

# Disinfection of Dental Gypsum Model with 0.5% Sodium Hypochlorite: Effect on Dimensional Stability

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## ABSTRACT

**Objective:** To evaluate and compare the effect different techniques of disinfection of irreversible hydrocolloid and type III dental gypsum, with 0.5% NaOCl, on their (linear) dimensional stability.

**Study design:** Quasi Experimental study.

**Setting:** Department of Metallurgy, Pakistan Council for Scientific and Industrial Research (PCSIR) Lahore.

**Duration with dates:** Six months, from June 1, 2006 to November 30, 2006.

**Subjects and methods:** Ninety (90) casts were made from Irreversible Hydrocolloid Impression by non-probability purposive sampling technique. Measurements of the casts at three specific points were carried out using measurement guiding template through screw gauge and were recorded.

**Results:** In this study Sodium Hypochloride 0.5% was used as disinfectant material for type III dental gypsum. Disinfection of type III dental gypsum, by Sodium Hypochloride 0.5% had no negative effect on their linear dimensional stability.

**Conclusion:** Disinfection of Dental Gypsum type – III either by immersion and incorporation is easy and dimensionally stable.

**Key-words:** Disinfection, cross infection, Sodium Hypochlorite, immersion, incorporation.

## INTRODUCTION

Currently dental patients and professionals are more concern for the infection control<sup>1-12</sup>. It is well established that oral cavity harbors a large number of opportunistic and pathogenic microorganisms. These may travel through contaminated dental impressions, casts, intra-oral records and patient's oral prosthesis. Thus may communicate to the dental personals including dentist, dental assistants, dental technicians and also to other patients<sup>13-15</sup>.

There is low level of infection control in dental practice in Pakistan.<sup>16</sup> Infectious diseases on the other hand are comprises one of the main burden among all diseases in Pakistan<sup>17</sup>.

The restorative dental treatment modalities also have indirect options which include fabrication of inlays, onlay, fixed or removable dentures over the cast of made of dental gypsum. The fabrication of prosthesis carries the risk of oral microorganisms to be transferred through the impression, dental cast and other prosthodontic records to the dental laboratories<sup>11-13,18-20</sup>. Therefore, this makes the disinfection of impressions and/or casts crucial without altering their dimensional stability and accuracy<sup>1,9,10,20-23</sup>.

Various methods have been devised and tested for the control of cross infection through dental impressions but, there are many reservations<sup>1-3,8,12,20</sup>.

Irreversible Hydrocolloid i.e. Sodium Alginate is most commonly used dental impression material<sup>3,6,7</sup>. Due to property of imbibition it may carry significantly higher numbers of bacteria, on the other hand the disinfection procedures are considerably less effective and/or difficult<sup>3,6,12,23-26</sup>.

Dental gypsum i.e. Calcium Sulphate hemihydrate ( $\text{CaSO}_4 \cdot \frac{1}{2} \text{H}_2\text{O}$ ), is most widely used for the die/cast formation<sup>13,27</sup>. Cast poured against contaminated impression have shown microorganisms; therefore, disinfection of stone cast is an important measure for the control of cross contamination. Disinfection should not alter the physical properties<sup>1,3,6</sup> of the cast, as the, prosthesis fabricated on the dimensionally distorted cast may exhibit poor fit.

Linear dimensional stability of the resultant cast is of utmost importance for the fabrication of dental prostheses. Therefore the purpose of this study is to evaluate and compare the effect on the linear dimensional stability of type III dental gypsum when disinfection treatment is given by immersion or incorporation of 0.5% Sodium Hypochlorite (NaOCl).

## OBJECTIVES

The objectives of this study are to evaluate and compare the effect of different techniques of disinfection of type III dental gypsum, with 0.5% NaOCl, on their linear dimensional stability. Disinfection of dental gypsum with 0.5 % Sodium Hypochlorite (NaOCl) does not produce linear dimensional instability.

## MATERIAL AND METHODS

This Quasi Experimental Design study was carried out in the Department of Metallurgy, Pakistan Council of Scientific and Industrial Research, (PCSIR) Lahore for a period of six months from 1<sup>st</sup> June 2006 to 30<sup>th</sup> November 2006. Ninety (90) impressions of irreversible hydrocolloid impressions were made and divided into three groups.

