

Evaluation of the Effect of a Tissue Conditioner on Surface Roughness of Dental Stone

Firouz, F.* Vafaei, F.* Heidari, B.* Soufiabadi, S.** Saleh, A.** Ansari, A.***
Khazaei, S.**

*Assistant Professor, Dept. of Prosthodontics, Dental Faculty, Hamadan University of Medical Sciences, Hamadan, Iran.

** Post-graduate Student, Dept. of Prosthodontics, Dental Faculty, Hamadan University of Medical Sciences, Hamadan, Iran.

*** Dentist, Private Practice, Hamadan, Iran.

ABSTRACT

Statement of the Problem: Although the primary use of tissue conditioners is to treat abused mucosa, these materials are also frequently used as functional impression materials. Insufficient information is available on the effect of these materials on the surface of dental stone casts.

Purpose: This study evaluated the effect of a tissue conditioner (Acrosoft) on surface roughness of dental stone.

Material and Methods: A tissue conditioner, Acrosoft (Marlic Medical Industries Co., Iran) was evaluated. One impression material (Impregum) was used as control. Ten specimens of Impregum and 20 specimens of Acrosoft, stored in water bath for 24 hours (n=10) and 48 hours (n=10), were prepared. Ring and stone molds, specified in ISO specification 4823 and ADA specification 19, were used in this study. Then, the stone mold was adapted on the ring, and the dental stone (Velmix) was mixed, poured over the top of each specimen and allowed to remain for 60 minutes. Mean surface roughness (Ra) values of dental stone casts made from the tissue conditioner were determined using a profilometer. Ra values were compared with one-way and two-way ANOVA and Tukey test.

Results: The results indicated that the surface roughness values significantly increased with the Acrosoft compared to that with Imperium (P=0.000). Duration of immersion in water had no significant effect on the surface roughness of stone casts (P=0.54).

Conclusion: Acrosoft cannot be used as a functional impression material because it is not compatible with dental stone.

Keywords: Acrosoft, Surface roughness, Coe Comfort.

INTRODUCTION

Tissue conditioners have been found to be effective in patients wearing complete dentures and are used for several purposes, including the conditioning of denture-bearing mucosa abused by ill-fitting dentures prior to fabricating new dentures,

Corresponding Author: S. Khazaei Address: Dept. of Prosthodontics, Dental Faculty, Hamadan University of Medical Sciences, Hamadan, Iran.
[Tel:09187048221](tel:09187048221) E-mail:sarakhazaei_83@yahoo.com

relining of ill-fitting dentures, temporary relining of immediate dentures and ill-fitting dentures and for taking functional impressions.⁽¹⁻⁴⁾ Their efficacy as functional impression materials is influenced by rheological properties, dimensional stability, ability to reproduce details and undercuts, durability and compatibility with dental stone.⁽⁴⁻¹¹⁾

Tissue conditioners are generally provided as a separate powder and liquid, which are

mixed and applied to the internal surface of denture clinically. The powder usually consists of poly (ethyl methacrylate) or a related copolymer, while the liquid is an ester plasticizer mixture, such as dibutyl phthalate, butyl phthalyl butyl glycolate, butyl benzyl phthalate or dibutyl sebacate, and 4–50 wt% of ethyl alcohol.^(12,13) The powder component has no initiator and the liquid has no monomer; thus, mixing results in the dissolution of polymers into a solvent, followed by polymer chain entanglement and formation of a gel.^(12–14) Initially, the materials present viscoelastic behavior suitable for tissue conditioning and functional impression taking. However, over time tissue conditioners undergo a marked loss of initial viscoelastic properties,^(5,6,15,16) dimensional changes^(4,7,8) and reduction of detail reproduction^(7,17) due to the washing out of the plasticizer and alcohol components,^(13,18) as well as due to the absorption of water into the materials.⁽⁸⁾ During clinical application, temporary liners are immersed in saliva, and out of the mouth, dentures are placed in water or water-soluble cleansers. As a result, plasticizers and ethanol components are leached out; in addition, saliva and water are absorbed.⁽¹⁹⁾ These reactions can affect the physical properties of tissue conditioners. To predict the clinical behavior of tissue conditioners, the amount of absorbed water and dissolved components should be evaluated within the

same time period of exposure in the oral cavity.⁽²⁰⁾

To assess the physical properties of tissue conditioners used as functional impression materials, it is also necessary to determine the changes in surface roughness of the materials over time and the compatibility with dental stones in addition to the previously mentioned properties. Several studies have evaluated the surface roughness of various tissue conditioners and dental casts made from them and also the effect of different factors on this property.

