MEDDOCS Open Access Publisher

ISSN: 2639-9210

Annals of Dentistry and Oral Health

Open Access | Research Article

To compare microwave and chemical disinfection and their effect on the dimensional stability of dental stone casts

Samarth Kumar Agarwal*; Romil Singhal; Nimra Mehraj

Department of Prosthodontics and Crown & Bridge, Kothiwal Dental College & Research Centre, Moradabad-244001, Uttar Pradesh, India

***Corresponding Author(s): Samarth Kumar Agarwal**
Professor, Department of Prosthodontics and Crown & Bridge, Kothiwal Dental College & Research Centre, Moradabad-244001, Uttar Pradesh, India
Email: dr.samarthagarwal@yahoo.co.in

Received: Mar 05, 2020

Accepted: Apr 22, 2020

Published Online: Apr 24, 2020

Journal: Annals of Dentistry and Oral Health

Publisher: MedDocs Publishers LLC

Online edition: http://meddocsonline.org/

Copyright: © Agarwal SK (2020). *This Article is distributed under the terms of Creative Commons Attribution 4.0 International License*

Keywords: Disinfection; Dimensional stability chemical disinfection; Microwave irradiation.

Abstract

Introduction: when the impression is removed from the patient mouth, it gets contaminated with the pathogenic microorganisms that are transported between the dental clinic and laboratory and may affect dental personale.

Materials and method: Forty impressions of a sterile metallic die using Zelgan 2002 were contaminated with suspension of staphylococcus aureus and pseudomonas aeruginosa respectively and poured in partitioned impressions to obtain 120 casts of Kalstone with the segments marked A,B and C for each cast. Part A and Part B were disinfected with microwave irradiation and chemical disinfectant and Part C was left untreated to serve as control. Scrapings of specimens were cultured and assessed for bacterial growth (cfu/ml). To evaluate dimensional stability seventy five Kalstone discs were prepared using an aluminium mould according to ADA specification 19. Linear dimension (A-B) was measured for each specimen using travelling microscope for dimensional stability

Results: Highly statistical significant difference ($p<0.01$) was seen between microwave irradiation and chemical disinfectant and there was no statistically significant difference of both on dimensional stability on Kalstone discs.

Conclusion: Microwave irradiation was more effective over chemical disinfection. There was no effect of microwave irradiation and chemical disinfection on the dimensional stability of Kalstone discs.

Cite this article: Agarwal SK, Singhal R, Mehraj N. To compare microwave and chemical disinfection and their effect on the dimensional stability of dental stone casts. Ann Dent Oral Health. 2020; 3(1): 1015.

Introduction

Disinfection means the destruction or removal of all pathogenic organisms capable of giving rise to infection [1]. The disinfection of the dental impressions has become a critical for dental professionals because it may be the first link in microbial contamination during dental care. In prosthodontics objects potentially contaminated with pathogenic microorganisms are transported between the dental clinics to dental laboratory [2].

From the dental laboratory point of view, a more practical approach may be to wash the impression of visible contaminants such as blood and saliva, pour the stone cast and then sterilize the cast [3,4]. One major concern regarding infection control is the effect of disinfection on dental impression materials. Concerns exist regarding any chemical interaction between the impression complex and the disinfectant solution and the effects of such interaction on the resultant models [5].

It is important that disinfectant solutions be effective as antimicrobial agents, but they should not depreciate the physical property like dimensional stability of gypsum cast and dies [7]. Dimensional stability is defined as the ability of a material to retain its size and form and require for exact replication of cast and dies and prosthesis made on it [6].

The aim of the present in vitro study is to compare the efficacy of microwave irradiation and chemical disinfection and their effect on the dimensional stability of gypsum casts.

Materials and method

Study was divided into two sections: one was to compare the effectiveness of microwave and chemical disinfection; and another was to evaluate the effect of these disinfectants on the dimensional stability of gypsum casts.

Microwave irradiation and chemical disinfection

Forty impressions of a sterile metallic die were made using Zelgan 2002 (Densply India) irreversible hydrocolloid impression material. These impressions were divided into 2 groups each having 20 specimen and each group was contaminated with staphylococcus aureus and pseudomonas aeruginosa respectively. Two sterile aluminium plates were embedded into the impression surface to divide the impression into three parts and the impression was then poured in Kalstone (Kalabhai Karson Pvt. Ltd.) and allowed to set for 45 minutes. Total 60 infected casts with marking A, B, C were retrieved and divided into three groups:

Group 1: Part A of 20 Kalstone casts were used for microwave irradiation by placing it on a sterilized plate of household microwave oven and irradiate at 2450 MHZ, 900W for 5 minutes [3].

