



Effect of Microwave Energy Disinfection on Roughness of Soft Lining Material

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Abstract

Introduction: Soft lining material enhance the patient's comfort, its rough surface affect oral health, the risk with soft liners was difficult hygienic maintenance, sterilization by microwave method more favor compared with chemicals disinfections. Objective to study the effect of disinfection by microwave irradiation at different exposure time on surface roughness of long-term soft-liner material.

Material and Methods: 45 Specimens of long-term soft liner were made in the form of square metal shaped pattern. The preparation of mould was done by conventional procedures according to manufacture instruction and divided into three groups: GroupA control (without disinfection), Group B daily disinfection by microwave for 5min at 650W and GroupC daily disinfection by microwave for15min at 650W. The specimens were irradiated daily for 15 days (both group B&C). Roughness measurement were made for three groups by profilometer device and analyzed by ANOVA 'test. Result show that high mean value surface roughness of long term soft liner after expose to microwave disinfection for 15 min(Group C), and low mean value before expose to microwave disinfection(Group A), there were highly significant differences ($P<0.01$) among tested groups and there was no significance difference ($p>0.05$) between control Group with (Group B) 5 min disinfection, while the difference was significance ($p<0.05$) between (Group C)15 min disinfection with : (Group B) 5 min disinfection and with (Group A)control group. **Conclusions:** the roughness of long-term soft-liner material was not adversely affected by microwave disinfection at 5 min, there was no significant differences with control group while adversely affected by microwave disinfection at 15 min, there was significant differences with control group also with group 5 min disinfection.

Introduction:

Soft lining material enhance the patient's comfort because they reduced and distribute the stress on the ridge⁽¹⁾. They used in case of residual ridge resorption, non-resilient mucosa, bony undercuts, and when dentures opposing natural teeth and for patient with xerostomia and bruxism^(2,3). The risk with soft reliners was difficult hygienic maintenance⁽⁴⁾. There were many methods for disinfections the reliners such as chemical disinfection but they had own disadvantages^(5,6,7). Microwave oven availability (household appliance), ease of use and less effect on its properties in addition less time consuming make sterilization by microwave method more favor compared with chemicals disinfections^(5,8). Since, roughness surface causes biofilm adherence also bacteria and candida much propensity adhere to rough surface and affect oral health^(9,10), the surface roughness was an important factor and disinfection seriously affected roughness^(11,12), therefore the study has been established to evaluate influence of the different exposure time to microwave energy disinfection on the roughness of soft lining material long term type.

Materials and methods

Preparation of mould:

Total sample were 45 specimens. All sample were prepared in the form of square metal shaped pattern according to {ADA Specification NO.12(1999)}⁽¹³⁾, the dimension (12mm*12mm*3mm) length, width, and thickness (Fig.1) were constructed to be used for surface roughness measurement. The preparation of mould was done by conventional procedures according to manufacture instruction and by using boiling water, the wax elimination was done, after that flask was opened and left for cooling (at room temperature), the soft liners material Vertex –soft (heat polymerizing acrylic based soft liner/ Vertex Holland) (Fig.2) was mixed in dry and clean glass jar the soft liner material which was mixed depending on manufacturer instructions

Powder Liquid ratio ; (2 g powder to 1ml of liquid)packed into the mould ,The two halves of the flask were closed and to ensure even flow of the soft liner gradual pressure was applied by hydraulic press, (100Kg/cm²) for 5 minutes after that the press was removed, and the clamped flasks transferred to the water path for curing ,the conventional procedures for the flasking and packing , were followed in the preparation of the specimen⁽¹⁴⁾. Finishing and Polishing: Remove grass of excess resin from the border of soft liner specimens by large acrylic burs until make smooth specimen. The polishing done by pumice with water then store it in water in the plastic container until needed⁽¹⁵⁾.

Microwave Irradiation:

All tested samples except control (not subjected to microwave disinfection) subjected daily to disinfection in microwave oven. Microwave sterilization was performed with the specimens immersed in 200 ml of water in glass container and put on the tray of microwave oven for disinfection. Figure (3)⁽¹⁶⁾.The specimens were irradiated daily for 15 days (both group B&C) at (650W)⁽¹⁷⁾ at different time :Group B at (650W) for 5 min daily ,Group C at (650W) for 15 min daily and between sterilization periods the specimens were stored in artificial saliva at 37°C in incubator.

