment of surface roughness of PMMA specimens by different disinfectant solutions (chlorexidine, sodium hypochlorite, and distilled water) was measured by Profilometer device.

The mean value as roughness change were analyzed and showed the specimens Polymerized by water bath presented smaller differences in roughness, while the largest difference in roughness were observed in specimens Polymerized by Light cure system.

Increase in surface roughness was observed for 0.5% sodium hypochlorite in comparison to chlorexidine disinfectant solution as in table 1 & figure 1.

In table 2 T- test for three disinfectant solutions were showed non significant difference among distilled water and chlorexidine and sodium hypochlorite for both water bath and light curing method.

In table 3 the t- test between water bath and light cure were showed a significant difference in surface roughness when different solution have been used.
DISCUSSION

In this study, the light cure acrylic resin and heat cure acrylic resin were investigated with respect to the effect of disinfectant solutions on surface roughness. Light cure specimens were significantly more surface roughness than that specimens prepared by water bath this result is due to light cure specimens not kept under pressure during polymerization results in voids with in the material (19).

In addition to the absences of water during polymerization which Lead to the reduction in degree of conversion and create linear polymeric chains, more extensive surface degradation could be present (20).

The present study assumes the hypothesis that water used in polymerization could interfere with important physical properties such as surface roughness, porosity and color stability (21-23).

The result of this study indicated that the roughness of acrylic materials was not affected by immersion in any disinfectant solution this is due to the effect of gluteraldehyde base disinfectants (alkaline, phenol buffered) on surface morphology of denture base resin (7) and also the disinfectant solution was able to reduce the pathogenicity and colorization of micro organism present on the surface of the material, so the acrylic surface remain smooth and polished (8).

REFERENCES


Table 1: Mean and standard deviation of surface roughness for two groups (water bath & light cure) with different disinfectant

<table>
<thead>
<tr>
<th>Method of curing</th>
<th>No.</th>
<th>Chlorhexidine solution</th>
<th>Sodium hypochlorite solution</th>
<th>Distilled water solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light cure</td>
<td>30</td>
<td>0.168</td>
<td>0.175</td>
<td>0.022</td>
</tr>
<tr>
<td>Water bath</td>
<td>30</td>
<td>0.138</td>
<td>0.144</td>
<td>0.027</td>
</tr>
</tbody>
</table>

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Table 2: student t-test for three disinfectant solutions between the two curing method

<table>
<thead>
<tr>
<th>Disinfectant solution</th>
<th>Water Bath t-test</th>
<th>Water Bath p-value</th>
<th>Light cure t-test</th>
<th>Light cure p-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distilled water &amp; chlorehexidine</td>
<td>0.631</td>
<td>0.544</td>
<td>NS</td>
<td>1.343</td>
<td>0.212</td>
</tr>
<tr>
<td>Distilled water &amp; sodium hypo chlorite</td>
<td>1.452</td>
<td>0.180</td>
<td>NS</td>
<td>0.164</td>
<td>0.135</td>
</tr>
<tr>
<td>Chlorehexidine &amp; sodium hypo chlorite</td>
<td>1.125</td>
<td>0.290</td>
<td>NS</td>
<td>0.684</td>
<td>0.511</td>
</tr>
</tbody>
</table>

*P>0.05 Non Significant

Table 3: t-test between water bath & light cure with different disinfectant solution

<table>
<thead>
<tr>
<th>Disinfectant solution</th>
<th>t-test</th>
<th>P-value</th>
<th>Sig</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distilled water</td>
<td>2.579</td>
<td>0.30</td>
<td>S</td>
</tr>
<tr>
<td>Chlorehexidine</td>
<td>3.111</td>
<td>0.013</td>
<td>S</td>
</tr>
<tr>
<td>Sodium hypochlorite</td>
<td>2.342</td>
<td>0.044</td>
<td>S</td>
</tr>
</tbody>
</table>

*P<0.05 Significant

Figure 1: Roughness means of specimens polymerized by different curing method with different disinfectant solutions

Figure 2: The metal pattern inside the flask

Figure 3: The glass mould for light cure acrylic resin
Figure 4: The samples of heat cure and light cure Acrylic resin after finishing and ready to test

Figure 5: Profilometer device