DOI: 10.14260/jemds/2015/1037

ORIGINAL ARTICLE

TO EVALUATE THE EFFECT OF MICROWAVE DISINFECTION ON THE HARDNESS OF HEAT CURE AND SELF CURE ACRYLIC RESIN: AN IN-VITRO STUDY

Neha Ahuja[1], A. J. Pakhan[2], S. R. Godbole[3], Seema Sathe[4], Yashshree Sancheti[5]

HOW TO CITE THIS ARTICLE:
Neha Ahuja, A. J. Pakhan, S. R. Godbole, Seema Sathe, Yashshree Sancheti. "To Evaluate the Effect of Microwave Disinfection on the Hardness of Heat Cure and Self Cure Acrylic Resin: An In-Vitro Study". Journal of Evolution of Medical and Dental Sciences 2015; Vol. 4, Issue 41, May 21; Page: 7127-7133,
DOI: 10.14260/jemds/2015/1037

ABSTRACT: INTRODUCTION: Increased prevalence of some infectious diseases i. e. Hepatitis B, AIDS altered the public opinion to infection control during dental service. Impressions trays, casts and prosthesis are all of potential sources of cross contamination to and from patients, clinical personnals and dental technicians. The purpose of this study was to evaluate the effect of microwave disinfection on the hardness of heat cure acrylic resin and self-cure acrylic resin. **MATERIALS AND METHODS:** Samples were made of heat cure and self-cure acrylic resins. First the samples were subjected to hardness test without the microwave disinfection and then the same samples were subjected to microwave disinfection which served as experimental group. Rockwell hardness tester was used to check the hardness of samples. **RESULT:** The result showed that microwave disinfection showed no significant changes in hardness of heat cure and self-cure acrylic resins. **CONCLUSION:** Microwave disinfection can be used safely to disinfect prosthesis made of heat cure and self-cure acrylic resin in clinical prosthodontic procedures. This study evaluated the effect of microwave disinfection on the hardness of heat cure and self-cure acrylic resin. 15 Samples each of self-cure and heat cure acrylic resin without microwave disinfection were used as a control group and the same samples were microwave disinfected and were used as a experimental group. 6 minute exposure at 650 W for 15 days to microwave was employed as disinfection procedure. The samples were stored in distilled water at 37 degree Celsius for 24 hours prior to disinfection. There were no statistically significant differences in the hardness of heat cure and self-cure acrylic resin after disinfection with microwave.
KEYWORDS: Microwave disinfection, hardness, heat cure acrylic resin, self-cure acrylic resin.

INTRODUCTION: Cross-contamination between patients and dental personnel can occur not only through contaminated dentures but also through polishing agents and instrumentation. . Williams et al demonstrated that denture laboratory pumice continues to be a major reservoir for bacterial contamination in prosthetic dentistry. A study by Kahn et al demonstrated the transfer of oral flora from a contaminated denture to a disinfected denture through the polishing wheel and pumice. These microorganisms can penetrate into the interior of porous acrylic resin. Therefore, to reduce the chances of cross-contamination, dentures should be completely disinfected before being sent to the laboratory and before insertion.[1]

In choosing a disinfectant for dental prostheses, consideration should be given to its compatibility with the type of material to be disinfected to avoid adverse effects.[2] Ideally, the physical and mechanical properties of denture base resins and artificial denture teeth should remain unaltered after the disinfection process. It has been demonstrated that the hardness,[3,4] flexural strength,[5] and colour stability,[6] of denture base resins can be significantly affected by disinfectant

DOI: 10.14260/jemds/2015/1037

solutions such as glutaraldehyde, chlorhexidine, phenolic-based, alcohol-based, and hypochlorite disinfectants.

Microwave irradiation has been suggested as a simple and effective method for denture disinfection, different regimens have been tested. Microwave irradiation 6 min in water at 650 W, performed on three hard chair side relining material proved to be completely effective against potentially pathogenic microorganisms such as staphylococcus aureus, pseudomonas aeruginosa, bacillius subtilis and candida albicans.[7]

Therefore, this in vitro study has undertaken to evaluate effect of microwave disinfection on hardness of heat cure and self-cure acrylic resins.

MATERIALS AND METHODS:

Materials:

1. Heat cure acrylic resin (DPI).
2. Self-cure acrylic resin (DPI).
3. Modelling wax (Link, MDM Corporation, New Delhi).
4. Type II gypsum product (Kalabhai Karson Pvt. Ltd, Mumbai).
5. Cold mould seal (DPI, Dental materials, Mumbai).