Distribution of the sample

45 specimens divided into three groups according to: microwave disinfection (15 specimens for each group) .The sterilization regimes were as follows:
*Group A(control group):(15 samples) stored in artificial saliva without microwave disinfection.
*Group B:(15samples)subjected to microwave disinfection at 650w for 5 mins.
*Group C: (15 samples) subjected to microwave disinfection at 650w for 15 mins.

Surface roughness test:

The samples were subjected to roughness test, profilometer device (surface roughness tester TR220 Portable TIME Group Inc, China) the device was supplied

by surface analyzer [with sharp stylus] (Fig. 4) to track the profile of surface irregularity and registering all the recess and peaks, via the needle passing a cross surface⁷, when specimen placed horizontally firm on smooth table according to device instruction which characterize the surface. For more accuracy, at least two measurement were done for each sample and a mean was calculated and the roughness value was calculated.

Results

Descriptive Statistic:

Table (1) represents descriptive statistics of studied readings in different groups of long term soft liner after expose to microwave disinfection with different minute (5 min, 15 min) as well as controlled group(A). Such as [Mean, Standard Deviation, Standard Error, and two extreme values, minimum, and maximum]. Results show that high mean value for surface roughness of long term soft liner was recorded by group(C) after expose to microwave disinfection for 15 min, and low mean value was recorded by group A(control) before expose to microwave disinfection.

Fig.(5) Bar Chart for " mean values" of surface roughness of long term soft liner in three groups, control group and groups after expose to microwave disinfection for (5min and 15 min). Table(2) Show the variances analysis (One Way ANOVA) comparing mean surface roughness among three groups. ANOVA test showed that there were highly significant differences at ($P < 0.01$) among tested groups. As shown in Table (3), that the LSD test between studied groups showed that the differences were not significantly $p > 0.05$, between Group A (control Group) with Group B (5 min disinfection), while the difference were significance $p < 0.05$ between: Group C (15 min disinfection) with Group B (5 min disinfection) and with Group A (control group).

Discussion

Roughness of surface was an importantly property because it was effect the bacterial adhesion, such as resilient liners material was the first step (in denture wearers) for

development even colonization of oral infections^(18,19), therefore, this materials must be present as possible with smooth surfaces in order to avoid formation of biofilm and inflammation of oral mucosa and facilitate cleaning of denture^(20,21,22).

The profilometer device was used for measuring the surface roughness value, it was the excellent device for studying the surface roughness of base denture material. It gives nearly the estimated value for surface roughness also give quantitative measurements that can be evaluated and statistically compared^(17,23).

In this study, microwave irradiation disinfection show no significant increasing in the roughness in Group B (after 5min disinfection) comparing to control (Group A) while there was highly significant increase in the mean value of roughness in Group C (after irradiate to 15min), also there was highly significant differences in the mean value of roughness in Group B (after irradiate to 5min) with Group C (after irradiate to 15min), the possible explanation to these finding was attributed to higher temperature that reached in the procedure course of disinfection which leads to alteration in surfaces of such material thus increasing their surface roughness, the highly significant increase in surface roughness of liner materials may be also related to reality that the degree of the residual monomer found in resin material was more in the surface level causing increasing in the roughness this was agree with study done by Chandrasinh, et al 2019⁽⁵⁾, Ana Lucia et al 2009⁽²⁴⁾ and Yatabe, et al, 2001⁽²⁵⁾. Also a significant increase in surface roughness of two hard chair side reline resins and heat polymerizing denture base resin was observed after repeated microwave disinfection^(26,27). Increase in surface roughness could be due to monomer vaporization at elevated temperatures during the sterilization procedures leaving porous surface so roughness was increase, this was agreement with Ravi et al study 2013⁽¹⁷⁾. Another study by Sartori et al. 2006⁽²⁸⁾ showed that using of microwave disinfection can modify the texture surface of acrylic resins causing increasing in roughness and this agree with this study. Heat acrylic material of

denture when subject to the hot water even boiling, causing a breakdown in the surface outlayer, perhaps results of micro crazing for the surface that loss its integrity, this assess by Scanning Electron Microscopy ^(16,29,30). Thus, to follow the importance for instruction the patient avoiding elevated temperature when cleaned even stored the denture lined with soft liner, the roughness of long-term soft-liner material was not adversely affected by microwave disinfection at 5 min {there was no significant differences with control group}. The distortion due to an increase

in temperature and emphasize that 15min disinfection regime should be avoided for acrylic liners. Conclusions: the roughness of long-term soft-liner material was not adversely affected by microwave disinfection at 5 min, there was no significant differences with control group while adversely affected by microwave disinfection at 15 min, there was significant differences with control group also with group 5 min disinfection.



