

Comparative Study to Evaluate the Surface Detail Reproduction of Dental Stone after Immersion in Various Different Disinfectant Solutions, Under Stereomicroscope 10 X Magnification –An In-Vitro Study

Rathika Rai, M A Easwaran, K T Dhivya

Department of Prosthodontics, Thai Moogambigai Dental College and Hospital Chennai, Tami Nadu, India.

Available Online: 25th March, 2017

ABSTRACT

Aim: To evaluate the surface detail reproduction of dental stone this is immersed in different disinfectant solution and studied under stereomicroscope. **Methodology:** Total number of 30 specimens of dental stone (Type III) were made with measurements of 1.5cm diameter and 1cm height. This samples are divided into 3 groups group A,B,C. were A is immersed in Distilled water which was taken as control group ;B is immersed in 2% Glutaraldehyde and C is immersed in 5% sodium hypochlorite. Each specimen were immersed in the disinfectant solution for 15 minutes and dried under room temperature for 24 hrs. After 24 hrs each specimens are studied under stereomicroscope for surface details. **Result:** The results showed no significant difference in the surface irregularities and porosities for a group 1 and group 2 except group 3 which showed significant increase in the porosities, surface irregularities and erosions after disinfection with 5% NaHOCl by immersion method. **Conclusion:** The surface detail reproduction capacity of die stone was adversely affected when 5% Sodium hypochlorite was used as disinfectant solution when compared to control group and 2% Glutaraldehyde.

Keywords: Dental Stone, Distilled Water, Stereomicroscope, Sodium hypochlorite, Glutaraldehyde.

INTRODUCTION

The need for an infection control program is felt because a number of bacteria, fungi, and viruses present in the dental environment have been linked to debilitating and life-threatening diseases. Every effort, therefore, must be made to avoid cross contamination of these microorganisms and to prevent the potential transfer of disease in the dental setting.

One common dental procedure that may cause cross contamination, especially between patients and dental laboratory personnel, is transfer of infectious agents from blood and saliva to the casts through impressions, record bases, occlusion rims, and trial dentures¹.

Gypsum products have been considered to be among the most widely used model and die materials. American Dental Association (ADA) and the Center for disease control and prevention (CDC) have suggested methods for the disinfection of dental casts including immersion in (or) spraying with a disinfectant. Several studies have been attempted to come up with an improved system for models and die constructions, the dental cast comes into direct contact with the impression which is made from the patients mouth contaminated with saliva and blood. To prevent the cross contamination these dental cast are disinfected with various solution; these disinfectant solution have adverse effect on dental cast². The properties of disinfectant influence the final outcome of gypsum cast but very rarely they are subjected to comparative

evaluation. Indian market is presently flooded with a number of brands and it was found to be necessary to evaluate the working properties to aid the clinician in selecting appropriate and quality material³.

Objective

The objective of this study was to evaluate the surface detail reproduction of the dental stone immersed in different disinfectant solution

MATERIALS

Dental stone (type III)
Rubber bowl Straight Spatula
Stainless steel rings
Petroleum jelly
Glass plate
Disinfecting solutions used in the study
Distilled water
2% Glutaraldehyde
5% Sodium hypochlorite
Equipments
Stereomicroscope 10 X magnification

METHODOLOGY

The apparatus for detail reproduction with gypsum was made using the standardized stainless steels master dies (1.5cm diameter and 1cm height) in fig .1 .A total number of 30 specimens of dental stone (Type III) were made.



Figure 1:



Figure 2:



Figure 3:

Table 1: One way ANOVA.

group	N	Mean	Std. Deviation	P value	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Water	10	2.0000	1.63299	<0.001	.8318	3.1682	0.00	4.00
2% GLUT	10	5.1000	2.13177		3.5750	6.6250	1.00	8.00
5% NaHocl	10	22.2000	3.39280		19.7729	24.6271	18.00	27.00

Prior to fabricating each specimen, the surface of the master metal die was rinsed with distilled water, dried and coated with thin layer of petroleum jelly. Dental stone was mixed according to manufacturer's instructions. The dental stone was mixed with water (water powder ratio 0.28-0.30) for one minute and added to the die in small increments which is over a glass plate and placed on a mechanical vibrator to prevent formation of air bubbles. The cylindrical specimens were allowed to set for 1 h at room temperature of $20^{\circ}\text{C} \pm 2^{\circ}\text{C}$. Similarly, 30 specimens were produced

These specimens were grouped into 3 groups with 10 specimens in each

Group A – Distilled water

Group B - 2% Glutaraldehyde

Group C- 5 %sodium hypochlorite

For the analysis of surface reproduction of dental stone; the group A which is immersed in distilled water was taken as control group. Each specimens were immersed in the

disinfectant solution for 15 minutes and dried under room temperature for 24 hrs .After 24 hrs each specimens are studied under stereomicroscope for surface details.

