Evaluation of Physical Properties of Tissue Conditioning Materials as used in Functional Impression - A Lab Study

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ABSTRACT

Background: The purpose of this study was to identify the basic physical properties of 3 commonly available tissue-conditioning materials to gain knowledge for their clinical use as impression materials.

Materials & Methods: A total of 60 samples were prepared and each sample was mixed and prepared according to manufacture direction. Finally five specimens of each tissue conditioners were subjected for each of the above test at different time duration.

Results & Conclusion: The study showed that all the materials underwent water loss from the time of mixing to 24 hr & became hard. The plasticity of coecomfort & viscogel decreased from the time of mixing upto 1hr & 2hr respectively & again increased after that till 24 hrs, but the softone showed decreased plasticity after 30 min till 24hrs.

Softone & coecomfort at 30 min showed better flow & more plasticity than that of viscogel. The dimensional accuracy of softone & viscogel at 30min is better than that of coecomfort.

Thus softone at 30 min after mixing has better Dimensional accuracy, Plasticity and Flow; suitable for making functional impression then that of Coe-comfort and Viscogel.

Key Words: Hardness, Water loss, Strain under compression, Dimensional accuracy, Flow, Plasticity.


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Introduction

Tissue conditioning material is a soft resilient temporary reliner, which rehabilitates unhealthy tissue to normal by reducing and evenly distributing stresses on the mucosa of the basal seat.¹

According to Wilson, Touline & Osborne [1969], for tissue healing, the material should remain soft, have a high elastic recovery with little flow to function as a protective cushion.²

On the contrary Mc Carthy & Moser (1978) suggested that the material should remain more plastic with a continuous flow under pressure so that all forces are equally spread over the healing mucosa.³ However various authors stressed that the material should be plastic at first to adapt to the changing mucosa and then after an initial
healing period, they should be more elastic and act as a cushion.²
For functional impression, the material with a considerable flow is required and the material should be stable without elastic recovery once a form is taken. The chemical composition of these materials is a polyethylmethacrylate (or copolymer) powder that is softened on mixing with liquid to form a gel containing ethyl alcohol and aromatic esters⁴ without undergoing cross linking reaction. The gel acts as a viscoleastic medium, flowing under a steady load and serving as a resilient cushion under dentures. This property is needed to reduce the stresses borne by the underlying unhealthy tissues.

Materials & Methods
The present in vitro study was conducted in Department of prosthodontics and Crown and bridges, K.L.E.S’s institute of dental sciences, Belgaum with the help of Central Institute for plastic engineering and testing, Hebbal, Mysore and K.L.E.S; s Engineering College, Belgaum.

Material used Trade name
1. Coe-comfort- GC Company
2. Viscogel -Dentsply Company
3. Softone- Bosworth Company

Methods conducted
The tissue conditioner were subjected to four physical properties, such as
a. Hardness
b. Weight loss
c. Strain in compression
d. Dimensional accuracy

A total of 60 samples were prepared and each sample was mixed and prepared according to manufacture direction.⁴ Finally five specimens of each tissue conditioners were subjected for each of the above test at different time duration.
The Tissue conditioning material are mixed according manufacture recommendation ie Co-Comfort 2.2 gm of powder to 1.8 gm of liquid for 30-60 sec, Softone one plastic vial of powder to one
Physical Properties of Tissue Conditioners…Shylesh K B S et al

Hardness Test

**Mould fabrication**
Metal specimen of 65 mm length, 10 mm width and 2.5 mm thick were prepared according to ADA specification no 12 and invested with type III dental stone.(fig;1)

**Test:**
The hardness test values is obtained using Shore-A-Durometer (fig;3) & readings taken at 15, 30, 60 min, 1, 2, & 24 hr intervals from the start of mix.