Equipments:

1. Varsity pattern Dental flask and clamps(Jabbar , India)
2. Hydraulic press(Carlo de giorgi, GD; Italy)
3. Digital acrylizer
4. Incubator
5. Domestic microwave (LG company)
6. Rockwell Hardness Tester (AI RAS company, available at DMCOE, Sawangi, Wardha)

Method:

1. **Preparation of heat cure acrylic resin sample:** Two piece metal mould was prepared of size 65mm in length, 20 mm in width, 3mm thickness to prepare wax samples. The mould was then packed with acrylic dough of heat cure and processing of acrylic resin sample using long curing cycle at 70 degree Celsius for 9 hrs using acrylizer to obtain samples of heat cured acrylic resin. Samples so retrieved were finished and polished. The samples were stored in distilled water at 37 degree Celsius for 24 hours prior to disinfection.

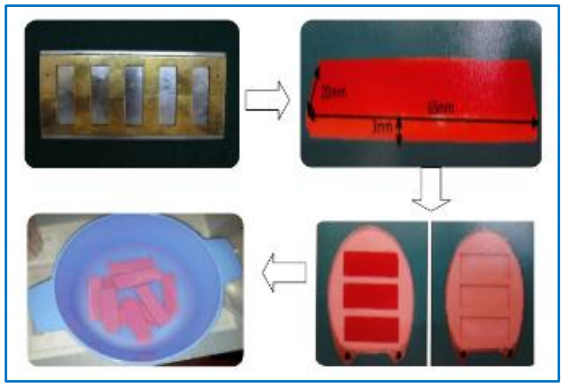


Fig. 1

DOI: 10.14260/jemds/2015/1037

2. **Preparation of self-cure acrylic resin sample:** Two piece metal mould was prepared of size 65mm in length, 20 mm in width, 3mm thickness to prepare wax samples. The mould was then packed with acrylic dough of self-cure. After room polymerization samples were retrieved and finished and polished. The samples were stored in distilled water at 37 degree Celsius for 24 hours prior to disinfection.
3. **Grouping of sample:** Total 30 sample size was used. Samples were divided in two groups. Control group A 30 samples (15 Heat cure + 15 self-cure acrylic resin) – not subjected to any disinfection. Experimental group B 30 samples (15 Heat cure + 15 self-cure acrylic resin) – same subjected to microwave disinfection.
4. **Disinfection and testing of the samples:**

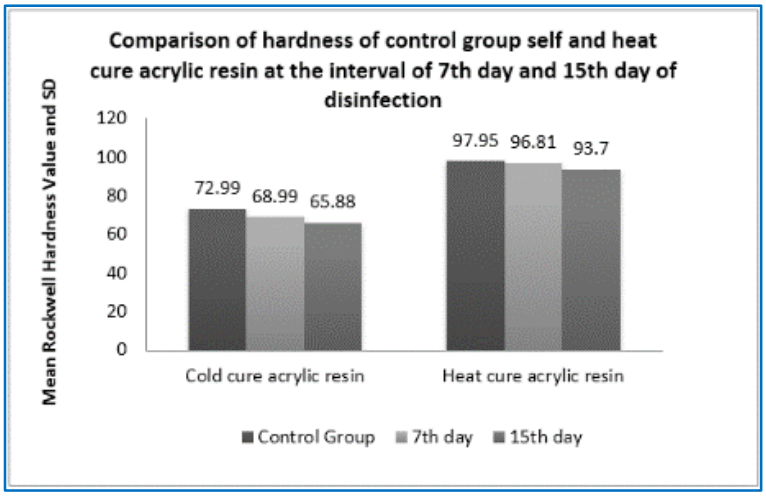
Fig. 2

All samples of were subjected to Rockwell hardness tester for evaluating hardness using 60-gf load and were denoted as Rockwell hardness number (RHN). Three indentations were made on each sample and RHN was calculated for each sample for all groups and then mean value for heat cure and self-cure acrylic resin was be calculated as control group. These samples as per grouping were then subjected to microwave disinfection for 6 min at 650 W daily for 15 days. After disinfection the hardness will then be measured using Rockwell hardness tester on 7th and 15th day.

