ORIGINAL RESEARCH

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 esters[4] 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

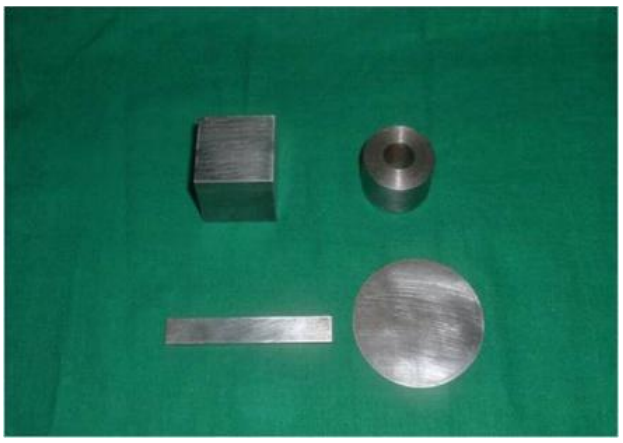


Fig. 1: Metal moulds used.

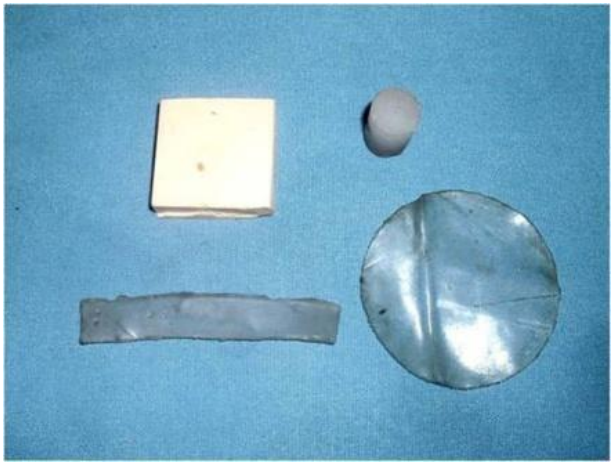


Fig. 2: Specimens obtained from metal moulds.

Fig. 3: Shore-A-Durometer

glass vial of liquid for 30 sec and Viscogel 3gm of powder to 2.2ml of liquid for 30 sec.

Fig. 4: Metler Balance

Fig. 5: Instron testing machine

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, 60min, 1, 2, & 24hr 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 15min, 30 min, 1 hr, 2 hrs and 24 hrs intervals.

Fig. 6: Travellon Microscope

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.

Duration	P value for 30 min						P value for 60 min					
	P value			Inf			P value			Inf		
	CC	VG	ST	CC	VG	ST	CC	VG	ST	CC	VG	ST
15m	0.8794	0.0910	0.3613	NS	NS	NS	0.1323	0.0168	0.2102	NS	S	NS
30m							0.2317	0.1202	0.4430	NS	NS	NS
60m	0.2317	0.1202	0.4430	NS	NS	NS						
2h	0.2838	0.2106	0.6394	NS	NS	NS	0.8779	0.6917	0.7245	NS	NS	NS
24h	0.0166	0.7397	0.0363	S	NS	S		0.1529	0.0190		NS	S

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

Duration	P value for 30 min						P value for 60 min					
	P value			Inf			P value			Inf		
	CC	VG	ST	CC	VG	ST	CC	VG	ST	CC	VG	ST
15m	0.3613	0.9027	0.7561	NS	NS	NS	0.2102	0.8425	0.6638	NS	NS	NS
30m							0.4430	0.9397	0.9004	NS	NS	NS
60m	0.4430	0.9397	0.9004	NS	NS	NS						
2h	0.6394	0.8667	0.7221	NS	NS	NS	0.7245	0.9262	0.8195	NS	NS	NS
24h	0.0363	0.7153	0.4864	S	NS	NS	0.0190	0.7702	0.5727	S	NS	NS

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 / cm^2 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.