Fig.(1): Specimens of roughness



Fig.(2): vertex soft liner



Fig. (3): Specimens inside microwave device



Fig.(4): roughness tester

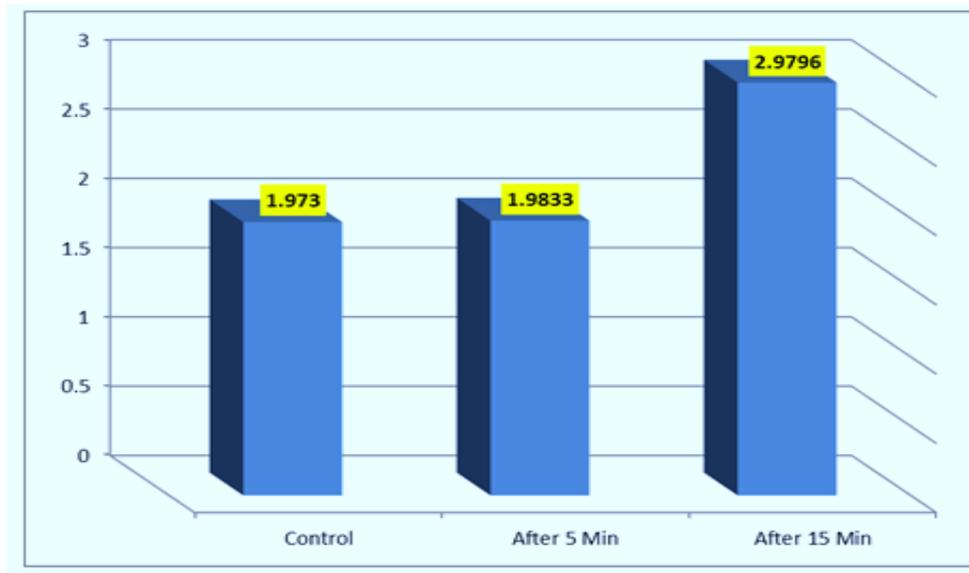


Fig. (5): Bar Chart for" mean values" of surface roughness

Table (1): Descriptive of surface roughness

	N.	Min.	Max.	Mean	Std. Error	SD
Group A control	15	1.31	2.55	1.9730	0.13519	0.42750
Group B after 5min	15	1.10	2.69	1.9833	0.20510	0.64858
Group C after 15min	15	1.67	4.41	2.9796	0.33018	1.04412

Table(2):ANOVA test for surface roughness between three different groups.

	F-test	P-value	Sig.
Between groups	5.992	0.007	P<0.01 highly significant

Table (3): LSD of Surface Roughness Groups

Groups		Mean Difference	Std. Error	P-value	Sig.
Group A Control	Group B after 5 min Group C	-.01030	0.33601	0.976	NS
	after 15 min	-1.00660-	0.33601	0.005	H.S
Group B After 5 min	Group C After 15min	-.99630*	0.33601	0.005	H.S