Each stone specimen was marked with 5mm x 5mm square in the middle of the specimen to examine under microscope as shown in the fig 2

Numbers of pores are counted for each specimen in the marked square shaped box and the statistical analysis is done

In Prosthodontics, objects potentially contaminated with pathogenic microorganisms are transported between dental laboratory and dental clinic. It has been claimed that to avoid cross contamination, specific disinfection measures should be followed. In the literature, the usual solution to this problem has been to chemically disinfect either the impressions or gypsum casts⁵.

In this study, gypsum specimens disinfected with immersion in disinfectant agents revealed the following results regarding the evaluated properties. Results were

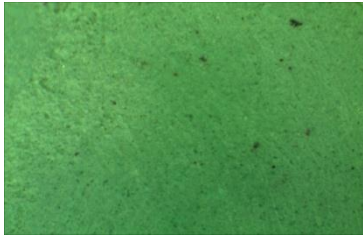


Figure 4: Group A specimens which is immersed in distilled water does not have any effect on the physical properties of the specimen, the surface were smooth and no surface irregularities were seen

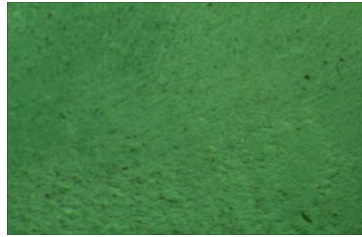


Figure 5: Group B specimens which is immersed in 2% Glutaraldehyde showed the same results as group A without any surface irregularities as showed in group A but had few number of pores

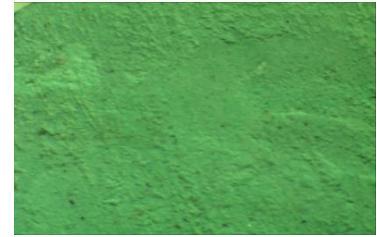


Figure 6: Group C specimens which is immersed in 5 % sodium hypochlorite showed adverse effect on the physical properties of the dental stone ,there are many surface irregularities and more number of porosities; the surface were not smooth and regular .

Table 2: Tukey HSD

(I) grp	(J) grp	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
DISTILLED WATER	2% GLUT	-3.10000*	1.11721	.026	-5.8700	-.3300
	5% NaHOCL	-20.20000*	1.11721	.000	-22.9700	-17.4300
2% GLUT	DISTILLED WATER	3.10000*	1.11721	.026	.3300	5.8700
	5% NaHOCL	-17.10000*	1.11721	.000	-19.8700	-14.3300
5% NaHOCL	DISTILLED WATER	20.20000*	1.11721	.000	17.4300	22.9700
	2% GLUT	17.10000*	1.11721	.000	14.3300	19.8700

*. The mean difference is significant at the 0.05 level.

obtained from the dental stone specimen after completely dried which is examined under stereomicroscope 10 X magnification for surface details.

The stereo (or) stereoscopic (or) dissecting microscope is an optical microscope variant designed for low magnification observation of sample, typically using light reflection from the surface of an object rather than transmitting through it instrument has 2 separate optical path with 2 objective and eyepieces to provide slight different viewing angles to left & right eyes, This arrangement produces a three dimensional visualization of the sample, The stereomicroscope overlaps macro photography for recording and examining the solid sample with complex surface topography and the three dimensional view is needed for analyzing the details.

The porosities in each sample were counted and the statistical mean value was calculated by One way ANOVA and Tukey HSD analysis.

RESULTS

The mean and standard deviation of the surface porosities of all tested group are listed in table (1). The results showed no significant difference in the porosities for a group 1 and group 2 except group 3 which showed significant increase in the porosities after disinfection with 5% NaHOCl by immersion method. The mean and standard deviation of the surface porosity for each tested group were calculated and listed in table (2). The results showed no significant difference in mean porosity for group 1&2 stone except the group 3 which is immersed in NaHOCl was high.

Post HOC Analysis

A porous surface will present more irregularities, depressions and ditches, which can contribute to higher roughness values. This correlation can be observed in the present study, since the specimens that presented the highest roughness values were also the most porous⁴.

Hypochlorite is a popular disinfecting solution with high toxicity. Glutaraldehyde is a safe substance with adequate disinfecting properties. Thus, considering the fact that in the process of denture fabrication, casts and articulator need to be transferred from the office to the lab and vice versa for a safe effective disinfection technique is critical.