Murata et al⁽²¹⁾ examined surface roughness of three tissue conditioners and their compatibility with 4 dental stones at baseline and 1-, 3-, 7- and 14-day intervals. They concluded that the surface roughness of dental stone casts formed from tissue conditioners increased significantly with an increase in immersion time of tissue conditioners. In addition, the tissue conditioner type was found to have a major influence on the surface quality of dental stone casts from tissue conditioners. In contrast, the type of dental stone was of less important.

Nili and Porbaferani compared the surface roughness of dental stone with three types of tissue conditioner impression materials over time. The results showed that surface roughness of Acrosoft in different storage times did not change significantly and there were no significant differences between Acrosoft and the control group. Viscogel's

surface roughness was significantly different from all the other groups at baseline; with an increase in storage time the surface roughness decreased.⁽²²⁾

Hong et al⁽²³⁾ conducted a study on the influence of storage methods on the surface roughness of tissue conditioners. It was found that the materials stored in air were the most stable. In addition, tissue conditioners produced smooth surfaces with minimal changes in surface roughness with time when stored in air compared to storage in distilled water and denture cleanser.

Khaledi et al⁽²⁴⁾ evaluated the effect of disinfectants on dimensional stability and surface roughness of a tissue conditioner. There were no significant differences between the various methods and disinfectants.

The aim of the present study was to evaluate the effect of a tissue conditioner, Acrosoft, on surface roughness of dental stone. It was hypothesized that the surface quality of dental stone casts was negatively influenced by tissue conditioners.

MATERIALS AND METHODS

In this study the effect of a tissue conditioner, Acrosoft (Marlic Medical Industries co Iran), was evaluated on surface roughness of dental stone. One

elastomeric impression material (Impregum, 3M, and USA) was used as a control (Figures 1 and 2).



Figure 1. Acrosoft

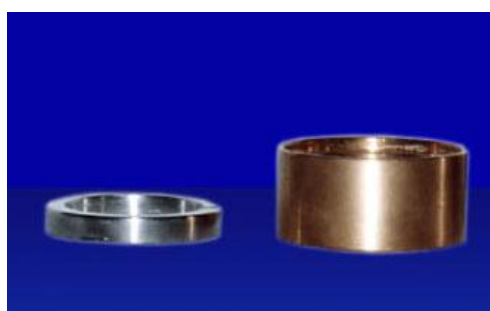


Figure 2. Impregum

The method used for measuring surface roughness values of the dental stone casts from the tissue conditioners has been previously reported.⁽²¹⁾ The ring and the plaster mold designed by ADA in the Instructions No. (19) 10 and the international standards are used. Gypsum mold is a hollow brass cylinder with a height of 20 mm and other dimensions are completely consistent with the ring (Figure 3).

Figure 3. Ring and plaster mold

Using the ring, disk-shaped specimens with a diameter of 30 mm were prepared from Impregum and Acrosoft. The powder and fluid required to prepare each specimen of Acrosoft were 3.2 mg and 2.5 mL,



respectively, and were mixed according to manufacturer's recommendations. The mixture was poured into the ring placed on a glass slab until slightly overfilled; another slab was immediately centered above the ring and pressed down onto the mass of the tissue conditioner to eject excess. Thus, 20 specimens of Acrosoft were prepared and divided into two groups (n=10). The specimens were transferred to a water bath at 37°C, one group for 24 hours and another group for 48 hours. After the immersion time, the specimens were removed from the bath water and the plaster mold was compatible. The dental stone (Velmix, Kerr Eurpe, Italy) and water were mixed in a water/powder ratio recommended by the manufacturer in a rubber bowl by hand and then mechanically under a vacuum for 15 seconds. Then, the dental stone mixture was poured into the plaster mold and stored in air at 23±2°C for 60 minutes. Finally, the plaster casts were separated from the tissue conditioner.

In order to prepare each Impregum specimen, an equal length (1.5 cm) of each one of the pastes (base and catalyst) were mixed according to manufacturer's recommendations. Then, the mixture was poured into the ring. Thus, 10 specimens of Impregum were prepared. In the same way as mentioned previously, 10 dental stone casts were prepared for Impregum specimens (Figure 4).



Figure 4. Dental stone cast

Thus there were three groups of subjects:

1. Dental stone casts made from Acrosoft molds immersed for 24 hours in a water bath.
2. Dental stone casts made from Acrosoft molds immersed for 48 hours in a water bath.
3. Dental stone casts made from Impregum molds.