Test for Weight loss

**Mould fabrication**
Metal disc specimen of 50 mm diameter and 0.5 mm thickness were prepared in the stainless steel die according to ADA specification NO 12.(fig;1)

**Test:**
The values for weight loss obtained using a Metler balance (fig; 4) at 15 min, 30 min, 1 hr, 2 hrs and 24 hrs intervals.

Test for Dimensional accuracy

**Standard die mould fabrication**
A metal test block dimension 31mm X 31mm was constructed with grooves as Per the ADA specification No 19. (Fig;1)

**Test:**
An impression of the die was made to be in contact with test block for 15 min, 30 min, 60 min, 2 hr and 24 hr from the start of mix & poured with dental stone. The distance between the two F lines on the cast is obtained by measuring with the help of a traveling microscope(fig;6). The formula used to calculate distance is as follows,
Table 1: p value for 30 minutes and 60 minutes for Coe comfort, Viscogel & Softone in hardness test.

<table>
<thead>
<tr>
<th>Duration</th>
<th>P value for 30 min</th>
<th></th>
<th>P value for 60 min</th>
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<tbody>
<tr>
<td></td>
<td>P value</td>
<td>Inf</td>
<td>P value</td>
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<tr>
<td></td>
<td>CC</td>
<td>VG</td>
<td>ST</td>
<td>CC</td>
</tr>
<tr>
<td>15m</td>
<td>0.8794</td>
<td>0.0910</td>
<td>0.3613</td>
<td>NS</td>
</tr>
<tr>
<td>30m</td>
<td>0.2317</td>
<td>0.1202</td>
<td>0.4430</td>
<td>NS</td>
</tr>
<tr>
<td>60m</td>
<td>0.2838</td>
<td>0.2106</td>
<td>0.6394</td>
<td>NS</td>
</tr>
<tr>
<td>24h</td>
<td>0.0166</td>
<td>0.7397</td>
<td>0.0363</td>
<td>S</td>
</tr>
</tbody>
</table>

Table 2: p value for 30 minutes and 60 minutes for Coe-comfort, Viscogel & Softone in weight loss.

<table>
<thead>
<tr>
<th>Duration</th>
<th>P value for 30 min</th>
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<th>P value for 60 min</th>
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<td></td>
<td>CC</td>
<td>VG</td>
<td>ST</td>
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<tr>
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<td>0.3613</td>
<td>0.9027</td>
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<tr>
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<tr>
<td>2h</td>
<td>0.0363</td>
<td>0.7153</td>
<td>0.4864</td>
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</table>

TR = MSR + CVD X LC
TR = Total reading.
MSR = Main scale reading.
CVD = Coincide Vernier Division.
LC = Least Count.

This same distance was measured on the metal die by using traveling microscope for determining the change in dimensions.

**Strain Under Compression**

**Standard die mould fabrication**

A cylindrical stainless steel mould of dimension 12.5 mm inside diameter and 19mm height was prepared according to ADA specification No 19.(fig;1)

**Test:**

The material is subjected to compressive force of 200 gm / cm² for 30 sec for two times with an interval of 10 sec using universal testing machine(fig;5) Two readings ie A (first load) & B (second load) recorded.

Percentage of Strain: (A-B / 19) x 100
Where (19.0 mm) being considered as the original length of the specimen.

**Results of material**

Table 1: Shows the p value at 30 and 60 min of coecomfort, viscogel, & softone for hardness test.

Table 2: Shows the p value at 30 and 60 min of coecomfort, viscogel, & softone for weight loss.

Table 3: Shows the p value for 30 and 60 min of coecomfort, viscogel, & softone for strain under compression.
Table 3: p value for 30 minutes and 60 minutes for Coe-comfort, Viscogel & Softone in strain under compression.