DISCUSSION

Interaction between dental clinic and dental laboratory personnel is intrinsic in practice of general dentistry. Transmission of infected materials from the clinic to the laboratory and then back to clinic not only place unaware staff at risk, but also results in high level of cross-contamination. Research over the past have demonstrated that microorganisms can be transferred from the stone casts to dental personnel handling the casts in first 24 hrs, following separation from the contaminated impressions. To overcome this, several methods have been proposed to disinfect the impressions and cast satisfactorily. According to guidelines proposed by ADA council (1996)⁶, it is recommended that the impressions should be rinsed under running water to remove saliva and to perform immersion disinfection using any compatible disinfectant for varying lengths of time. The techniques recommended for

disinfecting dental casts include immersion or a topical spray with a disinfectant solution. However Rudd et al (1970) showed that immersing a stone cast in tap water alone for 15 minutes altered surface properties. Since it is recommended that a cast should remain submerged in the solution for up to 30 minutes to achieve a disinfected surface, it is probable that there will be a negative effect on the surface integrity of the cast⁷.

Hence an alternative approach to cast immersion and spray disinfection i.e., incorporating disinfectants into gypsum at the time of its mixing has been proposed. Studies have shown that incorporation of disinfectants into gypsum at the time of mixing produced a significant and acceptable reduction in the number of bacteria. This indicates that addition of disinfectants to gypsum may be useful method to disinfect both the cast and impression. The specimens for surface detail reproduction were evaluated using stereoscopic microscope. M.G.Lucas et al conducted a study on surface detail reproduction and concluded that incorporation of 2% Glutaraldehyde solution presented results which are similar to the control group⁸. The various ADA recommended concentrations of Sodium hypochlorite for disinfection are 0.5%, 1%, 2%, 5% and 5.25%. However, all the previous studies done so far used only lower concentrations of Sodium hypochlorite to evaluate their effect on the physical properties of Gypsum products. In this study 5% Sodium hypochlorite was used to immerse the dental stone and the specimens were tested for surface detail reproduction.

The statistical analysis of the results achieved by one way ANOVA showed that the std Deviation for distilled water is 1.63299, 2% gluteraldehyde is 2.13177 and 5% NaHOCl is 3.39280 with the P value < 0.001. The surface detail reproduction of the dental stone was affected adversely by sodium hypochlorite and it was very low in case of distilled water, But the disinfectant property of distilled water is doubtful and unsatisfactory, Hence Glutaraldehyde can be used as effective disinfectant solution.

CONCLUSION

Within the limitation of the study
Surface Detail Reproduction:

The surface detail reproduction capacity of die stone was similar with that of control group when 2% Glutaraldehyde was used as disinfectant solution. The surface detail reproduction capacity of die stone was adversely affected when 5% Sodium hypochlorite was used as disinfectant solution when compared to control group. The surface detail reproduction capacity of die stone was less affected by 2% Glutaraldehyde as compared to 5% Sodium hypochlorite.

REFERENCES

1. Abdelaziz KM, Combe EC, Hodges JS: The effect of disinfectant additives on the properties of dental gypsum: 1. Mechanical properties. *J Prosthodont* 2002; 11:161-167.
2. Breault, LG, Paul JR, Hondrum SO, et al: Die stone disinfection: incorporation of sodium hypochlorite. *J Prosthodont* 1998; 1:13-16.
3. Ivanovski S, Savage, NW, Brockhurst PJ, et al: Disinfection of dental stone casts: antimicrobial effects and physical property alterations. *Dent Mater* 1995; 1:19-23.
4. Mansfield SM, White JM: Antimicrobial effects from incorporation of disinfectants into gypsum casts. *Int J Prosthodont* 1991; 4:180-185.
5. Matheus GL, Joao NAF, Sergio SN, Andre UDB, Rodrigo DPP. Effect of Incorporation of Disinfectant Solutions on Setting Time, Linear Dimensional Stability, and Detail Reproduction in Dental Stone Casts. *J Prosthodontics* 2009; 18: 521-526.
6. ADA Council, Infection control recommendations for the dental office and the dental laboratory. *Journal of American Dental Association* 1996; 127: 672 - 680.
7. Rudd KD, Morrow RM, Brown CE Jr, Powell JM, Rahe AJ, Comparison of effects of tap water and slurry water on gypsum casts. *Journal of Prosthetic Dentistry* 1970; 24:563-70.
8. M.G. Lucas, J.N.Arioli-Filho, S.Nogueira, A.U.D.Batista, R.P.Pereira, Effect of Incorporation of Disinfectant Solutions on Setting time, Linear Dimensional Stability and Detail Reproduction in Dental Stone Casts. *Journal of Prosthodontics* 2009;18: 521-526.