



The antibacterial activity of certain disinfectant solutions incorporated into stone mixture

Dr. Basima Mohammed Ali Hussein.*

Abstract

Cross infection control is a way of life and it was realized that a radical changes in the way of work in the dental clinic and laboratories would detect considerable revises of traditional working patterns. Disinfection of dental stone cast by incorporation of Chlorhexidine gluconate CHX, Sodium hypochlorite and Madacide 1¹ separately in a concentration of (0.5 , 0.5 , full strength) respectively according to the manufacturer instructions and testing their activity against *S.aureus*, α -haemolytic streptococcus pneumonia, *pseudomonas aeruginosa* and *E. coli* was performed. 5 trials were done for each disinfectant solution and control (distilled water).

The result showed that all the disinfectant solutions showed significant reduction of microbial growth in comparison with the control. Sodium hypochlorite sterilize dental stone cast followed by CHX. Sodium hypochlorite gave negative result for all the tested microorganisms in all the trials followed by chlorhexidine gluconate solutions .

Disinfection of stone cast is among recommended methods in infection control. Sodium hypochlorite was the best among the tested disinfected solutions.

Key words: disinfection, dental stone, Chlorhexidine, Sodium hypochlorite, Madacide 1.

Introduction

Since not all impression materials can be disinfected without adverse effect on the essential properties¹ , disinfection of dental stone cast was suggested^{2,3}. Several studies evaluated the antibacterial activity of certain disinfectant used for stone disinfection^{4,5}. Among different methods of disinfection it was found that incorporation was the best since it had

double action to disinfect the cast as well as impression⁴. Madacide 1, a new disinfectant solution recommended for dental use was tested to evaluate its effect on some properties of dental stone cast when it was used as a stone disinfectant⁶. In this investigation, the antibacterial action of chlorhexidine (CHX), Sodium hypochlorite and Madacide 1

*Lecturer, Department of Prosthodontist, College of Dentistry, Baghdad University

was evaluated as a disinfectant solutions incorporated into stone mixture.

Incorporation of chlorhexidine into stone mixture in different concentration was evaluated immediately after cast separation and after storage period, it was concluded that 0.2% CHX was enough to give proper disinfection for the dental stone cast^{4,5}. Later on the effect of some disinfectants incorporated into stone mixture on some properties was concluded that (0.2 – 0.5% CHX) gave good improvement for certain properties with minimal adverse effect on some properties⁷. A new disinfectant Madacide 1 was used as a stone disinfectant by incorporation, immersion and spraying its action based on double stabilization step (first stabilizer is dimethyl benzyl ammonium chloride and second stabilizer dimethyl ethyl benzyl ammonium chloride). It was shown that setting expansion, details production and compatibility with alginate was not affected, it was recommended also to use this disinfectant for stone by spraying since it had least adverse effect on stone properties⁶.

Materials and method

a- Infection Procedure

10 ml of sterile brain heart infusion in each of 4 sterile test tube, each one was used for one of the following microorganism as a growth media.

a- Staphylococcus aureus.

b- α -haemolytic streptococcus pneumonia .

c- Pseudomonas aeruginosa.

d- Escherichia coli.

Single well identified colony represent each one of the above microorganism was introduced in to one of the 4 broth media

separately, the broths were incubated at 37°C for 24h. After incubation

period 1 ml of each broth was introduced into sterile test tube, the final broth mixture of the 4 microorganisms was used as a contamination source.

b- Preparation of disinfectant solution

1- **Control** : sterile distilled water was used to be mixed with stone powder.

2- **Experimental groups:**

A-CHX (0.5%) was prepared by adding of 25 ml of 20% w/v of CHX in 1 liter.

B- Sodium hypochlorite (NaOCl₃) (0.5%) was prepared by adding of 78.1ml of 6.4% w/v chlorine as labeled on (FAS) container.

C- Madacide 1 : used in full strength as recommended by the manufacture.

c- Inoculation and culturing

Five steril metal mold represent upper edentulous replica were used to simulate clinical condition. Each mold was inoculated by 0.1 ml of the prepared (inoculated) broth mixture, spreaded all over the mold by sterile bacteriological loop. Alginate impression was taken by sterile stock tray for each mold after 2 minutes, the impressions were removed and poured by stone which was mixed according to the manufacturer's instruction (W/P ratio) by using distilled water for the control group and same ratio for experimental groups by using one of the prepared disinfectant solutions. After 60 minutes the impressions was opened and separated swab was taken from each cast, used to streak blood and

MacConkey agar plates, the plates were incubated at 37°C for 24 hours.

d- **Identification**

After incubation period, growth (if there's) on the blood agar was represented Gram (+ve) microorganisms and on MacConkey agar plate was represented Gram (-ve) microorganisms. The colonies were inspected and identified macro., microscopically and by certain biochemical tests. To determine any of the tested microorganisms grown.