References

- Machado AL, Breeding LC, Puckett A. Effect of microwave disinfection on the hardness and adhesion of two resilient liners. *J Prosthet Dent.* 2005 Aug;94(2):183-9. <https://doi.org/10.1016/j.prosdent.2005.04.017>
- Ronald S., Jack F. and John P. :Craigs. Restorative dental material .The Mosby Co. St. Lo. (2019)14th edition150 in/post/Book/Dentistry/Craig%27s
- Murata H., Taguchi N., Hamada T., McCabe JF.: Dynamic viscoelastic properties and the age changes of long-term soft denture liners. *Biomaterials.* 2000.21:1421-7. doi: 10.1016/s0142-9612(00)00010-7.
- H. NIKAWA T. YAMAMOTO S. HAYASHI Y. NIKAWA T. HAMADA. Growth and/or acid production of *Candida albicans* on soft lining materials in vitro *Journal of Oral Rehabilitation.* 1994. Volume 21, Issue 5 September Pages 585-594. <https://doi.org/10.1111/j.1365-2842.1994.tb01173.x>
- Chandrasinh Rajput, Keval Shah1 , Hiren Rana, Bhagyashree Dave, Yashpreet S. Bhatia, and Ritu Shah. Effects of Disinfection Procedures on Surface Roughness of Hard Chairside Relining and Denture Base Acrylic Resins: An In Vitro Study. *International Journal of Oral Care and Research.* 2019. Volume : 6 Issue : 4. Page : 54-57 .DOI: 10.4103/INJO.INJO_2_19
- Ma T, Johnson GH, Gordon GE. Effects of chemical disinfectants on the surface characteristics and color of denture resins. *J. Prosthet. Dent.* 1997.77:197-204. doi: 10.1016/s0022-3913(97)70235-x.
- Machado AL., Breeding LC., Vergani CE., da Cruz Perez LE. Hardness and surface roughness of relined and denture base acrylic resins after repeated disinfection procedures. *J. Prosthet. Dent.* 2009.102:115-22. doi: 10.1016/S0022-3913(09)60120-7.
- Ravikumar R., and Abdul Aziz Ak. The effect of chemical disinfection, autoclave and microwave sterilization on the dimensional Accuracy of polyvinylsiloxane Elastomeric impression materials. *World Applied Sciences Journal.* 2012.17(1): 127-132. [idosi.org/wasj/wasj17\(1\)12/19](http://idosi.org/wasj/wasj17(1)12/19).
- Verran J., Maryan C.J. Retention of *Candida albicans* on acrylic resin and silicone of different surface topography. *J Prosthet Dent.* 1997.77:535-9. doi: 10.1016/s0022-3913(97)70148-3.
- Radford DR., Challacombe S.J, Walter JD. Denture plaque and adherence of *Candida albicans* to denture-base materials in vivo and in vitro. *Cr Rev Oral Bio.l Med.* 1999.10:99-116. doi: 10.1177/10454411990100010501.
- Sarah Jackson, Lisa Coulthwaite, Zvi Loewy, Anthony Scallan, Joanna Verran. Biofilm development by blastospores and hyphae of *Candida albicans* on abraded denture acrylic resin surfaces *J Prosthet Dent .* 2014 Oct;112(4):988-93. doi: 10.1016/j.prosdent.2014.02.003. Epub 2014 Apr 14.
- Yamauchi M, Yamamoto K, Wakabayashi M, Kawano J. In vitro adherence of microorganisms to denture base resin with different surface texture. *Dent Mater J.* 1990.9. 19-24. Doi <https://doi.org/10.4012/dmj.9.19>
- American Dental Association Specification No. 12; 1999 for denture base polymers Chicago. Council on dental materials and devices . doi: 10.14219/jada.archive.1975.0069.
- Craig RG, Powers JM, Wataha JC. *Dental Materials: Properties and Manipulation.* 8th ed. St. Louis, USA: Mosby; 2004:578-580.

<https://www.worldcat.org/title/dental-materials-properties-and-manipulation/oclc/627298995>

15-Graig . R.G. Restorative dental material .The Mosby Co. St. Lo. 10th edition,1997 .pp:127-136.500-540.

<http://docshare03.docshare.tips/files/8430/84306995.pdf>

16-Ana Lucia Machado; Eunice Teresinha Giampaolo; Carlos Eduardo Vergani. Juliana Feltrin de Souza. Janaina Habib Jorge..Changes in roughness of denture base and relined materials by chemical disinfection or microwave irradiation. Surface roughness of denture base and relined materials.J.2011. Appl. Oral .Sci. vol.19 no.5 <https://doi.org/10.1590/S1678-77572011000500015>

17- M.B. Ravi, M.R. Dhakshaini, Anil Kumar Gujjari, S. Sowmya and K.N. Raghavendra Swamy .The Effectiveness of Microwave Sterilization on the Hardness of Silicone and Acrylic Based Soft Reliners. World Applied Sciences Journal .2013.22 (3): 313-318.ISSN 1818-4952. DOI: 10.5829/idosi.wasj.2013.22.03.65

18. Hashem MI.Advances in Soft Denture Liners: An Update. The Journal of Contemporary Dental Practice, 2015. Apr .16(4):314-318. doi: 10.5005/jp-journals-10024-1682.