Group 2: Part B of 20 Kalstone casts were used for chemical disinfection by immersing in 0.07% sodium hypochlorite solution for 10 minutes [2].

Group 3: Part C of 20 Kalstone casts were used as a control group which was not treated at all.

A suspension was made by mixing three grams of soyabean casein digest broth in 100ml of distilled water in a sterile glass beaker. The 1.2 ml of suspension was poured into sixty sterile test tubes (Fig 1). Surfaces of Kalstone cast of group 1, 2 and 3 were scraped off with a sterile B.P. knife and these scrapings were dropped into 60 test tubes containing Soyabean Digest Broth. Same procedure was repeated to prepare another 60 test tubes with scrapings of casts contaminated with pseudomonas aeruginosa. These 120 test tubes of soyabean Digest Broth were then placed in an incubator at 37^0C for six hours.

For the development of colony on agar plate a suspension was made by mixing four grams of Soyabean Agar Veg powder in 100 ml of distilled water in a sterile glass beaker. The suspension was poured into a sterile disposable petridish and was covered with a lid for 4 hours. Once the liquid solidified after slow and gradual cooling in the closed petridish, it was preserved in a deep freezer for six hours. The inoculation loop was preheated and allowed to gradually cool and then dipped in the test tubes containing scrapings and streaked on the agar culture plate. The procedure was carried out for 120 test tubes. The plates were placed in the incubator for 18 hours to allow growth of bacterial colonies. The colonies were then counted with the help of bacterial colony measuring counter.

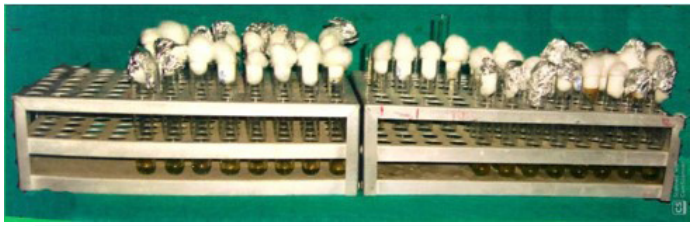

Figure 1: Suspension of Tryptic Soy Broth

Method to evaluate dimensional stability

Fabrication of the mould

According to ADA specification No. 19 a 31mm high solid cylinder of aluminium was made which had three parts: ruled aluminium block, metal collar and riser.

The outer diameter of the aluminium block was 38 mm and inner diameter was 30 mm. On this inner surface three parallel lines X Y and Z were engraved, 2.5 mm apart from each other, with line Y passing through centre denoting the diameter of the circular surface. Two lines (cd and c'd') were engraved perpendicular to the Y line such that cd and c'd' were equidistant from the centre and 25 mm apart from each other. The intersection of line cd and line Y was denoted as Point A and that of line c'd' and Y as Point B. When the metal collar was placed over the test surface of the aluminium block a mould cavity was observed measuring 30 mm in diameter and 2.5mm in depth which would be the dimensions of test specimen.

Prepration of test specimens

The aluminium block and the metal collar was lubricated with white petroleum jelly except the ruled surface to allow accurate reproduction of the said markings. The ruled surface was cleaned with 70% ethylalcohol to remove any foreign material. Seventy five discs of Kalstone were made by manually mixing of Kalstone in distilled water using 0.30 w/p ratio. This mix was vibrated on to the mould cavity and covered by galss plate under firm pressure to smoothen the surface and left undisturbed for 45 minutes. Seventy five discs were retrieved with the help of riser without damaging the markings reproduced on the surface of disc. 25 discs were dipped in 0.07 % sodium hypochlorite chemical disinfectant for 10 mins, 25 discs were irradiated in microwave oven for 5 minutes and 25 discs were left untreated for the control group (Fig 2). The dimensional changes were evaluated under travelling microscope at 30X magnifications. The specimen was placed under the eyepiece and the distance between the cross lines cd and c'd' and measured and then

recorded. Dimensional changes were calculate. Data obtained was statistically analysed.

