

Efficacy of Various Disinfectants on Dental Impression Materials

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Citation

U Sukhija, M Rathee, N Kukreja, S Khindria, V Singh, J Palaskar. *Efficacy of Various Disinfectants on Dental Impression Materials*. The Internet Journal of Dental Science. 2009 Volume 9 Number 1.

Abstract

Aim: Dental impressions often carry microorganisms that may cause cross infection from patients to dental staff. This in-vivo study evaluated microbial load on impressions (dentulous and edentulous) and the effectiveness of various disinfectants on the reduction of microorganisms from the impression surfaces after immersion and spray disinfection of impressions using five disinfectants for 10 minutes time. **Materials and Methods:** A total of 30 edentulous and 30 dentulous impressions were made using zinc oxide Eugenol and irreversible hydrocolloid respectively. Disinfectants used were Povidine-Iodine, Sodium Hypochlorite, Glutaraldehyde, Peracetic Acid (as immersion) and Isopropyl Alcohol (as spray). **Results:** The microbial load on irreversible hydrocolloid impression (dentulous subjects) was observed to be twice than that on the zinc oxide Eugenol impression (edentulous subjects). All disinfectants showed reduction in microbial growth. **Conclusions:** Peracetic Acid was found most effective followed by Glutaraldehyde and Sodium Hypochlorite; the latter disinfectants were comparable in their antimicrobial effect. Povidine-Iodine and Isopropyl Alcohol were found to be less effective than Peracetic Acid, Glutaraldehyde and Sodium Hypochlorite, but were effective than the control group. Disinfection of impression materials should be mandatory to prevent cross-infection.

INTRODUCTION

Infection control is imperative in dental practice. Dental instruments, worktops and equipments are being sterilized or disinfected in dental surgery to avoid cross infection from one patient to another and from patient to operator or dental surgery assistant. The cross- infection control guide published by the British Dental Association states that “the only safe approach to routine treatment is to assume that every patient may be a carrier of an infectious disease”. (1) Therefore, all impressions should be handled in the same way as an impression from a high risk patient. (2) Ray and Fuller 1963 showed a contamination with Mycobacterium tuberculosis of 12% of the dental impressions of patients with known tuberculosis. (3)

Leung and Schonfeld 1983 demonstrated that dental stone casts poured against contaminated impressions may be medium for cross- contamination between patients and dental personnel. (4) Impressions laden with microorganisms have shown microorganisms surviving up to 5 hours on an impression. (5)

Recovery of microorganisms from stone casts prompted

dentists to employ effective disinfection programmes for dental impressions to prevent such cross - contamination. The Federation Dentaire Internationale stated that all patients’ prosthesis should be cleaned and disinfected before delivery to the laboratory. (6)

Various methods have been reported in literature for the purpose of disinfection and sterilization of impressions including the use of disinfectant sprays, solutions and ethylene oxide gas sterilization. (7)

The aim of the study was to compare the efficacy of five commercially available disinfectants- Povidine-Iodine, Sodium Hypochlorite, Glutaraldehyde, Peracetic Acid and Isopropyl Alcohol on two commonly used impression materials namely zinc oxide Eugenol and irreversible hydrocolloid in preventing transmission of infections.

MATERIALS AND METHODS

Two impression materials were used in this study: Irreversible hydrocolloid (Septodont, Cedex, France) and zinc oxide Eugenol (DPI, India.).