<table>
<thead>
<tr>
<th>Duration</th>
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<td>P value</td>
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<tr>
<td></td>
<td>CC    VG    ST</td>
<td></td>
<td>CC    VG    ST</td>
<td></td>
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<tr>
<td>15m</td>
<td>0.7740 0.8124 0.1075</td>
<td>NS NS NS</td>
<td>0.8405 0.6906 0.2602</td>
<td>NS NS NS</td>
</tr>
<tr>
<td>30m</td>
<td></td>
<td></td>
<td>0.5502 0.9363 0.7010</td>
<td>NS NS NS</td>
</tr>
<tr>
<td>60m</td>
<td>0.5502 0.9363 0.7010</td>
<td>NS NS NS</td>
<td>0.8317 0.2684 0.8607</td>
<td>NS NS NS</td>
</tr>
<tr>
<td>2h</td>
<td>0.4832 0.3825 0.5439</td>
<td>NS NS NS</td>
<td>0.1653 0.0178 0.4955</td>
<td>NS S NS</td>
</tr>
<tr>
<td>24h</td>
<td>0.4446 0.0246 0.2640</td>
<td>NS S S NS</td>
<td>0.8405 0.6906 0.2602</td>
<td>NS NS NS</td>
</tr>
</tbody>
</table>

Table 4: p value for 30 minutes and 60 minutes for Coe-comfort, Viscogel & Softone in Dimensional accuracy.

<table>
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<tr>
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<tbody>
<tr>
<td></td>
<td>P value</td>
<td>Inf</td>
<td>P value</td>
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<tr>
<td></td>
<td>CC    VG    ST</td>
<td></td>
<td>CC    VG    ST</td>
<td></td>
</tr>
<tr>
<td>15m</td>
<td>0.0472 0.0208 0.0208</td>
<td>S S S</td>
<td>0.0274 0.7732 0.0002</td>
<td>S NS HS</td>
</tr>
<tr>
<td>30m</td>
<td></td>
<td></td>
<td>0.0013 0.1145 0.005</td>
<td>VS NS HS</td>
</tr>
<tr>
<td>60m</td>
<td>0.0031 0.0114 0.0005</td>
<td>NS NS HS</td>
<td>0.2066 0.0470 0.001</td>
<td>NS S HS</td>
</tr>
<tr>
<td>2h</td>
<td>0.0841 0.4877 0.0100</td>
<td>NS NS S</td>
<td>0.2066 0.0470 0.001</td>
<td>NS S HS</td>
</tr>
<tr>
<td>24h</td>
<td>0.2399 0.5915 0.1229</td>
<td>NS NS NS</td>
<td>0.006 1.4E-07 0.001</td>
<td>HS HS HS</td>
</tr>
</tbody>
</table>

Table 4: Shows the p value for 30 and 60 min of for coecomfort, viscogel, & softone for dimensional accuracy.

Discussion

1. Hardness test

The table 1 & graph 1 shows the hardness value at 30 min of Coe-comfort, Viscogel, & Softone are in agreement with the study of McCarth and J. B. Moser who stated that for a material to behave like functional impression, it should flow readily to attain maximum adaptation.2,3 Sheldon Winkler also stated that the tissue conditioner should have Shore-A Durometer hardness of approximately 20-25 units.5

The initial decrease and again increase in hardness value of table 2 and 3 is in accordance with McCarth and J. B. Moser. (1978) who stated...
that initial increase in hardness is due to loss of ethanol exceeding the water adsorption of the material. Then a degree of softening occurs as water adsorption increased. Again hardness increases as plasticizer are continuously leached to saliva.3

2. Weight Loss

Table 2 & graph 2 shows gradual decrease in weight loss of all the three materials between 15 m, 30m, 60m, 2 hr and 24 hrs interval. The weight loss at 30 min of Coe comfort, Viscogel & Softone has corresponding lesser hardness value than other time intervals. This is in agreement with study of McCarthy and Moser who stated that the plastic properties are gradually lost and the material exhibits the more elastic nature due to ethanol loss water adsorption and loss of plasticizer.3

Strain under Compression

The Strain under compression of Coe-comfort (Table 3 & graph 3), viscosgel (Table 8 & graph 3), Softone (Table 9 & graph 3) at various intervals shows the Strain under compression at 30 min (0.85263mm) is higher than that of 15min, 60 min, and 2 hr. It also corresponds to lesser hardness value of as compared to other time intervals. Hence at 30 min after mixing the Coe-comfort, viscogel & softone has sufficient flow and less elastic recovery to make an impression.4 Although the Strain under compression at other intervals of Coe- Comfort, Viscogel & Softone are higher but has correspondingly more hardness value which is unfavourable for functional impression.