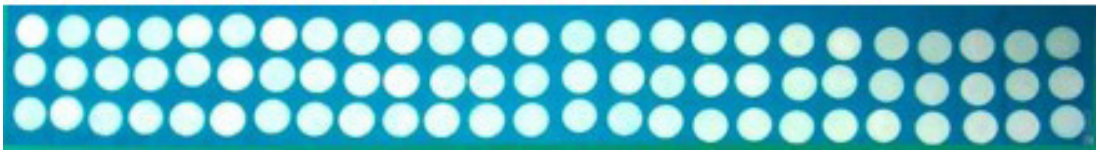

Figure 2: Seventy five Kalstone discs.

Results

Table 1: Seventy five Kalstone discs.

S.no	Level of microbial load	Number of specimens					
		Control		Microwave		0.07% sodium hypochlorite	
		No.	%	No.	%	No.	%
1.	10^0	0	0	19	95	0	0
2.	10^1	0	0	0	0	5	25
3.	10^2	0	0	0	0	14	70
4.	10^3	0	0	0	0	1	5
5.	10^4	0	0	0	0	0	0
6.	10^5	0	0	0	0	0	0
7.	10^6	19	95	0	0	0	0
8.	10^7	1	5	0	0	0	0
Median rank		10^6		10^0		10^2	

Z: 56.480;p<0.001 (wilcoxon signed rank test)

On comparing data statistically for samples contaminated with staphylococcus aureus a significant difference was seen on comparing microbial load to control as well as chemical group (p<0.001) while chemically treated group had significantly lower microbial load as compared to control (p<0.001).

Table 2: Comparison of three groups for Staphylococcus aureus.

S.no	Comparison	"Z"	"p"
1.	Control vs microwave	6.102	<0.001
2.	Control vs chemical	5.873	<0.001
3.	Chemical vs microwave	5.805	<0.001

Table 3: Assess the presence of microbial load of pseudomonas aeruginosa

S.no	Level of microbial load	Number of specimens					
		Control		Microwave		0.07% sodium hypochlorite	
		No.	%	No.	%	No.	%
1.	10^0	0	0	20	100	0	0
2.	10^1	0	0	0	0	1	5
3.	10^2	0	0	0	0	16	80
4.	10^3	0	0	0	0	3	15
5.	10^4	0	0	0	0	0	0
6.	10^5	0	0	0	0	0	0
7.	10^6	20	100	0	0	0	0
Median rank		10^6		10^0		10^2	

Z: 57.833;p<0.001 (wilcoxon signed rank test)

On comparing data statistically for samples contaminated with pseudomonas aeruginosa a significant difference was seen on comparing microbial load to control as well as chemical group (p<0.001) while chemically treated ,group had significantly lower microbial load as compared to control(p<0.001).

Table 4: Comparison of three groups for Pseudomonas aeurignosa.

S.No	Comparison	"Z"	"p"
1.	Control vs microwave	6.245	<0.001
2.	Control vs chemical	6.007	<0.001
3.	Chemical vs microwave	6.007	<0.001

The difference in mean dimension as compared to control group did not show a statistically significant difference between microwave and chemical treated specimen (p=0.573).

Table 5: Comparison of dimensional stability in different groups

S.No	Variable	Microwave	Chemical
1.	Mean dimension	25.0136	25.0144
2.	SD	0.0049	0.0051
3.	Mean difference from control	0.0036	0.0144
4.	Comparison of difference	t=0.568; p= 0.573	

Discussion

In this study microwave irradiation and 0.07% sodium hypochlorite chemical disinfection were compared and their effects on dimensional stability of Kalstone casts were evaluated. The household microwave was used at 2450 MHZ, 900 W for 5 minutes as it is effective disinfectant according to previous studies [2,3,8]. The concentration of sodium hypochlorite being used was 0.07% in this study. In higher concentrations it causes dimensional instability due to its high oxidative and corrosive property [9-12]. In the present study the samples were contaminated by two strains as indicators of different types of pathogen microorganisms and commonly found in oral cavity. Vegetative strains of gram positive non-sporogenic bacteria (S. aureus) and gram negative non-sporogenic bacteria (P. aeruginosa) were recommended as indicators of pathogens.