Figure 1

Table (1): Disinfectant materials used

S No.	Disinfectants used	Method of disinfection	Contact Time
1.	Povidine-Iodine (Cipla Ltd., Mumbai, India)	Immersion	10 min
2.	Sodium Hypochlorite (5.25% NaOCl) [Qualikems, Fine chemicals Pvt. Ltd., New Delhi]	Immersion	10 min
3.	Glutaraldehyde – 2% (Central drug house Pvt. Ltd., New Delhi)	Immersion	10 min
4.	Peracetic Acid (Perasafe™ liquid sterilant[Du Pont™ Rely™On™ U.K])	Immersion	10 min
5.	Isopropyl Alcohol spray[Dimenol, Septodont Healthcare, India]	Spraying	10 min

MICROORGANISMS INCLUDED IN MICROBIOLOGICAL TESTS ÷

To check the efficacy of various disinfectant the following microbial species i.e. *Staphylococcus aureus*, *Streptococcus viridans* (Oral Isolates), *Streptococcus mutans*, *Streptococcus faecalis*, *Streptococcus pneumoniae*, *Streptococcus Group A*, *Staphylococcus albus*, *Pseudomonas aeruginosa*, *E. coli*, *Lactobacillus*, *Candida albicans*, *Diphtheroids*, *Kleb. pneumoniae* were checked by culturing the samples on the respective culture media.

METHODOLOGY

The samples for this study consisted of discs taken from impressions of thirty dentulous and thirty edentulous patients with irreversible hydrocolloid and zinc oxide Eugenol respectively.

Dentulous and edentulous impressions were made in perforated sterilized stock metal trays and sterilized custom trays respectively. Both the impression materials were manipulated according to manufacturer's recommendations.

After removal from oral cavity, impressions were rinsed with distilled water for 10 seconds to remove saliva, blood and organic debris. Six samples were taken from each impression (irreversible hydrocolloid and zinc oxide Eugenol impressions) in the form of 8 mm diameter disk. These were taken aseptically from the palatal impression surface with the help of sterile cork borer (fig.1&2). Selected sample sites were changed for each impression thus allowing randomization in an attempt to reduce any inconsistency and variability. Samples from irreversible hydrocolloid (dentulous) were labeled as SD (Sample Dentulous) and samples from zinc oxide-Eugenol paste (edentulous) were labeled as SE (Sample Edentulous).

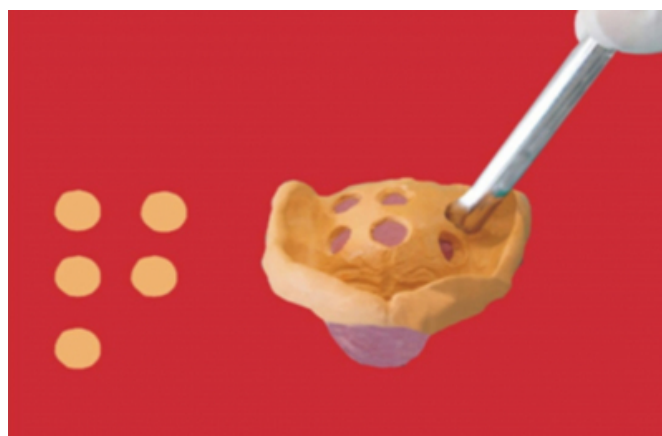
Figure 2

Fig 1. Samples taken from irreversible hydrocolloid impression



Figure 3

Fig 2 Samples taken from zinc oxide Eugenol impression



The samples from impressions were divided randomly in six groups and samples in each group were disinfected for 10 minutes at room temperature in following ways:

- Immersion in sterile water (SD1 and SE1)- control group
- Immersion in 0.5% Povidine-Iodine. (SD2 and SE2)
- Immersion in 1:10 dilution of 5.25% Sodium Hypochlorite (fresh solution) (SD3 and SE3)
- Immersion in 2% Glutaraldehyde. (SD4 and SE4).
- Immersion in 0.2% Peracetic Acid. (SD5 and SE5)
- Spray disinfection using Isopropyl Alcohol.(SD6 and SE6)

