Avicenna J Dent Res. 2013 June; 5(1): e21107. DOI: 17795/ajdr-21107

Published online 2013 June 25. **Research Article**

Antibacterial Effect of Sanosil 2% and 6% and Sodium Hypochlorite 0.5% on Impressions of Irreversible Hydrocolloid (Alginate) and Condensational Silicone (Speedex)

Alireza Izadi [1,*]; Firouz Farnaz [1]; Samira Soufiabadi [1]; Fariborz Vafaee [1]; Shahin Kasraei [2]

[1]Department of Prosthodontics, Faculty of Dentistry, Hamadan University of Medical Sciences, Hamadan, IR Iran
[2]Dental Research Center, Department of Operative Dentistry, Faculty of Dentistry, Hamadan University of Medical Sciences, Hamadan, Iran

*Corresponding author: Alireza Izadi, Department of Prosthodontics, Faculty of Dentistry, Hamadan University of Medical Sciences, Hamadan, IR Iran. Tel: +98-9181114470, Fax: +98-8138381085, E-mail: dralireza_izadi@yahoo.com

Received: April 4, 2013; **Accepted:** May 20, 2013

Background: Dental impressions often carry microorganisms that may cause cross-infection from patients to dental staff. Impressions should be disinfected to eliminate the risk of cross-contamination.
Objectives: The aim of this study was to determine the effectiveness of three different disinfectant solutions on two commonly used impression materials.
Material and Methods: Seventy-two impressions were taken from dentate arches of nine dental staff from the school of dentistry, Hamadan University of Medical Sciences. Eight successive impressions were recorded in two different impression materials for each participant as four alginate and four condensational silicones (Speedex). For each impression material, specimens were exposed to four different regimens; one was immersed in sterile water as control, and the remaining specimens were exposed to three different disinfection treatments (0.5% sodium hypochlorite, 2% Sanosil, and 6% Sanosil) for 10 minutes. The impressions were washed with distilled water for 15 seconds, were inserted into sterilized tubes, and covered with Tryptic soy broth media (TSB). The tubes were incubated at 350 °C for 24 hours. In total, 0.01 milliliter was obtained from each tube, and inoculated on blood agar medium. Gram staining and biochemical tests were performed for bacterial detection. Data was analyzed by SPSS software using Fisher exact test.
Results: Bacterial growth was observed in all impressions immersed in sterile water for 10 minutes (control group). Disinfected alginate impressions were not contaminated withany microorganisms. None of the solutions under examination were completely effective for condensational Silicone impressions. Antibacterial effects on condensational silicone impressions ranked in a decreasing order as 0.5% sodium hypochlorite, 6% Sanosil and 2% Sanosil.
Conclusion: Within the limitations of this study, disinfectants were able to completely eliminate microorganisms carried by the alginate impressions. However, more efficient disinfection methods are needed to eliminate the risk of cross contamination by condensational silicone impressions.

Keywords: Cross Infection; Disinfectants; Dental Impression Materials

1. Background

Dentistry profession can play an important role in cross-contamination. Pathogens like tuberculosis, herpes, and differenthepatitis viruses can easily enter the impression materials from patients' blood and saliva and are finally crossed to cast and technician leading to infection especially in case of host weak immune system(1).Study of Powell and coworkers showed that 67 percent of impressions sent to dental laboratories were contaminated with bacteria such as *Enterobacter cloacae*, *Escherichia Coli* and *Klebsiella oxytoca*(2). Rice and coworkers detected microorganisms such as gram-negative cocci and gram-negative bacilli in 25 percent of studied Alginate specimens(3). Another study of this researcher showed bacterial contamination of different Alginate commercial brands containing antibacterial agents (4). Study of Sofou and coworkers showed that 12 percent of impressions obtained from patients infected with tuberculosis carry *Mycobacterium tuberculosis*. In the same way it was observed that 77 of 107 Alginate impressions send to laboratory in plastic bagshad positive findings in bacterial culture (5). Infected impressions transferred microorganisms to the casts. By cast and die trimming microbes disseminate in laboratory environment (6). Therefore, impressions, casts, wax rims, inter occlusal records and the equipment with direct or indirect contact with the patient's mouth and its secretions should be disinfected before sending to laboratory(7).Cleaning dental impressions is performed by using different materials including compounds containing hypochlorite, glutaraldehyde and chlorhexidine. Effects of different concentrations of sodium hypochlorite on impression materials were examined in different studies (1, 8). The Center of Disease Control and the American Council of Dentistry stated that all dental

impressions should be disinfected before pouring cast and sending them to laboratory by immersing them in 5 percent hypochlorite solution for 10 minutes.