Fig. 3

DOI: 10.14260/jemds/2015/1037

RESULTS:



	N	Mean	Std. Deviation	Std Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Control Group	15	72.99	4.96	1.28	70.24	75.74	65.00	82.66
Experimental Group 7th day	15	68.99	7.55	1.95	64.81	73.18	55.00	80.66
Experimental Group 15th day	15	65.88	5.21	1.34	62.99	68.77	57.66	75.00

Source of variation	Sum of Squares	Df	Mean Square	F	p-value
Between Groups	381.25	2	190.62	5.247	0.009 S,p<0.05
Within Groups	1526.01	42	36.33		
Total	1907.27	44			

Group		Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval	
					Lower Bound	Upper Bound
Experimental Group 7th day	Control Group	4.00	2.20	0.135 NS,p>0.05	1.03	9.03
Experimental Group 15th day		7.11	2.20	0.005 S,p<0.05	2.07	12.14

DOI: 10.14260/jemds/2015/1037

	N	Mean	Std. Deviation	Std Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Control Group	15	97.95	3.35	0.86	96.09	99.81	93.33	105.00
Experimental Group 7th day	15	96.81	5.26	1.36	93.90	99.73	88.33	105.66
Experimental Group 15th day	15	93.70	5.89	1.52	90.44	96.97	80.00	102.00

Source of variation	Sum of Squares	Df	Mean Square	F	p-value
Between Groups	144.94	2	72.47	2.94	0.06 NS,p>0.05
Within Groups	1033.52	42	24.60		
Total	1178.47	44			

Group		Mean Difference (I-J)	Std. Error	p-value	95% Confidence Interval	
					Lower Bound	Upper Bound
Experimental Group 7th day	Control Group	-1.13	1.81	0.757 NS,p>0.05	-5.27	3.01
Experimental Group 15th day		-4.24	1.81	0.044 S,p<0.05	-8.39	-0.09

		Mean	N	Std. Deviation	Std. Error Mean
Cold cure acrylic resin	7th day	68.99	15	7.55	1.95
	15th day	65.88	15	5.21	1.34
Hot cure acrylic resin	7th day	97.95	15	3.35	0.86
	15th day	96.81	15	5.26	1.36

Paired Differences						t	df	p-value
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
				Lower	Upper			
Cold cure acrylic resin	3.11	8.53	2.20	-1.61	7.83	1.412	14	0.180 NS,p>0.05
Hot cure acrylic resin	1.13	5.69	1.47	-2.01	4.28	0.771	14	0.453 NS,p>0.05

DOI: 10.14260/jemds/2015/1037

Result of the study was not statistically significant, there was no difference in the hardness of samples before and after disinfection with microwave.

DISCUSSION: Dental prosthesis are usually fabricated in acrylic resin. Self-cure acrylic resin are used for temporary purposes and heat cure acrylic resin are used for permanent purposes. In days of cross-infection it is mandatory for every person to perform disinfection procedure for all the stages of denture fabrication. This investigation evaluates the effect of microwave disinfection on the hardness of heat cure and self-cure acrylic resin. Heat cure and self-cure acrylic resin (DPI) revealed non-significant decrease in hardness after disinfection with microwave.

Shen et al reported that the rigidity and surface morphology of denture base resins were affected by glutaraldehyde-based disinfectants (alkaline, phenol buffered.[8] It may be assumed that the sodium hypochlorite solution may have penetrated into the tested materials and resulted in softening. Asad et al[8] reported that a significant decrease in hardness was observed when heat-polymerized resin specimens were immersed in 0.5% chlorhexidine gluconate solution for 7 days.[3] Residual monomer content may adversely affect the mechanical properties of denture base resins owing to a plasticizing effect which reduces the inter-chain forces so that deformation occurs more easily under load during hardness tests. Dixon et al evaluated the effect of 5 exposures to microwave irradiation as a disinfection method for dentures on the hardness of denture base materials. The authors found that there were no significant differences for the resilient lining material (Molloplast-B; Detax, Ettlingen, Germany) (39.9 Shore A), and the denture base acrylic resin (Lucitone 199) (98.4 Shore A) tested.[9]

Rockwell Hardness Tester was used for 6 min at 650W to check the hardness of heat cure and self-cure acrylic resin before and after disinfection with microwave. The heat cure acrylic resin exhibited more hardness than self-cure in control group. Self-cure acrylic resin exhibited more loss of hardness as compared to heat cure acrylic resin after disinfection for 7 days. Microwave disinfection for 15 days, heat cure acrylic resin exhibited marginal loss than self-cure where more loss of hardness is observed. Self-cure acrylic resin materials exhibited more reduction in hardness as compared to heat cure acrylic resin materials after microwave disinfection. However this loss of hardness has negligible influence on the functioning of the prosthesis. In spite of various investigation there exists a need for further research to elucidate, the efficacy of microwave disinfection of the hardness of heat cure and self-cure acrylic resins.