Inoculation, culturing and identification steps were performed for each one of the experimental as well as for control groups five times.

e- **Statistical Analysis**

It performed by application of Fisher exact probability test at 0.05 level of significance.

Results

It was proved that gypsum cast is a potential source of microbial cross contamination³. The results of incorporation of disinfectant solutions into stone mixture against certain type of bacteria is identified in this research by (+ve) if there's growth and (-ve) if there isn't growth for each microorganism, table (1).

It was clear that using distilled water (control group) showed luxuriant growth for all the microorganisms included in this test and all the types were isolated from the incubated agar plates.

For the Experimental group. Sodium hypochlorite gave negative growth for all tested bacteria in all the 5 trials done

Stone cast made by Chlorhexidin solution showed growth

of Escherichia coli in 2 trials and one trial showed growth of pseudomonas aeruginosa.

Escherichia coli was recovered from the cast incorporated by madacide 1 disinfectant solution in four trials, while pseudomonas aeruginosa recovered from three trials and one trial showed S. aureus growth. Statistical analysis showed significant differences between the control and each of the experimental group also, between madacide 1 and the two other experimental group and non significant difference between CHX and sodium hypochlorite, table (2).

Discussion

Dental casts come into direct contact with impression materials and other items that are contaminated with saliva and blood from patient's mouth, leaving the casts susceptible to cross-contamination⁸. Furthermore; contamination of the stone cast can occur if the record bases are improperly disinfected or inadvertently not disinfected during fabrication of a prosthesis⁹.

Isolation of microorganisms from stone casts represent control group is an indication that microorganisms can be recovered from dental stone cast during clinical work transmitting the infection to the other clinical or laboratory workers¹⁰. Therefore; it is essential to develop an effective means of disinfecting dental stone cast from professional, medical, and legal points of view⁹.

Statistical significant reduction of microorganisms growth between experimental and control group showed that disinfection of stone cast by incorporation using any type of tested disinfectant solutions would help to minimize bacterial count and in turn

it might reduce the microbial population to a safe level¹¹.

In this study, the result showed that sodium hypochlorite was effectively sterilize the stone cast in all the trials this indicated that its incorporation produced potent antibacterial effects against tested microorganisms. Same result was concluded when Sodium hypochlorite used as a disinfectant solution for acrylic^{12,13}.

Incorporation of chlorhexidine solution as stone disinfectant produced significant difference in comparison with the control. Its less bacteriocidal activity against *E.coli* or *Pseudomonase aeroginosa* could be attributed to its lower activity against Gram (-ve) microorganisms. Since chlorhexidine showed a non significant difference in comparison with sodium hypochlorite, it might be chosen as an effective disinfectant for stone cast because of its prolonged action through its adsorption and slowly release on subsequent contaminations (Husein et al 1998), moreover chlorhexidine produced less or improve mechanical properties of the stone cast when compared with sodium hypochlorite^{7,14}.

Madacide 1, according to the manufacturer, is a bactericidal, virucidal, fungicidal and tuberculocidal in just 10 minutes at room temperature. Its action based on double stabilization step and this makes it capable of killing all kinds of bacteria. It showed less activity when incorporated into dental stone cast as a disinfectant solution, this could be explained that this solution might be beneficial as a special formula for other purposes rather than dental stone casts, since it did show reduction and activity against certain type of microorganisms when it used as a disinfectant, disinfection, generally as a term is minimization or reduction but not ~~complete elimination in the bacterial~~ count to be in a concentration that can

be overcome by human immunity (Jawetz, 1993).

Conlussions

- 1- Disinfection of stone cast by incorporation of disinfectant solution is recommended to minimize if not eliminate, as possible, bacterial population recovered during impression taking, cast production and subsequent laboratory and clinical dental work.
- 2- Sodium hypochlorite and CHX solutions give power disinfection so it's recommended to be used for stone disinfection.

