Effect of silica coating on retention of acrylic complete dentures

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Abstract
Objective: To evaluate the effect of silica coating on retention of acrylic complete dentures.
Methodology: Edentulous maxillary model with resilient surface simulating oral mucosa was made. Twelve denture bases were fabricated for this model. The bases were divided into four groups which served as test samples. These bases were fixed to the model using silica nanoparticles, saliva and saliva substitutes. Retention of the bases were then tested using a pull force through an Instron.
Results: It was seen that the maximum amount of retentive force was with silica coating and artificial saliva - 10.6N and the minimum amount of retentive force was with natural saliva - 2.5N
Conclusion: Coating a denture base material with silica nanoparticles was effective in increasing the retention of the dentures compared to natural saliva.
Key words: Silica nanoparticles, Edentulous maxillary model, Natural saliva, Artificial Saliva, Instron

Introduction
Silica coating of dentures reduces the adherence of candida albicans species by making the surface of dentures smooth and regular and at the same time maintaining hydrophilicity. Silicone coating modifies hydrophobic denture base materials to have a hydrophilic surface because of surface hydroxyl groups of silica and which reduces biofilm development. Silica nanoparticles also increase interfacial adhesion between silica and resin matrix in dental nanocomposites thereby increasing the tensile strength. Silica nanoparticles are used to polish tooth surfaces which reduces the roughness, enhances removal of bacteria and prevent caries. It was decided to find out whether silica coating will affect the retention of complete dentures

Materials and Methods
Preparation of Model
A standard maxillary edentulous cast was selected and a silicone putty mould was prepared over it. Molten modelling wax was poured into the mould to form a coating of 2mm thickness. The wax coating was limited to the sulcular area and the excess was taken off. Five retention cylinders were attached to the wax surface. The wax portion was reseated into the mould and the rest of the mould was filled with auto-polymerising acrylic resin. The acrylic cast with wax surface was flanked in a conventional denture flask. After dewaxing the surface was filled with room temperature vulcanising silicone.

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By this process maxillary cast with soft tissue simulating surface was made.

Preparation of the bases
Edentulous maxillary model with resilient surface simulating mucosa was made (fig.1). This model was duplicated and twelve casts were poured (fig.2). Twelve denture bases were fabricated on these casts with heat cured acrylic resin (fig.3). An acrylic bar of length 5 cm was made. A hole of diameter 5 mm was made on that to engage the retentive hooks of the Instron (Instron corpo, model 1341) (fig.4). These were attached to the mid portion of the polished surfaces of all the denture bases. A similar extension was prepared on the maxillary model and was attached to the mid portion of the acrylic model. The bases were divided into four groups as shown in Table no 1.

Method of application of saliva or saliva substitutes
The saliva stimulated with the help of chewing gum was collected in a container and applied onto the denture base with the painting brush for 30 seconds. In a similar way artificial saliva (Sodium carboxy methyl cellulose-10g/1l) collected from a laboratory in a

<table>
<thead>
<tr>
<th>Group</th>
<th>Silica coating</th>
<th>Intervening media</th>
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<tbody>
<tr>
<td>1</td>
<td>Coated</td>
<td>Natural saliva</td>
</tr>
<tr>
<td>2</td>
<td>Coated</td>
<td>Artificial saliva</td>
</tr>
<tr>
<td>3</td>
<td>Uncoated</td>
<td>Natural saliva</td>
</tr>
<tr>
<td>4</td>
<td>Uncoated</td>
<td>Artificial saliva</td>
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</tbody>
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<table>
<thead>
<tr>
<th></th>
<th>Sample 1</th>
<th>Sample 2</th>
<th>Sample 3</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural saliva</td>
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<td>2.9</td>
<td>2.5</td>
<td>2.5</td>
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<tr>
<td>Artificial saliva</td>
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<td>3.9</td>
<td>2.8</td>
<td>3.3</td>
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<td>5.5</td>
<td>6.8</td>
<td>6.1</td>
</tr>
<tr>
<td>Silica coating and Artificial saliva</td>
<td>10.6</td>
<td>11.1</td>
<td>10.2</td>
<td>10.6</td>
</tr>
</tbody>
</table>
container is applied onto the denture base for the same duration. (Fig 5)

**Method of silica coating**

Silicon Dioxide nanoparticles (Sigma Aldrich) was mixed in ethanol in a proportion of 2:1 by volume. This was applied onto the denture bases for thirty seconds with a painting brush. (Fig 6,7)

**Testing of Retention**

The saliva component was applied on to the simulated maxillary model. The Silica coating was applied on to the denture bases. The denture bases were then held firmly with finger pressure onto the maxillary model. Retention of the denture bases for all the groups were tested using a pull force through an Instron at a crosshead speed of 10mm/min (Instron corpo, model 1341) (Fig 8).

**Results :**

It was seen that retentive force with Natural saliva was 2.5N ,with artificial saliva it was 3.3N, with silica coating and natural saliva it was 6.1N and with silica coating and artificial saliva it was 10.6N

**Discussion:**

Coating denture base with silica nano particles was effective in reducing the adherence of candida albicans to the dentures. The solvent ethanol dissolves the surface of the Polymethyl methacrylate and the silica nanoparticles go and adhere there and this could be a factor for the decrease of surface roughness. Silica coating modifies hydrophobic denture base materials to have a hydrophilic surface because surface hydroxyl groups of silica makes it hydrophilic which reduces biofilm development.

**Conclusion:**

It was concluded that coating a denture base material with silica nano particles did not affect the retention of the denture bases but in turn enhanced the retention.

**References**