The surface roughness values of the dental stone casts made from the tissue conditioners were determined with a profilometer (HOMNEL WERKE T800, Germany) with a tracing length of 2.5 mm and cut-off value of 0.8 mm (Figure 5).



Figure 5. Profilometer

The profilometer are used for measurement of surface roughness with various tracing

length. The device is composed of two parts: fixed and mobile. The mobile part has a sensitive rod which transfers the roughness to the fixed part for its registration during its movement. Mean surface roughness (R_a) values were determined as the average of the centerline values and recorded in micrometers ⁽²¹⁾.

The R_a values of dental stone casts from the Acrosoft at each time were compared with each other and with R_a values of dental stone casts made from the Impregum.

Mean R_a values and standard error (SE) of each tissue conditioner/dental stone cast combination were calculated. Comparisons of R_a values were subjected to one-way and two-way ANOVA and Tukey test.

RESULTS

This data showed that stone casts made from Acrosoft tissue conditioner had maximum values of surface roughness ($1.04 \pm 0.16 \mu\text{m}$) after immersing for 24 hours, whereas the influence of the Impregum on surface roughness of dental stone were minimal ($0.5 \pm 0.17 \mu\text{m}$). The

surface roughness of dental stone affected by the Acrosoft tissue conditioner was measured to $1.005 \pm 0.13 \mu\text{m}$, which was significantly higher than the surface roughness of dental stone affected by the Impregum ($P=0.000$).

One-way ANOVA results indicated that the immersion time of Acrosoft tissue conditioner in water bath had no effect on increasing the surface roughness of dental stone; therefore, the surface roughness of the stone casts formed from Acrosoft were, respectively, $1.04 \pm 0.16 \mu\text{m}$ and $0.97 \pm 0.11 \mu\text{m}$ after immersing for 24 and 48 hours, with not statistically significant differences ($P=0.54$).

However, the results of Tukey test indicated significant differences in surface roughness between the two groups of dental casts made from Acrosoft (after 24 and 48 hours immersion) and the control group (the stone casts formed from the Impregum impression material) ($P=0.000$, $P=0.000$).

Table 1. Comparison of surface roughness of dental stones affected by Acrosoft and Impregum

Study groups	Quantity	Surface roughness (μm) of stone	P*
Stone casts made from Acrosoft	20	1.005 ± 0.13	
Stone casts made from Impregum	10	0.5 ± 0.17	0.000**

*Two-way ANOVA

**Significant

Table 2. Comparison of surface roughness of dental stones affected by Acrosoft (after 24 and 48 hours) and Impregum

Study groups	Quantity	Difference in surface roughness (μm) of stone	P*
Stone casts made from Acrosoft (after 24 hours)	10	1.04 \pm 0.16	
Stone casts made from Acrosoft (after 48 hours)	10	0.97 \pm 0.11	0.000**
Stone casts made from Impregum	10	0.5 \pm 0.17	

*One way ANOVA

**Significant

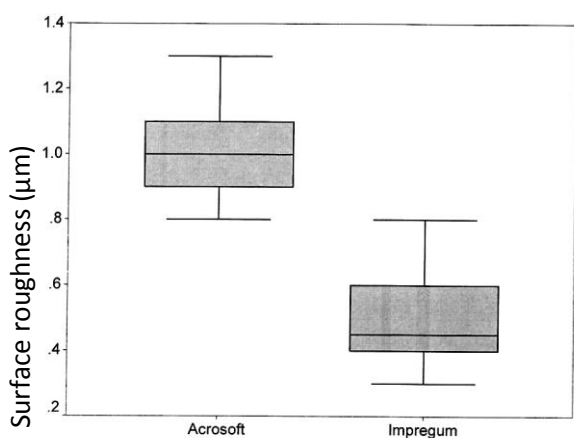


Diagram 1. Comparison of surface roughness of dental stones affected by Acrosoft and Impregum.

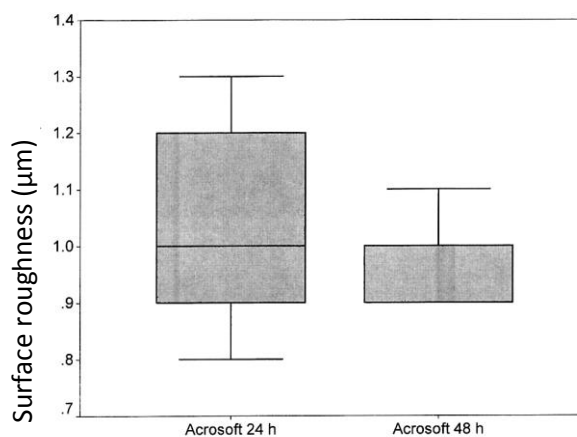


Diagram 2. Comparison of surface roughness of dental stones affected by Acrosoft after 24 and 48 hours.