Duration	P value for 30 min						P value for 60 min					
	P value			Inf			P value			Inf		
	CC	VG	ST	CC	VG	ST	CC	VG	ST	CC	VG	ST
15m	0.7740	0.8124	0.1075	NS	NS	NS	0.8405	0.6906	0.2602	NS	NS	NS
30m							0.5502	0.9363	0.7010	NS	NS	NS
60m	0.5502	0.9363	0.7010	NS	NS	NS						
2h	0.4832	0.3825	0.5439	NS	NS	NS	0.8317	0.2684	0.8607	NS	NS	NS
24h	0.4446	0.0246	0.2640	NS	S	NS	0.1653	0.0178	0.4955	NS	S	NS

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

Duration	P value for 30 min						P value for 60 min					
	P value			Inf			P value			Inf		
	CC	VG	ST	CC	VG	ST	CC	VG	ST	CC	VG	ST
15m	0.0472	0.0208	0.0208	S	S	S	0.0274	0.7732	0.0002	S	NS	HS
30m							0.0013	0.1145	0.005	VS	NS	HS
60m	0.0031	0.01145	0.0005	NS	NS	HS						
2h	0.0841	0.4877	0.0100	NS	NS	S	0.2066	0.0470	0.001	NS	S	HS
24h	0.2399	0.5915	0.1229	NS	NS	NS	0.006	1.4E-07	0.001	HS	HS	HS

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

Graph I: Shows mean values of Coecomfort, viscogel and softone for hardness obtained at 15 min, 30 min, 60 min, 2 hr and 24 hr.

Graph II: Shows mean values of Coe-comfort, Viscogel and Softone for weight loss obtained at 15 min, 30 min, 60 min, 2 hr and 24 hr.

Graph III: Shows mean values of Coe-comfort, Viscogel and Softone for strain under compression obtained at 15 min, 30 min, 60 min, 2 hr and 24 hr.

Graph IV: Shows mean values of Coe-comfort Viscogel and Softone for dimensional accuracy obtained at 15 min, 30 min, 60 min, 2 hr and 24 hr.

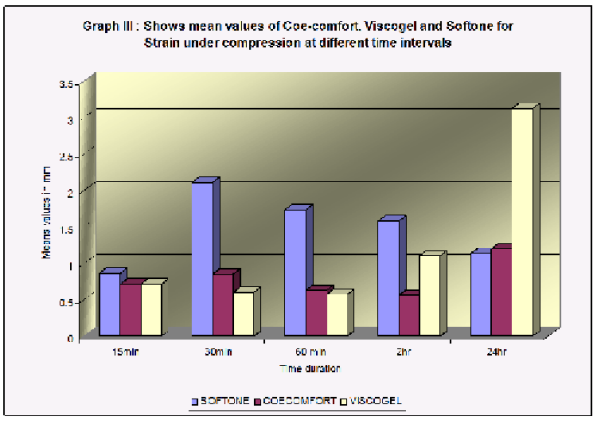
Discussion

1. *Hardness test*

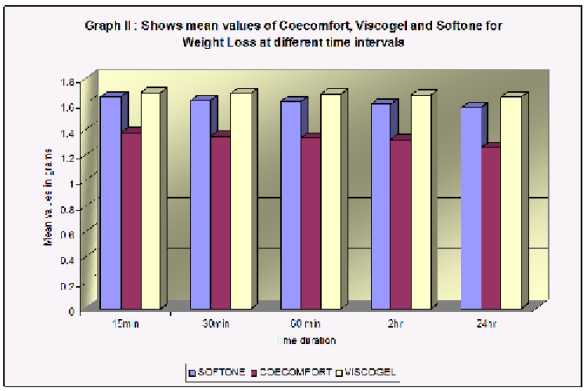
The table 1 & graph 1 shows the hardness value at 30 min of Coe-comfort, Viscogel, & Softone are in agreement with the study of Mc Carthy and J. B. Moser who stated that for a material to behave like functional impression, it should flow readily to attain maximum adaptation. [2-3]