American Dental Association (ADA) recommends the use of sodium hypochlorite for disinfection of dental impressions, but it has some problems; for instance, it is volatile and its effectiveness decreases by 30 percent monthly. Moreover, sodium hypochlorite is a poisonous material and has destructive effects over living things (6).Recently, the Sanosil Company has introduced and supplied a non-poisonous material under the name of Sanosil, which has a wide range of antibacterial effects. It is a combination of H_2O_2 and Ag ions with a wide range of effect on different microorganisms. There are few studies about its antiseptic effects especially on dental impressions. In addition, the information is very limited due to its particular concentrations in dentistry. If Sanosil antibacterial effect is confirmed, its usage is recommended in dentists' office and dental laboratories for a proper technique of disinfection.

2. Objectives

The present study was performed to investigate the antibacterial effect of 6% and 2% concentrations of Sanosil and 0.5%hypochlorite on condensational Silicone (Speedex) and Alginate impressions.

3. Materials and Methods

In this experimental study, somestaff of Hamadan Dentistry College were chosen and details of the investigation were declared to them. After obtaining their agreement, nine staff entered the study. Impressions were made of mandible between 10 AM and 12 PM. Volunteers should have had their breakfast but not lunch. They were instructed not to have any nonvegetarian food or anything sweet in their diet two days prior to making impressions. Four impressions were taken from each participant by using Alginates and four impressions with condensation Silicone. In each turn, impression was made by a separated steriletray.

Four Alginate impressions were separately placed for ten minutes in following solutions:

1) Sterile distilled water (control)
2) 0.5% sodium hypochlorite
3) 2%Sanosil
4) 6% Sanosil

In the same way, four condensational Silicone impressions were taken from each personand put in the same solutions for ten minutes. Then the impressions were taken out of the solutions and separately sent inside sterile containers to microbiology laboratory of Department of Microbiology, School of Medicine of Hamadan University of Medical Sciences. Impressions were washed under laboratory ventilation system with distilled water for 15 seconds and put in sterile containers, and then sterile TSB medium was added to the impressions. Containers containing impression and medium were kept in incubator at 35 °C for 24 hours. Then, 0.01milliliterof each specimen was removed from the medium and inculcated on blood agar; the obtained media were put in incubator for 24 hours(9). Then microbial growth was evaluated from colony characteristics in blood agar plates (BAP) and confirmed by biochemical tests, also specific tests were performed for isolated microorganisms. Colony forming units (CFU) were counted and the results documented. BAP contains mammalian blood (usually sheep or horse), typically at a concentration of 5-10%. BAP is enriched to differentiate fastidious organisms and detect hemolytic activity. Colonies on each plate were counted after 24 hours of incubation at 35°C.

4. Results

Table 1 presented some information about bacteria grown in each of the alginate impressions and silicone after immersion in water and disinfectant solutions. The highest inhibition rate of bacterial growth was observed for sodium hypochlorite 0.5 % (88.9%). Inhibition rates of bacterial growth ranked in a decreasing order as Sanosil 6% (83.3%), Sanosil 2% (61.1%) and distilled water (zero percent). Chi-square test showed significant differences between the groups (P = 0.001).Inhibition rates of bacterial growth in the alginate and silicone impressions after disinfection were 75% and 41.7%, respectively. There was a significant difference between the two groups by using Chi-square test (P = 0.004).