After the disinfection, samples were again rinsed with 250 cc

sterile water for 10 seconds. Excess water was shaken by hand from irreversible hydrocolloid impressions. Impressions were stored in tightly sealed, labeled plastic bags that contained damp cotton wool to prevent drying. The samples were taken with sterile swabs and microbial analysis was done (fig 3&4). The swabs were inoculated in Blood Agar medium and McConkey Agar medium and plates were incubated in an incubator for 24 hours at 37 °C for aerobic microorganisms and placed in CO₂ jar. Jar was incubated for micro-aerophilic organisms. The plates were read for presence of microorganisms. Organisms were confirmed by doing the Gram- staining and biochemical reaction. Antibiotic sensitivity testing was done in Muller Hinden medium. Growth was identified from colony characters. The data obtained was compiled and statistical analysis was done. The chi- square test was used. It was done by calculating the expected frequencies on the basis of null hypothesis & finding the square of difference between the observed and expected frequencies. Dividing this quantity by the expected frequency and finding the summation gives the required χ^2 value.

Figure 4

Fig 3. Petri dishes with culture media

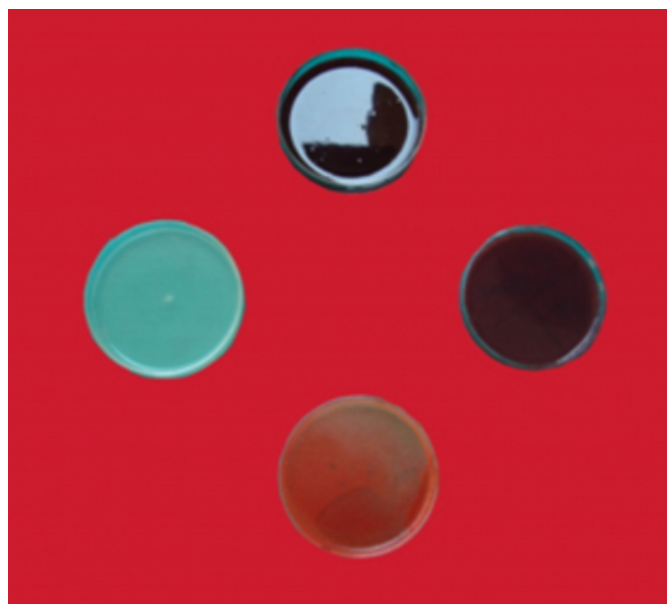
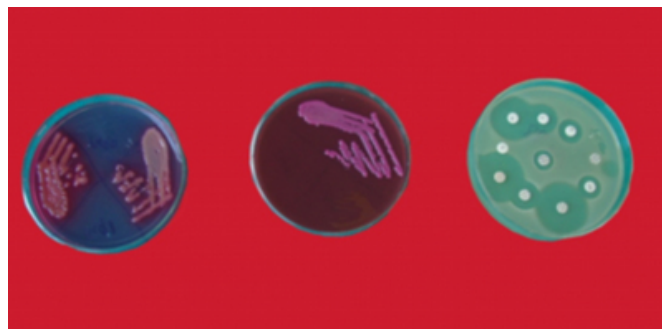


Figure 5

Fig 4. Culture media showing microbial colonies after inoculation



RESULTS

Of the disinfectants used, Peracetic Acid was shown to be the most effective followed by Glutaraldehyde, Sodium Hypochlorite, Povidine-Iodine, Isopropyl Alcohol and control group for both the impression materials. When the control group was compared with different disinfectants in both the impression materials, the results obtained on statistical analysis were found to be significant, as p- value is 0.001.

Povidine-Iodine has significant efficacy against microbial growth as compared to efficacy of Sodium Hypochlorite, Glutaraldehyde and Peracetic Acid, with the $p < 0.05$. But it is not significant compared to that of Isopropyl Alcohol, as p value is 0.59. When Sodium Hypochlorite was compared with Glutaraldehyde and Peracetic Acid for microbial growth values, the difference is not statistically significant as p value is 1 and 0.237. When Sodium Hypochlorite compared with Isopropyl Alcohol, results obtained are statistically significant with a p value of 0.017.