According to Wilson et al (1969), Alan Harrison (1981)2,6, & B.Demot, M. Declercq,2 functionl impression materials should have more flow less recovery at a shorter period (be plastic) & cast has
to be poured immediately after the impression because of the rigid recovery of this materials.\textsuperscript{2,6} B. Demot, M. Declercq, stated that Viscogel would be more suitable for a functional impression because of its larger flow and smaller elastic recovery during shorter ageing times. He also said that the cast must be poured immediately to avoid deformation and fading of impression details.\textsuperscript{2}

B. S. Graham & D. W. Jones et al stated that Dynamic flow in the material is necessary in the early stages of impression process to allow the material to adapt closely to the supporting tissue. The material should then have a well-defined final setting stage, so that it becomes sufficiently rigid and elastic to resist permanent distortion when the impressions are removed.\textsuperscript{7}

Hirosi Murata et al (1998) stated that Softone and Shofu tissue conditioner materials would be more suitable for functional impression making because of its larger flow at the initial stage and its higher rate of reduction of the flow properties with time.\textsuperscript{8}

**Dimensional Accuracy**

The standard steel test block measured with travelling microscope was found to be 25 m. Dimensional changes of Coe-comfort (Table 10 and graph 2), Viscogel (Table 11 and graph 4), Softone (Table 12 and Graph 4) over period ranging from 15 min, 30 min, 60 min, 2 hr, and 24 hrs recorded with travelling microscope.

The Dimensional change at 30 min of coe-comfort, Viscogel, & softone shows a lesser value than the other intervals. This also corresponds to lesser hardness value and more strain under compression than the other intervals seen in table 1, 2, 3 and table 7, 8, 9 respectively. Thus the Coe-comfort, Viscogel & Softone at 30 min has better dimensional accuracy, flow and less elasticity (i.e. more plasticity) to make a functional impression. The Dimensional accuracy of Viscogel is better than Coe-comfort. This is in agreement with Mahmoud Khams Abdel Razek (1979).\textsuperscript{9} Hence Viscogel at 30min and 60 min after mixing can be used as a functional impression material.

In general, the material to behave like functional impression, it should initially exhibit characteristics similar to those of a tissue conditioner i.e. early flow followed by a degree of plasticity. Thus at 30 min after mixing, the Coe-comfort, Viscogel and Softone have good flow, Plasticity and better Dimensional accuracy suitable for functional impression than that of other intervals,\textsuperscript{1,3}

**Conclusion**

The study showed that all the materials underwent water loss from the time of mixing to 24 hr & became hard. The plasticity of coecomfort & viscogel decreased from the time of mixing upto 1hr & 2hr respectively & again increased after that till 24 hrs, but the softone showed decreased plasticity after 30 min till 24hrs.

Softone & coecomfort at 30 min showed better flow & more plasticity than that of viscogel. The dimensional accuracy of softone & viscogel at 30min is better than that of coecomfort.

Thus softone at 30 min after mixing has better Dimensional accuracy, Plasticity and Flow; suitable for making functional impression then that of Coe-comfort and Viscogel.

**Clinical Significance**

Tissue conditioners are widely used for the conditioning of tissues and functional impression. There is little known about the time to be left in the mouth for taking the impression. The effective result of the impression is obtained if it is left for 30 min in the mouth beyond which the material loses its properties with poor result.
References: