

THE INFLUENCE OF DIFFERENT IMMERSION TIME INTERVALS AND DISINFECTION OF TISSUE CONDITIONER FUNCTIONAL IMPRESSION MATERIALS ON THE SURFACE ROUGHNESS OF STONE CAST

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ABSTRACT

Tissue conditioners are used as a functional impression material, to re-condition the denture-bearing mucosa abused by ill-fitting dentures and as a temporary lining material for immediate dentures. The immersion of tissue conditioners in disinfectant prior to pouring the impression can significantly affect the properties of dental stone depending on the duration of immersion. The present study aims to evaluate the effect of immersion time of tissue conditioner on the surface roughness of dental stone. Thirty specimens of tissue conditioner stone casts were prepared on cylindrical split aluminum with a lower hollow ring designed to receive the tissue conditioner and an upper ring adjusted to receive the stone mix. The thirty specimens of tissue conditioner were divided into 3 equal groups of 10 specimens according to the storage period (1hr, 24hrs and 48hrs). The three groups were subdivided into two subgroups: subgroup (a) 2% chlorhexidine (CHX) solution were sprayed on the surface of tissue conditioner specimens prior to pouring with dental stone materials while the other subgroup (b) specimens were poured with dental stone but without using (CHX) disinfection. The dental stone mixture was poured into molds and stored at room temperature for 60 minutes. The stone casts were then separated from the tissue conditioner and the surface roughness values of these dental stone casts was determined. Our results revealed a significant higher means values of surface roughness of groups (IIa and IIIa) when chlorhexidine was used compared to groups (IIb and IIIb). Comparison between subgroups (a and b) showed a statistical significance between (IIa and IIb) and (IIIa and IIIb). Based on the obtained results it can be concluded that the optimum time for using tissue conditioner as functional impression is from 24 to 48 hours after immersion. The use of 2% chlorhexidine solution disinfectant had adverse effect on surface roughness of dental stone.

Keywords: Tissue conditioner, functional impression, stone cast, surface roughness, disinfection.

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INTRODUCTION

Wearing a denture for a long period of time may result in abuse to the oral tissues. The corrective measures involve restoring the tissue health by using gingival massage, tissue conditioners and modification in the impression technique after border molding. ⁽¹⁾

Impression making is an essential step in denture construction and can be made with a variety of materials and techniques. Although accurately recorded impressions provide superior retention, support and stability for the denture, it is vital to carefully conduct the laboratory procedures that lead to the construction of the prosthesis including pouring the impression to obtain the master casts (replica of denture bearing tissues). ⁽²⁾

The accuracy of master casts is dependent on many factors including the accuracy of final impression, water/powder ratio, mixing method (vacuum versus hand) and the type of dental stone used as well as its compatibility with impression materials. ^(3,4,5,6)

Functional impression can be used very effectively to improve denture stability in cases exhibiting extreme resorption. The prosthesis should remain stable within the oral cavity and withstand the functional movement of muscles and tongue. The use of temporary soft liners and tissue conditioners as functional impression materials is possible due to their delayed setting which allows recording all possible movements of the mandibular musculature over a longer period of time. ⁽¹⁾

Tissue conditioners are used as functional impression materials in addition to re-conditioners for denture bearing mucosa abused by ill-fitting dentures and temporary lining materials for immediate dentures. ^(7,8) Tissue conditioners exhibit viscoelastic behavior suitable for tissue conditioning and functional impression taking. Nevertheless, over time, tissue conditioners undergo a marked loss of initial viscoelastic properties, dimensional changes and reduction of detail reproduction due to the

leaching of the plasticizer and alcohol components. In addition to the absorption of water leading to changes in the material dimensions. ^(9,10) To assess the physical properties of tissue conditioners used as functional impression materials, it is also necessary to determine the changes in the surface roughness of the materials over time and the compatibility with dental stones. ⁽¹¹⁾

Pouring the impression is the most critical step when using tissue conditioner as an impression material due to the strain rate-dependent plastic characteristics of the material, thus, immediate pouring of the impression is required. ⁽¹²⁾

A crucial factor in the construction of the dental prosthesis is having a master cast that is both accurate and possesses a smooth surface since the surface roughness of models affects the surface roughness of the dental prosthesis and may affect the retention to prosthesis. ⁽¹³⁾

During recording the impression, the impression material comes in contact with saliva and blood from the oral cavity making it a significant source for cross contamination as microorganisms can be transferred to the stone casts. Washing the impression or rinsing in running water does not completely remove these microorganisms and transmission of such pathogenic microorganisms is a hazard during the first 24 hrs. Disinfectant must be effective antimicrobial agent, yet cause no adverse effect to the dimensional accuracy and surface features of the impression material or the resultant gypsum cast. ^(14, 15, 16, 17, 18, 19)

The aim of the present study was to evaluate the effect of immersion time of tissue conditioner on the surface roughness of dental stone depending on the duration and protocol of immersion.

MATERIALS AND METHODS:

This laboratory study was conducted at King Abdulaziz University, Advanced Technology Dental Research Laboratory. A total number of 30 specimens of tissue conditioner / stone cast were

prepared of cylindrical split aluminum molds (50mm length × 30mm diameter). The metallic mold consists of a lower hollow ring (A) designed according to ADA specification no.25 to receive the tissue conditioner and an upper ring (B) adjusted to receive the stone mix to ensure intimate contact at the tissue conditioner / cast interface. (Fig.1)

The tissue conditioner material (coe-comfort, Gc America, Inc.) was mixed according to the proportion indicated by the manufacturer. The mixture was poured within the cylindrical mold and a glass slab was placed on top of the ring to ensure smooth surface during setting of the material. (Fig.1)

The thirty specimens of tissue conditioner were divided into 3 equal groups of 10 according to the storage period. (Table 1)

The specimens were transferred into sealed containers each containing artificial saliva at 37°C to simulate clinical conditions and stored as follow:

Group I: Ten specimens of tissue conditioner were stored for 1 hour

Group II: Ten specimens of tissue conditioner were stored for 24 hours

Group III: Ten specimens of tissue conditioner were stored for 48 hours

The three groups were subdivided into 2 subgroup (a, b). Subgroup (Ia, IIa and IIIa) were sprayed with 2% chlorhexidine (CHX, Ava Inc, IL, USA) solution on the surface of tissue conditioner specimens prior to pouring in dental stone materials while the other subgroup (Ib, IIb and IIIb) specimens were poured in dental stone without disinfection. The dental stone used was (New Plastone Type 3, GC Corp., Tokyo, Japan) mixed in a water / powder ratio as recommended by the manufacturer's. Mechanical mixing was carried out under a vacuum for 15 seconds then the mixture was poured into the mold and stored at room temperature for 60



Fig (1): Cylindrical mold, lower ring (A) for tissue conditioner material and upper ring (B) to receive stone material.

TABLE (1) The grouping and subgrouping distribution.

Grouping	
Group (I): One hr. immersion (10 specimens)	Group (II): 24 hrs. immersion (10 specimens)
Group (III): 48 hrs. immersion (10 specimens)	
Subgrouping	
Subgroup I,II,III (a) (15 specimens)	The tissue conditioner impression specimens were sprayed with 2% chlorhexidine (CHX) solution prior Pouring with dental stone
Subgroup I,II,III (b) (15 specimens)	The tissue conditioner impression specimens were poured with dental stone without spray of chlorhexidine solution

minutes. The stone casts were then separated from the tissue conditioner. Surface roughness values of the resulting dental stone casts were determined.

Surface roughness measurements:

The surface roughness (Ra, μm) of the specimens of all the groups and subgroups were determined with a surface profilometer (Surftest SJ-201P, Mitutoyo; America Corporation). The stylus of the meter was passed across and perpendicular to the abraded surface of the specimen under constant pressure. Three measurements were obtained from different area of each specimen, and then the average of these reading of surface roughness was calculated and expressed as (Ra) value, which is defined as the average vertical deviation along the surface of the specimen measured in micrometer (μm).

RESULTS

The mean value of surface roughness values (Ra, μm) are presented in Table (2). Comparison of subgroup (a) using Student’s t- test revealed a statistically significant difference between (IIa and Ia) at 5% level (p₂=0.050). similarly, comparison between subgroups (Ib, IIb and IIIb) using Student’s t- test revealed a statistically significant difference (P₁=0.050, P₂=0.050 and P₃= 0.513) at 5% level respectively.

The mean values of surface roughness of group IIa, IIIa using 2% chlorehexidine solution were

significantly higher than group IIb, IIIb without using chlorhexidine at different time intervals as shown in Table (2).

Mann Whitney test used for comparing between the subgroups (a and b) showed statistically significance between (IIa and IIb) and (IIIa and IIIb) (P=0.050 and 0.050) at 5% level respectively.

TABLE (2) Descriptive analysis of the surface roughness (Ra, μm) in the studied groups and subgroups.

Subgrouping			
with chlorhexidine solution (a)	Group (Ia) 1hr	Group (IIa) 24hr	Group (IIIa) 48hr
Mean ± SD	3.87 ± 0.71	2.56 ± 0.59	2.39 ± 0.59
Sig. between periods	p1=0.127,	p2=0.050*,	p3=2.08
without chlorhexidine solution (b)	Group (Ib)	Group (IIb)	Group (IIIb)
Mean ± SD	4.53 ± 0.063	1.76 ± 0.20	1.71 ± 0.07
Sig. between periods	p1=0.050*	p2=0.050*	p3=0.513*
U	2.00	0.00	0.000
P	0.275	0.050*	0.050*

Student’s t- test was used to compare between test groups. p₁: p value for comparing between one hour and 24 hours, p₂: p value for comparing between one hour and 48hours, p₃: p value for comparing between 24 hours and 48hours U and p values for Mann Whitney test for comparing between the subgroup

**Statistically significant at p ≤ 0.05*

DISCUSSION

Tissue conditioners have undergone great revolution in their composition over the years and offer several applications in prosthodontics. The greatest virtue of tissue conditioners lies in their versatility and ease of use.⁽²⁰⁾

The present study employed the use of tissue conditioner as a functional impression material due to its rheological properties, efficacy, dimensional stability, compatibility with dental stone and visco-gel material that have a satisfactory flow and elastic recovery. These properties should be stable following treatment with disinfection prior to sending to the dental laboratory. Strict spray disinfection technique was implemented in the current study as some disinfection can cause adverse effects on the dimensional stability of the impression material and the surface quality of stone cast.

One of the most important properties of successful dental prostheses is having a smooth surface with no surface scratches to achieve optimum esthetics and maintain a hygienic surface since surface roughness of denture base promote adhesion of microorganisms.^(21, 22)

Surface roughness was determined using the profilometer, which gives measurement in micron (μm) to record the irregularities present on this surface, and provide information on the surface roughness characteristics of the material but does not represent the morphological configuration of the surface.^(23, 24)

Chlorhexidine (CHX) 2% solution was used in the present study as spray disinfectant. It is an antiseptic and antimicrobial disinfectant which provides fast-acting activity against a wide range of microorganisms while being a non-toxic, non-irritating agent. Many studies reported that CHX has a more efficient candidacidal effect in comparison to other antifungal drugs. This evidence has been shown on microbiologic tests.^(25, 14, 26, 27, 28)

Type IV stone (gypsum) was used for pouring of tissue conditioner functional impression due to its ease of manipulation, affordability, appropriateness for impression material used and availability in various colors.⁽²⁸⁾

Our results revealed that the mean surface roughness (R_a , μm) of dental stone made from tissue conditioner had the highest values after immersion for 1hr. in subgroup (Ia and Ib). This may be due to immediate loss of plasticizer and ethyl alcohol in water leading to the formation of tiny bubbles and small pores on stone surface which is reflected on the measured surface roughness.⁽¹¹⁾