Sheldon Winkler also stated that the tissue conditioner should have Shore-A Durometer hardness of approximately 20-25 units. [5]

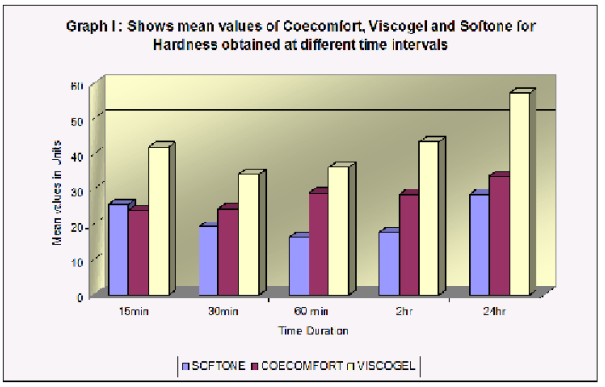
The initial decrease and again increase in hardness value of table 2 and 3 is in accordance with Mc Carthy and J. B. Moser. (1978) who stated



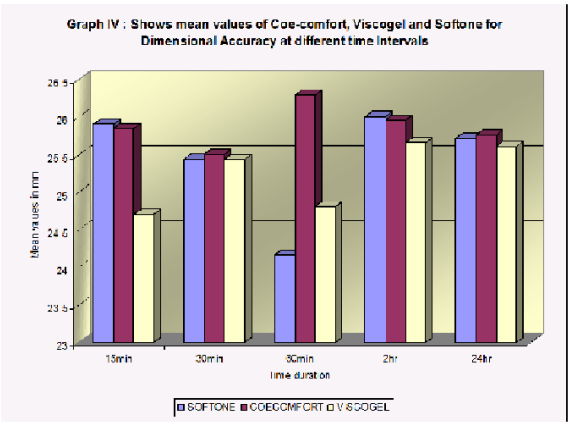
Graph 1: Showing Hardness Test



Graph 2: Showing Weight Loss



Graph 3: Showing Strain under Compression



Graph 4: Showing Dimensional Accuracy

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), viscogel (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.[6] 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.[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.[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. [7]

Hiroshi 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.[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. [6, 7]

The Dimensional accuracy of Viscogel is better than Coe-comfort. This is in agreement with Mahmoud Khamis Abdel Razek (1979).[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. [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:

1. BS Graham, DW Jones, EJ Sutow. Clinical implication of resilient dentures lining materials research, Part II Gelation and flow properties of tissue conditioners .J Prosthet Dent. 1991;65(3):413-8.
2. B De Mot, M De Clecq, P Rousseeuw. Viscoelastic properties of four currently used tissue conditioners. J Oral Rehabil. 1984;11(5):419-27.
3. JA McCarthy, JB Moser. Mechanical properties of tissue conditioners Part Theoretical considerations, behavioral characteristics and tensile properties. J Prosthet Dent. 1978;40(1):89-97.
4. Zvi- Yoeli, Miller V, Zeltser C. Consistency and softness of softness. J Prosthet Dent. 1996;75(4):412-8.
5. Sheldon Winkler. Essentials of complete denture prosthodontics : The use of Resilient denture liners: 427-32.
6. Alan Harison. Temperory soft lining materials. A review of their uses. British dental Journal 1981 ; 151-419.
7. BS Graham, DW Jones, EJ Sutow. Clinical implications of resilient denture lining materials research Part I ; Flexibility and elasticity. J Prosthet Dent. 1989;62(4):421-8.
8. Hiroshi M, Hamada T, Eha Djulaeha, Hiroki Nikawa. Rheology of tissue conditioners. J.P.D. 1998; 79: 188-99.
9. Mahmoud K, Abdel R. Assessment of tissue conditioning materials for functional impressions. J.P.D. 1979; 42(4) : 376-80.