Sampling technique was Non-Probability Purposive

### Inclusion Criteria

Type III dental gypsum mixed mechanically in vacuum mixer and poured over dental vibrator.

NaOCl was freshly diluted every time before use to 0.5% with double distilled water, using graduated cylinder.

Temperature was measured in degree centigrade by thermometer and maintain between 18<sup>o</sup>-24<sup>o</sup> C by Sabro air conditioner (dual cycle).

Humidity was measured in percentage, regulate and monitor by Humifier between 50-55%\*.

Water Powder (W/P) Ratio was followed as per manufacturer's instruction.

**Exclusion Criteria:** Distorted impressions were not considered

- a. Under-extended impressions
- b. Impressions which were detached from the tray before pouring
- c. Impressions with voids

Model with the following defects were not included.

- a. Under-extended or incomplete pouring
- b. Models with voids
- c. Models with bubbles

**Data collection:** One hundred and eleven (111) impressions were made out of which twenty-one (21) were not included in the study. Out of these as seven (7) impressions were detached from the tray and five (5) impressions had voids and nine (9) casts showed defects in pouring. Ninety (90) models/casts were selected for the study. Highly milled, aluminum master die was fabricated which resembles mandibular arch in linear fashion. The die was fixed on a perspex sheet with four guides around the die to guide and limits the improvised impression tray. The guides were placed in such a way so that the thickness of the impression material was maintained 5±1mm. The impression tray was lined with tray adhesive, for IRH impression material. The impressions were made with irreversible hydrocolloid and poured with type III dental gypsum over dental vibrator, with-in 15 minutes of mixing of alginate. Type III dental gypsum mixed mechanically in vacuum mixer. Casts removed from the impression within one hour of mixing of Alginate. Water and powder ratio were according to the manufacturer's instruction. Type III dental cast was removed in 50±10-minute after pouring. This procedure was repeated for all the models. Measurements of the models were taken in 24±1 hour using the measurement template with Screw Gauge. Sodium Hydrochlorite (NaOCl) was freshly diluted every time before use to 0.5% with double distilled water, using graduated cylinder.

Group-A: Sixty (60) casts of the test die were made in dental gypsum from irreversible hydrocolloid impressions. And the casts were treated with 0.5% Sodium Hypochlorite. The casts were divided into two sub-groups Group-A1 and A2 were subjected to disinfection treatments similar to the impression groups.

In Group-A1, thirty (30) acceptable samples, were immersed in 200ml solution of 0.5 % Sodium Hypochlorite for 10-minute.

Second sub-group i.e. Group-A2, solution 0.5% Sodium Hypochlorite was used as water substitute, of same quantity, for mixing type III dental gypsum, for model pouring. Group C: This was the control group of thirty (30) samples. No treatment was provided to alginate impressions and gypsum casts.

A template was fabricated for the measurement. Measurements were made with screw gauge with an accuracy and reliability of 0.02mm and results obtained were tabulated.

**Data analysis:** The collected data was transferred and analyzed accordingly on SPSS version 11.0. Measurements of casts were taken through screw gauge at three points. Mean and standard deviation was calculated separately for three points of measurements. The mean and standard deviation of total casts were calculated. Comparison was made for total measurements of the cast between Group A1, A2 and C with master die applying independent t-test.  $\alpha$ -error was fixed at 0.05.

## RESULTS

The descriptive analysis regarding thickness of cast in different groups is as follows:

Table 1 shows the result of at points A, B and C

Group A1 (immersion of Dental Gypsum Type III in 200ml solution of 0.5% NaOCl for 10 minutes).

Group A2 (incorporation 0.5% NaOCl in Dental Gypsum Type III in lieu of water).

Group C (Control group).

Group D (Aluminum master die).

Differential analysis regarding comparison of measurements in different groups to that of master die is given below:

In table 2 by applying Independent-Sample t-test for the quantitative data between the Group A1 with Master die (df=33) it shows statistically not significant at all three points.

In table 3 by applying Independent-Sample t-test for the quantitative data between the Group A2 with Master die (df=33) it shows statistically not significant at all three points.