A statistically significant decrease in surface roughness in stone cast made from tissue conditioner in group IIb and IIIb could be due to the longer immersion time of the material for at least 24hrs. and 48hrs. prior to pouring of the dental stone cast. This may have limited the distortion of the impression surface caused by insufficient elastic recovery^(11, 9). Thus 24 hours. and 48 hours. were considered to be the most appropriate times for tissue conditioners used as functional impression material possibly due to allowing the water sorption process to reach equilibrium. The time duration may also be a more important factor for the elasticity of the material.

Clinical significance

The use of tissue conditioners as functional impression places these materials in close contact with saliva, blood and/or food particles more than any other material, therefore, proper disinfection of the impression is critical.^(28, 29) The current study highlighted the effect of disinfection on the surface roughness of casts obtained from such impressions following various immersion and disinfection protocols.

CONCLUSION

Within the limitation of this study we can concluded that: The surface quality of tissue

conditioners significantly affects the surface roughness of stone casts produced using them. The optimum time for using tissue conditioner as functional impression is between 24 and 48 hours. The use of 2% chlorhexidine solution disinfectant had deleterious effect on the surface roughness of dental stone. Tissue conditioners functional impression is particularly useful in geriatric patient and certain clinically compromised situation. Further clinical studies are recommended to correlate with the current laboratory study.

REFERENCES

- 1- Jain M.: Impression techniques for the resorbed mandibular arch: A guide to increased stability. *J Sci Soc.* 2015, 42:2:88-91.
- 2- Hanif A, Khan J, Bangash M.F.Kh: Impression technique and materials used for fabrication of complete denture. *A Survey. Pakistan Oral & Dental Journal*, 2014. 34:1.
- 3- Yuzbasioglu E., Kurt H., R Turunc R., and Bilir H.: Comparison of digital and conventional impression techniques: evaluation of patients perception, treatment comfort, effectiveness and clinical outcomes. *BMC Oral Health* 2014, 14:10.
- 4- Ali A.O.; Accuracy of Digital Impressions Achieved from five different digital impression systems. *Dentistry*, 2015; 5:5.
- 5- Kenyon BJ, Hagge MS, Leknius C, Daniels WC, Weed ST: Dimensional accuracy of seven die materials. *J Prosthodont* 2005 ,14: 25-31.
- 6- Chen SY, Liang WM, Chen FN : Factors affecting the accuracy of elastomeric impression materials. *J Dent* 2004, 32: 603-609.
- 7- Murata H, Narasaki Y, Hamada T, McCabe JF. An alcohol free tissue conditioner - a laboratory evaluation. *J Dent* 2006; 34: 307-315.
- 8- Chander S, Hill M, Moore D, Morrow L. Tissue conditioning materials as functional impression materials. *Eur J Prosthodont Restor Dent* 2007; 15: 67-71.
- 9- Murata H, Kawamura M, Hamada T, Saleh S, Kresnoadi U, Toki K. Dimensional stability and weight changes of tissue conditioners. *J Oral Rehabil* 200; 28:9 18-23.
- 10- Murata H, Hamada T, Djulaeha E, Nikawa H. Rheology of tissue conditioners. *J Prosthet Dent* 1998;79:188-99.
- 11- Murata H, Hong G, Ying Ai Li, Hamada T. Compatibility of tissue conditioners and dental stones: Effect on surface roughness. *J Prosthet Dent* 2005; 93:274-81.
- 12- Chughi D., Phull S., Rana A., Saini Y.; Modified functional impression technique for resorbed mandibular ridge : Two case studies. *International Journal of Medical Dentistry* 2015: 5:2.
- 13- Chih Chang Y., Hung Yu Ch., Miin Liang W., Gene Tu M., Yue Chen S.: Comparison of the surface roughness of gypsum models constructed using various impression materials and gypsum products *Journal of Dental Sciences*, 2016. 11:23- 28.
- 14- Amin W.A., Al-Ali M.H., Al Tarawneh S.K., Taha S.Th., Saleh M.W., Ereifij N.: The Effects of disinfectants on dimensional accuracy and surface quality of impression materials and gypsum casts. *Journal of clinical medicine research*, 2009 : 1; 81-89.
- 15- Melilli D, Rallo A, Cassaro A, Pizzo G. The effect of immersion disinfection procedures on dimensional stability of two elastomeric impression materials. *J Oral Sci* 2008; 50 (4): 441-446
- 16- Fabiani L, Mosca G, Giuliani AR: Hygiene in dental practices. *Eur J Paediatr Dent* 2006;7:93-97.
- 17- Infection control recommendations for the dental office and the dental laboratory. ADA Council on Scientific Affairs and ADA Council on Dental Practice. *J Am Dent Assoc* 1996;127:672-680.
- 18- Kohn WG, Collins AS, Cleveland JL, Harte JA, Eklund KJ, Malvitz DM. Guidelines for infection control in dental health-care settings--2003. *MMWR Recomm Rep* 2003;52:1-61.
- 19- Taylor RL, Wright PS, Maryan C. Disinfection procedures: their effect on the dimensional accuracy and surface quality of irreversible hydrocolloid impression materials and gypsum casts. *Dent Mater* 2002;18:103-110.
- 20- Alapatt, G.J, Varghese N.M., Correya B.A., Saheer M. K.; Tissue Conditioners: A Review. *IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)* 2015 : 14:5 ; PP 54-57.
- 21- Kakaboura, A., Fragouli M., Rahiotis C., and Silikas N. : Evaluation of surface: characteristics of dental composites using profilometry, scanning electron, atomic force