Table 3. Pair-wise comparison of surface roughness of dental stones affected by Acrosoft after 24 and 48 hours and Impregum

Group 1	Group 2	Difference in stone surface roughness (μm);mean \pm SE	P*
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Stone casts made from Acrosoft after 24 hours	Stone casts made from Acrosoft after 48 hours	0.075±0.065	0.54
Stone casts made from Acrosoft after 24 hours	Stone casts made from Impregum	0.54±0.065	0.000**
Stone casts made from Acrosoft after 48 hours	Stone casts made from Impregum	0.47±0.065	0.000**

*Tukey test
 **Significant

DISCUSSION

The hypothesis that the surface quality of stone casts from tissue conditioners would be influenced by the type of the tissue conditioner used and that the quality would degrade with aging of the tissue conditioners was accepted. However, the influence of the type of the dental stone was found to be considerably lower than the effect of the type of the tissue conditioner and time of immersion in water of tissue conditioners.⁽²¹⁾ The results of the present study also confirmed this. The increased surface roughness of dental stone casts made from tissue conditioners might be related to changes in quality of surface molds due to loss of plasticizer and ethyl alcohol and water absorption.^(13,18,20) Once the material is submerged in the aquatic environment, the loss of ethanol begins and it will continue until loss of a large part of it.⁽²⁶⁾ Simultaneously, the polymer will absorb water from the environment. The rate of water sorption depends on chemical composition of the polymer and its concentration in the gel. Following the loss

of ethanol and water sorption, the weight of the mass decreases, which might be a cause for a lack of dimensional stability and a decrease in the resistance of the material against volume changes.⁽²⁾ Materials with high concentrations of ethanol show more weight loss and deformation.⁽²⁷⁾ This problem in using tissue conditioners is important for functional molding. One study has shown that the Hydrossoft tissue conditioner has smaller dimensional changes and can be used for functional molding due to its low ethanol level.⁽²⁶⁾ Since the rate of loss of ethanol is not the same as water sorption, physical properties of a solid matter may change with time. Initially, because the rate of loss of ethanol is faster than water sorption, hardness increases and then with water sorption, the material will become softer. When the water sorption reaches equilibrium, hardness increases because ethanol and finally, plasticizer, are continuously secreted into the saliva.⁽¹⁸⁾ The loss of these soluble materials (ethanol and plasticizer) increases the number of tiny bubbles on the

mold surface, which in is reflected as surface roughness.⁽¹⁸⁾ Therefore, it can be concluded that an increase in plasticizer and alcohol content in tissue conditioner, over time, will increase the surface roughness of the molds and subsequently the casts. Therefore, the immersion time in water bath will certainly help increase surface roughness of the molds. In this study, the differences in surface roughness of dental stone casts made from Acrosoft were not statistically significant after immersing for 24 and 48 hours in water bath, which might be attributed to the fact that in this study only two time intervals (24 and 48 hours) were considered. It should be noted that in a previous study, these two time intervals were reported as the best times to immerse Acrosoft in a water bath for reconstruction of surface details and dimensional stability.⁽²¹⁾ Therefore, these time intervals were selected for this study.

The materials used for functional molding should be compatible with dental stone casts,⁽²⁸⁾ in addition to their ability to reproduce details and their dimensional stability. The compatibility should be at level of elastomeric impression materials and the casts made from these materials should have a smooth surface similar to elastomeric impression materials.⁽²⁾ In this study Impregum, a reliable elastomeric impression material, was used as a control. The results of this study indicated that the surface roughness of dental stone casts made from Acrosoft was significantly

greater than dental stone casts made from Impregum, and if surface roughness is a criterion for compatibility with plaster, it can be concluded that Acrosoft is not compatible with dental stones. Although, in another study, Acrosoft has been confirmed to have the ability to reproduce surface details and to be dimensionally stable,⁽²¹⁾ this tissue conditioner is not compatible with dental stones and cannot be used as a functional impression material with its current composition.

It should be noted that the conditions of this study were not similar to functional molding in the clinic because the forces exerted in the mouth are not static.

CONCLUSION

- 1- The surface roughness of dental stone casts made from Acrosoft is significantly greater than that of dental stone casts made from Impregum.
- 2- Acrosoft cannot be used as a functional impression material because it is not compatible with dental stones.

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