Bacterial contamination after immersing in solutions was presented in Table 2. Alginate impressions of all specimens were kept in distilled water and evaluated for bacterial development. In none of the impressions disinfected with 0.5%sodium hypochlorite, 2% Sanosil or 6% Sanosil bacterial growth was observed. Bacterial growth was observed in all samples of Silicone impressions were stored in distilled water. In two of nine samples disinfected with sodium hypochlorite 0.5%, bacterial growth was observed (22.2%). In seven of nine samples disinfected with Sanosil 2%, bacterial growth was observed (77.8%). In three cases of nine samples disinfected with Sanosil 6%, bacterial growth was observed (33.3%)

4.1. Different Isolated Microorganisms

Diphtheroids formed small white colonies and sometimes β type of hemolysis. Gram staining showed Gram-positive bacilli arranged at angles. Alpha hemolytic Streptococcus species cause iron oxidization in hemoglobin molecules within red blood cells, giving it a greenish color on blood agar. *Streptococcus pneumonia* bacteria were seen as pinpoint with α hemolysis pattern and gram-positive flame shaped cocci in pairsin gram staining. *Lactobacillus* is a genus of Gram-positive facultative anaerobic or microaerophilic rod-shaped bacterium. *Staphylococcus epidermidis* is Gram-positive and circular and forms pinhead colonies, which are convex with entire margins. The data was analyzed using SPSS 15 for Windows (SPSS Inc., Chicago,Illinois) and Fisher exact test.

Table 1. The Type and Number of Bacteria After Disinfection in Alginate and Silicone Impressions[a]

Study Groups	Bacteria number, CFU/mL								
	1	2	3	4	5	6	7	8	9
Alginate									
Distilled water	30 (diphtheroid)	200 (diphtheroid)	10^5 (bacillus, lactobacillus)	10^5 (bacillus, Diphtheroid, Staphylococcus epidermidis)	10^5 (bacillus, diphtheroid	10^5 (alpha-hemolytic Streptococci, lactobacillus)	10^4 (alpha-Hemolytic Streptococci	10^4 (alpha-Hemolytic Streptococci, Lactobacillus)	1000 (alpha-Hemolytic Strepto-cocci)
0.5% Sodium hypochlorite	-	-	-	-	-	-	-	-	-
2% Sanosil	-	-	-	-	-	-	-	-	-
6% Sanosil	-	-	-	-	-	-	-	-	-
Silicone									
Distilled Water	5000 (alpha-Hemolytic Streptococci)	5000 (diphtheroid)	10^4	10^6 (alpha-Hemolytic Streptococci)	10^4 (alpha-Hemolytic Streptococci)	10^6 (alpha-Hemolytic Streptococci)	10^5 (alpha-Hemolytic Streptococci)	10^8 (alpha-Hemolytic Streptococci)	10^4 (alpha-Hemolytic Streptococci)
0.5% Sodium hypochlorite	-	-	-	-	-	10 (alpha-Hemolytic Streptococci)	-	300 (alpha-Hemolytic Streptococci)	-
2% Sanosil	-	10^4 (alpha-Hemolytic Streptococci)	300 (alpha-Hemolytic Streptococci)	50 (alpha-Hemolytic Streptococci)	400 (alpha-Hemolytic Streptococci)	50 (alpha-Hemolytic Streptococci)	10 (alpha-Hemolytic Streptococci)	10^5 (alpha-Hemolytic Streptococci)	-
6% Sanosil	3000 (alpha-Hemolytic Streptococci)	1000 (alpha-Hemolytic Streptococci)	-	-	-	-	-	200 (alpha-Hemolytic Streptococci)	-

[a] Abbreviation: CFU, colony forming units

Table 2. The Frequency Distribution of Three Bacterial Contaminations After Disinfection in Alginate and Silicone Impressions

Disinfection Solution	BacterialContamination, No. (%) (n = 9)	P value [a]
Alginate		< 0.001
Distilled water	0 (0)	
0.5% Sodium hypochlorite	9 (100)	
2% Sanosil	9 (100)	
6% Sanosil	9 (100)	
Silicone		< 0.001
Distilled water	0 (0)	
0.5% Sodium hypochlorite	7 (77.8)	
2% Sanosil	2 (22.2)	
6% Sanosil	6 (66.7)	