The comparison of efficacy of Glutaraldehyde with Peracetic Acid showed that the difference is statistically non significant with p value of 0.49. Comparing Glutaraldehyde with Isopropyl Alcohol, the results obtained are highly significant (p value is 0.006). When Peracetic Acid was compared with Isopropyl Alcohol for microbial growth values, the difference statistically are significant with p value is 0.0004. Comparing the microbial load in zinc oxide Eugenol with irreversible hydrocolloid, the ratio is 1:2.64.

DISCUSSION

Recommendations exist for the use of safety measures, as well as for the disinfection techniques required after impression making. American Dental Association issued guidelines for disinfecting impressions in 1988, revised in

1991 and 1996. These guidelines recommend using an ADA accepted spray or immersion disinfectant, depending on the material and for the manufacturer recommended contact time. (7)

The efficacy of a disinfectant depends on sufficient length of treatment time and effective concentration of the disinfectant. (9) Disinfection time is dependent on the method used: immersion, spray, or intermediate. (10)

Merchant 1989 suggested that immersion disinfection is most popular, most reliable and method of choice than spraying that ensures a more even contact, but it is time consuming and chances of distortion are there. (11)

Rinsing is considered beneficial as it removes organic matter that may prevent exposure of the impression surface to the disinfectant and compromises the activity of disinfectant and reduces the load of viruses and bacteria. It has been reported by Bergman 1989 (12), McNeill 1992 (14) and Beyerle 1994 (13) that washing the impression materials with water alone removes only 40% to 90% of bacteria and should be regarded as merely a gross decontamination. Gerhardt and Sydiskis 1991 observed that materials differ widely in terms of absorption and retention of bacteria and viruses, it is therefore not sufficient to simply rinse the impressions with water without further disinfection procedures. (15)

According to the Organization for Safety and Asepsis Procedures and Health Department of the French Ministry of Employment and Solidarity indicates the similar disinfection time 10 to 15 minutes for all impression materials, whatever their properties (hydrophilic and hydrophobic). (10,16) Various studies carried out by Rueggeberg 1992 (17), Bal et al 2007 (18) recommended 10 minutes immersion time.

Peracetic Acid, since its introduction in the market in 1998, has been indicated for high-level disinfection and sterilization of hospital equipment and devices. (8)

Peracetic Acid based disinfectants are not inactivated in the presence of organic matter, does not leave residues and does not produce harmful byproducts because its mechanism of action involves release of free oxygen and hydroxyl radicals decomposing in oxygen, water and acetic acid. Peracetic Acid is a peroxidate that acts rapidly against all microorganisms even at low concentrations. (8)

The results are in concurrence with study done by Samaranayake et al 1991 revealed that retention of

microorganisms on irreversible hydrocolloids impression is 2 - 3 times greater than other impression material and the microbial load was significantly greater in dentulous than edentulous patients. (5) Al-Omari et al 1998 also concluded that alginate carry significantly higher numbers of microorganisms. (20) Kononen 1991 in his study revealed that the common occurrence of Streptococci, Diptheroids, Lactobacilli, Candida albicans, is less in edentulous cases. (21) The results are in concurrence with studies done by Jennings and Samaranayake 1991 (22). Bal et al 2007 (18) concluded that 10 minute immersion in 2% Glutaraldehyde and 0.525% Sodium Hypochlorite was effective for disinfection and there was great reduction in microorganisms count.

Look 1990 et al concluded that Sodium Hypochlorite and Glutaraldehyde were better than iodophors. (23) Efficacy of Sodium Hypochlorite was almost similar to Glutaraldehyde. The results are similar to a study conducted by Jennings et al 1991 concluded that Glutaraldehyde and Sodium Hypochlorite exhibited comparable microbiocidal activity. (22)

Although no attempt was made in this study, to identify the complete microbial flora on impression materials, it is highly likely that other infectious viral agents could be retained and transferred on impression materials, resulting in cross-contamination.