CONCLUSION: Control of cross-infection has been a subject of interest to the dental area over the last few decades, due to the concern about the transmission of infectious-contagious diseases, such as AIDS, hepatitis, tuberculosis, pneumonia, and herpes, between the dental patients and dental personnel and the dental office and dental prosthesis laboratory. Dental practitioner has a legal and ethical responsibility to prevent infections in patients and staff members and an interest in protecting her-himself from contracting a disease from a patient. Microwave disinfection is an effective, quick, easy, and inexpensive versatile tool that can be performed by dentists, assistants, technicians, patients and/or their caregivers to inactivate microorganisms. In addition, the use of a microwave oven does not require special storage and does not induce resistance for fungi or other microorganisms. Thus this method may have an important potential use in dental offices, dental laboratories, and institutions and hospitals in which patients are treated, especially those wearing

removable dentures. Further studies using different brands of acrylic resin should be carried out to strengthen the research data.

REFERENCES:

1. Karin Hermana Neppelenbroek, DDS, MSc, a Ana Cla´udia Pavarina, DDS, MSc, PhD, b. Carlos Eduardo Vergani, DDS, MSc, PhD, c and Eunice Teresinha Giampaolo, DDS, MSc, PhDd: Hardness of heat-polymerized acrylic resins after disinfection and long-term water immersion, Journal Of Prosthetic Dentistry 2005; 93: 171-6.
2. Smith DC. The cleansing of dentures. Dent Pract Dent Rec 1966; 17: 39-43.
3. Asad T, Watkinson AC, Huggett R. The effects of various disinfectant solutions on the surface hardness of an acrylic resin denture base material. Int J Prosthodont 1993; 6: 9-12.
4. Polyzois GL, Zissis AJ, Yannikakis SA. The effect of glutaraldehyde and microwave disinfection on some properties of acrylic denture resin. Int JProsthodont 1995; 8: 150-4.
5. Asad T, Watkinson AC, Huggett R. The effect of disinfection procedureson flexural properties of denture base acrylic resins. J Prosthet Dent1992; 68: 191-5.
6. 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.
7. Ana Lucia Machado, DDS, MSc, PhD; Larry C. Breeding, MSc, DMD; and Aaron D. Puckett, PhD. Effect of Microwave Disinfection Procedures on Torsional Bond Strengths of Two Hard Chair side Denture Reline Materials J Prosthodont 2006; 15: 337-344.
8. Shen C, Javid NS, Colaizzi FA. The effect of glutaraldehyde base disinfectants on denture base resins. J Prosthet Dent 1989; 61: 583-9.
9. Dixon DL, Breeding LC, Faler TA: Microwave disinfection of denture base materials colonized with Candida albicans. J Prosthet Dent 1999; 81: 207-214.

AUTHORS:

1. Neha Ahuja
2. A. J. Pakhan
3. S. R. Godbole
4. Seema Sathe
5. Yashshree Sancheti

PARTICULARS OF CONTRIBUTORS:

1. Post Graduate Student, Department of Prosthodontics. Datta Meghe Institute of Medical Sciences.
2. Dean, Professor & Guide, Department of Prosthodontics. Datta Meghe Institute of Medical Sciences.
3. HOD, Department of Prosthodontics. Datta Meghe Institute of Medical Sciences.
4. Professor, Department of Prosthodontics. Datta Meghe Institute of Medical Sciences.
5. Post Graduate Student, Department of Prosthodontics. Datta Meghe Institute of Medical Sciences.

NAME ADDRESS EMAIL ID OF THE CORRESPONDING AUTHOR:

Dr. Neha Ahuja,
Radhikabai PG Hostel,
SPDC, Sawangi (M),
Wardha.
E-mail: drneha.a.ahuja@gmail.com

FINANCIAL OR OTHER COMPETING INTERESTS: None

Date of Submission: 28/04/2015.
Date of Peer Review: 29/04/2015.
Date of Acceptance: 13/05/2015.
Date of Publishing: 19/05/2015.