[a] Fisher Exact Test

5. Discussion

Impression usually causes bleeding in soft dental tissues. Blood is a suitable carrier for transmission of microbes. Microbes can transfer to environment and exposed people (10). Therefore, disinfection of dental impressions and impression equipment is necessary to prevent pathogen transmission (11). In the present study, sodium hypochlorite 0.5% and Sanosil 2% and 6% were used for disinfection of dental impressions. In this study, immersing time was 10 minutes. By this time, the effectiveness of sodium hypochlorite 0.5% was very desirable, in such a way that bacterial growth was not observed in none of the Alginate specimens. Although, it is recommended to immerse Alginate impressions in 0.1-1 sodium hypochlorite solution for 15 to 20 minutes (11). However, according to the instructions given by the manufacturer, 20 to 40 minutes is recommended for Sanosil 6%. The probable reason is that in some of the silicone impressions, bacterial development was observed in a shorter time as observed in this study. Grown bacteria in culture were usually normal flora of the mouth and nonpathogenic in individuals without any immune system disorder in this study. This approves the results of Sofou et al. study, which showed that transferability of infection is so little in dental staff by Alginate, polyvinyl siloxane and polyether impressions even after long-term bacterial contamination. Therefore, prevailing hygienic methods instead of using disincentive materials is recommended (11). In the present study, obtained results from 0.5% sodium hypochlorite solution were very desirable, in such a way that bacterial growth was not observed in any of the Alginate specimens. According to Samaranayake and Jennings report, disinfection of irreversible hydrocolloid impressions by sodium Hypochlorite decreased *pseudomonas aeruginosa* and *Candida albicans* colonies and total removal of *streptococcus sobrinus* (12). Besides, Memarian

and coworkers found that antibacterial effect of sodium hypochlorite on irreversible hydrocolloid impression materials was desirable and in accordance with the ADA recommendations (1).

We found that total effectiveness of 0.5% sodium hypochlorite was higher than Sanosil 6% and 2%. This is similar to the results of Ghahramanloo, which showed a superior antibacterial effect of 0.525% sodium hypochlorite spray over Sanosil solution (13).According to one report, Sanosil was more effective to disinfect environment surface including dental seat and office cabinets (14).Effectiveness of this material in removal of water contamination in dental units is also shown (15) . Sanosil has been reported to be effective on Alginate materials (13). In the present study, Sanosil in Alginate impressions led to completed is infection. Nevertheless, bacterial disinfection was not complete in case of condensation silicone impressions. In the present study, similar solutions and immersion duration for two kinds of impressions were used for disinfection, but microbial removal for Alginate impression was more desirable than condensation silicone impressions. These results can be due to antibacterial compounds present in each of them. Alginate contains fluoride, which is an antimicrobial factor (16). Fluoride prevents transformation of glucose inside bacteria and has destructive effects on energy production mechanisms, glucose synthesis and metalloenzymes (17). Alginates also contain magnesium oxide, which has disincentive properties (18). Study of Koper and coworkers showed that magnesium oxide could kill 90% of *Bacillus globigii, Bacillus cereus* and *Escherichia* in a few minutes (19). In addition, antifungal and antiyeast effects of magnesium oxide over *Saccharomyces*, *Candida albicans*, *Rhizopusstolonifer* and *Aspergillus* is reported (20).

Controlling infection in offices and dental laboratories is necessary. Most effective disinfecting agents ranked in a decreasing order as 0.5% sodium hypochlorite, Sanosil 6%and 2%. Sodium hypochlorite 5%, Sanosil 2% and 6% were more effective on Alginate impression and similar to each other. In such a way that bacterial growth was not observed on Alginate impressions in none of the three groups. On condensational Silicone impressions, none of the solutions under examination showed complete effectiveness. Despite the fact, the most effective solution was sodium hypochlorite 0.5% and then Sanosil 6% and 2%.

Acknowledgements

The authors would like to thank the Dental Research Center, Hamadan University of Medical Sciences, for supporting this study.