In table 4 by applying Independent-Sample t-test for the quantitative data between the Group C (Control Group) with Master die (df =33) it shows statistically not significant at all three points

Table 1

Groups	Measurements $\pm$ Mean Standard Deviation		
	Point A	Point B	Point C
A1	20.02 $\pm$ 0.04	20.03 $\pm$ 0.04	20.04 $\pm$ 0.03
A2	20.02 $\pm$ 0.07	20.02 $\pm$ 0.06	20.03 $\pm$ 0.04
C	19.99 $\pm$ 0.06	19.99 $\pm$ 0.05	20.01 $\pm$ 0.04
Master Die	20.03 $\pm$ 0.004	20.03 $\pm$ 0.004	20.04 $\pm$ 0.004

Table 2: Comparison of Group B1 (immersion of dental gypsum cast in 0.5% NaOCl for 10 minutes) with Master die (df =33).

Points	Means STD DEV	T	P
<b>A</b>			
A1	20.02 $\pm$ 0.04	-0.898	N S
Master Die	20.03 $\pm$ 0.004		
<b>B</b>			
A1	20.03 $\pm$ 0.04	-0.294	N S
Master Die	20.03 $\pm$ 0.004		
<b>C</b>			
A1	20.04 $\pm$ 0.03	-0.090	N S
Master Die	20.04 $\pm$ 0.004		

NS = non-significant

Table 3: Comparison of Group B2 (incorporation 0.5% NaOCl in Dental Gypsum Type III as water substitute) with Master die (df =33).

Points	Means STD DEV	t	P
<b>A</b>			
A2	20.02 ± 0.07	-0.243	N S
Master Die	20.03 ± 0.004		
<b>B</b>			
A2	20.02 ± 0.06	-0.608	N S
Master Die	20.03 ± 0.004		
<b>C</b>			
A2	20.03 ± 0.04	-0.578	N S
Master Die	20.04 ± 0.004		

NS = non-significant

Table 4: Comparison of Group C (Control Group) with Master die (df =33).

POINTS	Means STD DEV	T	p
<b>A</b>			
C	19.99 ± 0.06	-1.622	N S
Master Die	20.03 ± 0.004		
<b>B</b>			
C	19.99 ± 0.05	-1.700	N S
Master Die	20.03 ± 0.004		
<b>C</b>			
C	20.01 ± 0.04	-1.660	N S
Master Die	20.04 ± 0.004		

NS = non-significant

## DISCUSSION

The results of the study support the hypothesis that disinfection of dental gypsum with 0.5 % Sodium Hypochlorite (NaOCl) does not produce linear dimensional instability.

NaOCl is widely used disinfectant in 0.525% whereas in this study concentration of 0.5% was used. However in other studies it has been proved to be microbiologically effective<sup>28-31</sup> but this study focuses on the linear dimensional stability.

Immersion of model of Type III dental gypsum for 10-minute in solution of 0.5% NaOCl showed no statistically significant difference between the cast from master die and control group, this is similar to the study of Bass RA et al (1992)<sup>32</sup> who immersed gypsum cast in saturated calcium sulfate (clear slurry) with 0.525% NaOCl. Soares CR and Ueti M (2001)<sup>18</sup> immersed their cast in 1% NaOCl for 30-minute the results support the current study. However, they suggested that in addition there was a decrease in the compressive strength of the cast. But this study was focused on the linear dimensional stability.

Use of 0.5% NaOCl solution as water substitute for Type III dental gypsum showed very acceptable results. The results of our study are similar to studies reported by Abdullah MA (2006)<sup>33</sup> who did repeated immersion of gypsum cast in slurry with 0.525% NaOCl solution. Author also found decreased compressive strength.

Abdelaziz et al (2004),<sup>13</sup> (2002)<sup>34,35</sup> Soares CR and Ueti M (2001)<sup>18</sup>. They found no significant dimensional alteration in stone dies but reduced compression resistance of the dies. Breault et al (1998)<sup>36</sup> investigated setting time, compressive strength, rigidity, diametral tensile strength, setting expansion, hardness and detail reproduction after using 0.525% NaOCl as water substitute and found statistically significant increased in the compressive strength and rigidity and decreased in setting time. While other properties remained unchanged.

## CONCLUSION

Results of this study regarding the linear dimensional stability have statistically proven the disinfection of the cast with 0.05% NaOCl to be very acceptable.

It has also been observed that clinically it is impractical to control cross infection through disinfection of irreversible hydrocolloid impression material due to its desired accuracy in reference to time of immersion and concentration of disinfection solution. On the other hand, disinfection of dental gypsum (plaster) casts is easy and simple.

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