- microscopy and gloss-meter. *Journal of Materials Science: Materials in Medicine*, 2007. 18(1): p. 155-163.
- 22- Victorin L.: Effect of tooth brushing on acrylic resin veneering material. II. Abrasive effect of selected dentifrices and toothbrushes. *Acta Odontol Scand* 1972; 30: 383–395.
- 23- Hilmi H.B.M., Ariffin Z., and Alam M.Kh. : A Comparative Study on the Accuracy of the Dental Impression Material. *International Medical Journal* 2013 :20(4):518-520
- 24- Khaledi A., Borhanihighi Z., Vojdani M. The effect of disinfectant agents on dimensional stability and surface roughness of a tissue conditioner material. *Indian journal of dental research* 2011;22;4, P.499-504.
- 25- Kim Ki.B, Kim j.h , and Kim S.H.: Impact of surface roughness of gypsum materials on adaptation of zirconia cores. *Adv. Prosthodontic*. 2015 ;7(3):199-206.
- 26- Vafaei F.F., Heidari F., Soufiabadi B., Saleh S., Ansari A., Khazaei A. S.: Evaluation of the effect of a tissue conditioner on surface roughness of dental stone. *DJH* 2012; 4:1.
- 27- Salim N, Moore C, Silikas N, Satterthwaite J, Rautemaa R. Chlorhexidine is a highly effective topical broad-spectrum agent against *Candida* spp. *International Journal of Antimicrobial Agents* 2012a;41:65–9.
- 28- Kadkhoda Z., Najafabadi M.P., Rafiei S.Ch., Abolhasani A., Fayazi F.: A comparison of tissue conditioner alone versus tissue conditioner with chx for treatment of the denture stomatitis in older adults *J Craniomax Res* 2017; 4(3) : 395-400.
- 28- Jin C, Nikawa H, Makihira S, Hamada T, Furukawa M, Murata H. Changes in surface roughness and colour stability of soft denture lining materials caused by denture cleansers. *J Oral Rehabil* 2003; 30: 125-130.
- 29- Murata H., Chimori H., Hong G., Hamada T. and Nikawa H.: Compatibility of tissue conditioners and denture cleansers: Influence on surface conditions. *Dental Materials Journal* 2010; 29(4): 446–453.