In statistical analyses wilcoxan signed rank test has been done to assess the presence of microbial load i.e. staphylococcus aureus and pseudomonas aeruginosa colonies in Kalstone casts of different groups. The findings of present study showed that microorganisms were reduced on dental cast after microwave irradiation and chemical disinfection (Table 1 and 3).

The results in table 2 and 4 showed that irradiated method was effective for both staphylococcus aureus and pseudomonas aeruginosa and 0.07% sodium hypochloride suspension was more effective for staphylococcus aureus than pseudomonas

aeruginosa but on comparison of the microwave irradiation and 0.07% sodium hypochlorite chemical disinfection method microwave was superior over 0.07% sodium hypochlorite chemical disinfected casts. The differences in the microbial load for 0.07% sodium hypochlorite treated casts may be due to fact that this concentration was unable to kill all the microorganisms or dipping for 10 minutes in 0.07% sodium hypochlorite was not effective. These findings are in agreement with Berg et al. Tullner et al. and Abbas et al [2,6,8].

For dimensional stability the difference in mean dimension as compared to control group did not show a statistically significant difference between microwave irradiation and chemical disinfected specimen because t= 0.568; and p= 0.573 which shows non significant values. The dimensional stability of the microwave irradiation and chemical disinfection was found to be similar and there was no significant difference found between two materials. Results of previous studies were similar on dimensional stability of Kalstone cast [8,13].

Conclusion

1. Marked reduction of bacterial colony forming units per milliliter for both the staphylococcus aureus and pseudomonas aeruginosa by microwave irradiation and 0.07 sodium hypochlorite chemical disinfection.
2. Suspension of sodium hypochlorite was more effective against staphylococcus aureus than pseudomonas aeruginosa.
3. Microwave irradiation was more effective over 0.07% sodium hypochlorite chemical disinfection.
4. There was no effect of microwave irradiation and 0.07% sodium hypochlorite chemical disinfection on the dimensional stability of Kalstone discs.

References

1. Ananthanarayan R, Paniker CKJ. Textbook of Microbiology. 6th ed. Orient Longman. Hyderbad. 2000: 23.
2. Berg E, Skaug NN. High level microwave disinfection of dental gypsum casts. Int J Prosthodont. 2005; 18: 520-525.
3. Davis DR, Curtis DA, White JM. Microwave irradiation of contaminated dental casts. Quintessence Int. 1989; 20: 583-595.
4. Schutt RW. Bactericidal effect of a disinfectant dental stone on irreversible hydrocolloid impressions and stone casts. J Prosthet Dent. 1989; 62: 605-607.
5. Rios MD, Morgano SM, Sheldon-Stein R, Rose L. Effect of chemical disinfectant solutions on the stability and accuracy of the dental impression complex. J Prosthet Dent. 1996; 76: 356-362.
6. Tullner JB, Commette JA, Moon PC. Linear dimensional changes in dental impressions after immersion in disinfectant solutions. J Prosthet Dent. 1988; 60: 725-729.
7. The glossary of prosthodontic terms. J Prosthet Dent. 2005; 94: 32.
8. Abbas SM, Mahmood MA, Khalaf BS. Effect of microwave irradiation on the disinfection, dimentional accuracy and surface porosity of dental casts. Med J Dent. 2011; 8: 177-187.
9. Rueggeberg FA, Beall E, Kelly MT, Schuster GS. Sodium hypochlorite disinfection of irreversible hydrocolloid impression material. J Prosthet Dent. 1992; 67: 628-631.
10. Vandewalle KG, Charlton DG, Schwartz RS, Reagan SE, Koeppen RG. Immersion disinfection of irreversible hydrocolloid impressions with sodium hypochlorite. Part 1: effect on gypsum. Int J Prosthodont. 1994; 7: 315-322.
11. DaSilva SMLM, Salvador MCG. Effect of the disinfection technique on the linear dimensional stability of dental impressions materials. J App Oral Sci. 2004; 12: 244-249.
12. Amin WM, Al-Ali MH, Tarawneh SKA, Taha ST, Saleh MW, et al. The effects of disinfectants on dimensional accuracy and surface quality of impression materials and gypsum casts. J Clin Med Res. 2009; 1: 81-89.
13. Powell GL, Runnells RD, Saxon BA, Whisenant BK. The presence and identification of organisms transmitted to dental laboratories. J Prosthet Dent. 1990; 64: 235-237.