References

1. Memarian M, Fazeli MR, Jamalifar H, Azimnejad A. Disinfection efficiency of irreversible hydrocolloid impressions using different concentrations of sodium hypochlorite: a pilot study. *J Contemp Dent Pract.* 2007;**8**(4):27–34.
2. Powell GL, Runnells RD, Saxon BA, Whisenant BK. The presence and identification of organisms transmitted to dental laboratories. *J Prosthet Dent.* 1990;**64**(2):235–7.
3. Rice CD, Moghadam B, Gier RE, Cobb CM. Aerobic bacterial contamination in dental materials. *Oral Surg Oral Med Oral Pathol.* 1990;**70**(4):537–9.
4. Lee YK, Lim BS, Kim CW. Effect of fluoride addition on the properties of dental alginate impression materials. *J Mater Sci Mater Med.* 2004;**15**(3):219–24.
5. Sofou A, Larsen T, Fiehn NE, Owall B. Contamination level of alginate impressions arriving at a dental laboratory. *Clin Oral Investig.* 2002;**6**(3):161–5.
6. Haralur SB, Al-Dowah OS, Gana NS, Al-Hytham A. Effect of alginate chemical disinfection on bacterial count over gypsum cast. *J Adv Prosthodont.* 2012;**4**(2):84–8.
7. Infection control recommendations for the dental office and the dental laboratory. ADA Council on Scientific Affairs and ADA Council on Dental Practice. *J Am Dent Assoc.* 1996;**127**(5):672–80.
8. Badrian H, Ghasemi E, Khalighinejad N, Hosseini N. The effect of three different disinfection materials on alginate impression by spray method. *ISRN Dent.* 2012;**2012**:695151.
9. Samra RK, Bhide SV. Efficacy of different disinfectant systems on alginate and addition silicone impression materials of Indian and international origin: a comparative evaluation. *J Indian Prosthodont Soc.* 2010;**10**(3):182–9.
10. Dasgupta D, Sen SK, Ghosh S, Bhattacharyya J, Goel P. Effectiveness of mouthrinses and oral prophylaxis on reduction of microorganisms count in irreversible hydrocolloid impression: an in vivo study. *J Indian Prosthodont Soc.* 2013;**13**(4):578–86.
11. Sofou A, Larsen T, Owall B, Fiehn NE. In vitro study of transmission of bacteria from contaminated metal models to stone models via impressions. *Clin Oral Investig.* 2002;**6**(3):166–70.
12. Jennings KJ, Samaranayake LP. The persistence of microorganisms on impression materials following disinfection. *Int J Prosthodont.* 1991;**4**(4):382–7.
13. Ghahramanloo A, Sadeghian A, Sohrabi K, Bidi A. A microbiologic investigation following the disinfection of irreversible hydrocolloid materials using the spray method. *J Calif Dent Assoc.* 2009;**37**(7):471–7.
14. Javaheri M, Zanganeh N. Evaluating antibacterial effects of three disinfectants on dental operatory surfaces. *J Qazvin Univ Med Sci.* 2008;**11**(4):41–36.
15. Schel AJ, Marsh PD, Bradshaw DJ, Finney M, Fulford MR, Frandsen E, et al. Comparison of the efficacies of disinfectants to control microbial contamination in dental unit water systems in general dental practices across the European Union. *Appl Environ Microbiol.* 2006;**72**(2):1380–7.
16. Jeevarathan J, Deepti A, Muthu MS, Rathna Prabhu V, Chamundeeswari GS. Effect of fluoride varnish on Streptococcus mutans counts in plaque of caries-free children using Dentocult SM strip mutans test: a randomized controlled triple blind study. *J Indian Soc Pedod Prev Dent.* 2007;**25**(4):157–63.
17. Wiegand A, Buchalla W, Attin T. Review on fluoride-releasing restorative materials–fluoride release and uptake characteristics, antibacterial activity and influence on caries formation. *Dent Mater.* 2007;**23**(3):343–62.
18. Sawai J. Quantitative evaluation of antibacterial activities of metallic oxide powders (ZnO, MgO and CaO) by conductimetric assay. *J Microbiol Methods.* 2003;**54**(2):177–82.
19. Koper OB, Klabunde JS, Marchin GL, Klabunde KJ, Stoimenov P, Bohra L. Nanoscale powders and formulations with biocidal activity toward spores and vegetative cells of bacillus species, viruses, and toxins. *Curr Microbiol.* 2002;**44**(1):49–55.
20. Sawai J, Yoshikawa T. Quantitative evaluation of antifungal activity of metallic oxide powders (MgO, CaO and ZnO) by an indirect conductimetric assay. *J Appl Microbiol.* 2004;**96**(4):803–9.