19-Radford DR. Sweet SP. Challacombe SJ.Walter JD.Adherence of Candida albicans to denture-base materials with different surface finishes.J Dent. Sep1998.26(7):577-83.[https://doi.org/10.1016/S0300-5712\(97\)00034-1](https://doi.org/10.1016/S0300-5712(97)00034-1).

20. Tamara Perchyonok : Bio-active denture soft liner materials from design to application: in vitro approach Dent Health Oral Disord Ther. 2017.6(4):101-105. DOI: 10.15406/jdhodt.2017.06.00206

21- Neppelenbroek KH, Pavarina AC, Spolidorio DM, Vergani CE, Mima EG, Machado AL.Effectiveness of microwave sterilization on three hard chairside relined resins Int J Prosthodont. 2003 Nov-Dec;16(6):616-20. http://www.quintpub.com/userhome/ijp/ijp_16_6_Neppelenbroek7.pdf

22- Quirynen M,and Bollen CM, The influence of surface roughness and surface-free energy on supra- and subgingival plaque formation in man. A review of the literature J Clin Periodontol. 2018 Jun;45 Suppl 20:S246-S266. doi: 10.1111/jcpe.12954. <https://pubmed.ncbi.nlm.nih.gov/7706534/>

23- Al-khafaji A.M.: The effect of prepared denture cleaners on some properties of stained acrylic resin denture base material cured by two different techniques; Master thesis, College of Dentistry.Baghdad University. Iraq 2004; 67-70

24- Ana Lucia Machado , Larry C Breeding, Carlos Eduardo Vergani, Luciano Elias da Cruz Perez

.;Hardness and surface roughness of relined and denture base acrylic resins after repeated disinfection procedures J. Prosthet. Dent.; 2009 .Aug;102(2):115-22. [https://doi.org/10.1016/S0022-3913\(09\)60120-7](https://doi.org/10.1016/S0022-3913(09)60120-7)

25- M Yatabe , H Seki, N Shirasu, M Sone.Effect of the reducing agent on the oxygen-inhibited layer of the cross-linked relined material J Oral Rehabil 2001; 28(2):180-5 . <https://doi.org/10.1046/j.1365-2842.2001.00634.x>

26-Azevedo A, Machado AL, Vergani CE, Giampaolo ET, Pavarina AC, Magnani R. Effect of disinfectants on the hardness and roughness of relined acrylic resins. J Prosthodont. 2006;15(4):235-42 . <https://pubmed.ncbi.nlm.nih.gov/16827736>

27- Zissis AJ, Polyzois GL, Yannikakis SA, Harrison.Roughness of denture materials: a comparative study Int J Prosthodont .Mar-Apr 2000;13(2):136-40. <https://pubmed.ncbi.nlm.nih.gov/11203622/>

28-SARTORI, Evandro Afonso; SCHMIDT, Caroline Bom; WALBER, Luiz Fernando and SHINKAI, Rosemary Sadami Arai Effect of microwave disinfection on denture base adaptation and resin surface roughness. Brazilian Dental Journal. 2006, vol.17, n.3, pp.195-200. <https://doi.org/10.1590/S0103-64402006000300004>

29-Andrea A.,Machado A., Vergani C., Giampaolo E.T. and Pavarina A.,Effect of disinfectants on the hardness and Roughness of Relined Acrylic Resin..J.of prosthodontics. 2006.Volume15.Issue4,Pages235-242. <https://doi.org/10.1111/j.1532-849X.2006.00112.x>

30- Evandro Afonso Sartori; Caroline Bom Schmidt; Luiz Fernando Walber; Rosemary Sadami Arai Shinkai; Effect of microwave disinfection on denture base adaptation and resin surface roughness.2006.Braz. Dent. J. vol.17 no.3 Print version ISSN 0103-6440Online version ISSN 1806-4760. <https://doi.org/10.1590/S0103-64402006000300004>