References

- 1- Mathias K., Reinhold M.R. and Jorg R.S. :- Three dimensional investigation of the accuracy of the impression materials after disinfection J. prosth. Dent. 1993; 70(5): 449 – 456.
- 2- Gelson L.H., Elaine Z., Fonseca R. G. and Santos C.A.(Effect of disinfectant agents on dimensional stability of elastomeric impression materials). J. Prosthe. Dent. 1999, 81(5): 621-624.
- 3- Leung, R.L. and Schonfeld, S.E. (Gypsum cast as a potential source of microbial cross contamination) J. Prosth. Dent. 1983 49, 210-24.
- 4- AL-Jalili, S.N.(The effect of chlortexidine in the disinfection of alginate impression and dental stone cast) Master thesis. University of Baghdad 1994.
- 5- Hussein, B.M., AL-Ammer S.S. and AL-Najjar:(Role of time and concentration on the activity of chlortexidine incorporated into stone mixture). Iraqi Dent. J. 1998; 23: 187-196.
- 6- Berko, R.Y.(Effect of Madacide disinfectant solution on some physical and mechanical properties of dental stone) master thesis. University of Baghdad 2001.
- 7- AL-Shakily, G.A.H. (The effect of disinfectant solutions on some properties of dental stone cast). Master thesis. University of Baghdad 1995.
- 8- Twomey JO, Adelaziz KM, Combe EC, Anderson DL.(Calcium hypochlorite as a disinfecting additive for dental stone.)J Prosthet Dent.2003 Sep;90(3):282-8.
- 9- Mitchell DL, Hariri NM, Duncanson MG Jr, Jacobsen NL, McCallum

RE(Quantitative study of bacterial colonization of dental casts).J Prosthet Dent.1997 Nov;78(5):518-21.

10-Tortora (Microbiology. An Introduction) 2nd ed. 1986. The Benjamin / Cummings Publishing comp. Inc.

11-Jawetz W, Melnick and Adelberg's (A review of Medical Microbiology) 20th ed. 1993.

12-Chau, V.B., Saunders T.R., Pimsler M., and Elfring D.R. (In – depth. Disinfection of acrylic resins) J. Prosthe. Dent 74, 1995 :309-313.

13-Rasheed, A.H., (disinfection of acrylic resin cured by two different techniques) master thesis. University of Baghdad 1997.

14-Abdullah MA(Surface detail, compressive strength, and dimensional accuracy of gypsum casts after repeated immersion in hypochlorite solution.)J Prosthet.Dent.2006 June;95(6):462-468.

Table(1):Results of disinfection of Dental stone cast –Experimental and control

CHX: chlorhexidine gluconate

- a. Staphylococcus aureus.
- b. α .Haemolytic Staphylococcus pneumonia
- c. Pseudomona aeroginosa.
- d. Escherichia Coli.

Group	(1)	(2)	(3)	(4)	(5)
Control	a.(+) b.(+) c.(+) d.(+)	a.(+) b.(+) c.(+) d.(+)	a.(+) b.(+) c.(+) d.(+)	a.(+) b.(+) c.(+) d.(+)	a.(+) b.(+) c.(+) d.(+)
CHX	a.(-) b.(-) c.(-) d.(-)	a.(-) b.(-) c.(-) d.(+)	a.(-) b.(-) c.(-) d.(-)	a.(-) b.(-) c.(+) d.(+)	a.(-) b.(-) c.(-) d.(-)
Sodium Hypochlorite	a.(-) b.(-) c.(-) d.(-)	a.(-) b.(-) c.(-) d.(-)	a.(-) b.(-) c.(-) d.(-)	a.(+) b.(-) c.(-) d.(-)	a.(-) b.(-) c.(-) d.(-)
Madacide 1	a.(-) b.(-) c.(+) d.(+)	a.(-) b.(-) c.(+) d.(+)	a.(+) b.(-) c.(+) d.(-)	a.(-) b.(-) c.(-) d.(+)	a.(-) b.(-) c.(+) d.(+)

Table (2): Comparison between the results of each of the experimental and the control and between the experimental group (P < 0.05).

Disinfectants	P < 0.05
Control X CHX	S
Control X Sodium Hypochlorite	H.S
Control X Madacide 1	S
CHX X Sodium Hypochlorite	N.S
CHX X Madacid	S
Sodium Hypochlorite X Madacid 1	S

CHX chlorhexidine gluconate;

- S Significant;
- N.S not significant;
- H.S high significant