CONCLUSIONS

From the present study it is concluded that:

1. Under the conditions of the study, carriage of microbial load in dentulous impressions was more as compared to edentulous impressions in a ratio of 2.64:1.
2. Among the studied disinfectants Peracetic Acid was most effective, Glutaraldehyde and Sodium Hypochlorite equally effective but less than that of Peracetic Acid, Isopropyl Alcohol and Povidine-Iodine being least effective and immersion proved to be more secure than spraying.

References

1. Watkinson AC. Disinfection of Impressions in UK Dental Schools. Br Dent J 1988; 164: 22-23.
2. British Dental Association: Guide to blood-borne viruses and the control of cross - infection in Dentistry. London 1987.
3. Ray KC, Fullner ML: Isolation of Mycobacterium from dental impression material. An overview of infection control in dental practice. J Prosthet Dent; 1963; 13:93-4.

4. Leung RL, Schonfeld SE: Gypsum casts as a potential source of microbial cross-contamination. *J Prosthet Dent*; 1983;49:210-1.
5. Samaranayake LP, Meena H, Jennings KJ: Carriage of oral flora on irreversible hydrocolloid and elastomeric impression materials. *J Prosthet Dent* ;1991;65:244-9.
6. Federation Dentaire Internationale: Recommendations for hygiene in dental practice, including treatment for infectious patients. A Revision of Technical Report No. *Int Dent J*;1987;37:142-5.
7. ADA Council on scientific affairs and ADA Council on dental practice: Infection control recommendations for dental office and the dental laboratory. *J Am Dent Assoc*;1996;127:672-80.
8. Chassot ALC, Poisl MIP, Samuel SMW.:In Vivo and In Vitro Evaluation of the efficacy of a Peracetic acid based disinfectant for decontamination of acrylic resins. *Braz Dent J* 2006; 17(2):117-21.
9. Al-Jabrah O, Al-Shumailan Y, Al-Rashdan M: Antimicrobial effect of 4 disinfectants on alginate, polyether, and polyvinyl siloxane impression materials. *Int J Prosthodont.* ;2007;20(3):299-307.
10. Muller-Bolla M, Lupi-Pégurier L, Velly AM, Bolla M: A survey of disinfection of irreversible hydrocolloid and silicone impressions in European Union dental schools: epidemiologic study. *Int J Prosthodont* 2004; 17(2):165-71.
11. Merchant VA: Prosthodontics and infection control-it's a whole new ball game. *J Calif Dent Assoc*; 1989;17:49-53.
12. Bergman B: Disinfection of Prosthodontic impression materials: A literature review. *Int J Prosthodont*; 1989;2:537-42.
13. Beyerle MP, Hensley DM, Bradley DV Jr., Schwartz RS, Hilton TJ: Immersion disinfection of irreversible hydrocolloid impressions with sodium hypochlorite. Part I: Microbiology. *Int J Prosthodont*; 1994;7(3):234-8.
14. McNeill MR, Coulter WA, Hussey DL: Disinfection of irreversible hydrocolloid impressions: a comparative study. *Int J Prosthodont* 1992 ; 5(6):563-7.
15. Gerhardt DE, Sydiskis RJ. Impression materials and viruses: *J Am Dent Assoc*1991;122:51-4.
16. Organization for safety and asepsis procedures: chemical agents for surface disinfection. Annapolis, MD, OSAP;1998.
17. Rueggeberg FA, Beall FE, Kelly MT, Schuster GS: Sodium hypochlorite disinfection of irreversible hydrocolloid impression material. *J Prosthet Dent*; 1992;67:628-31.
18. Bal BT, Yilmaz H, Aydin C, Dogruman F, Sultan N: Efficacy of various disinfecting agents on the reduction of bacteria on the surface of silicone and polyether impression material. *Eur J Prosthodont Rest Dent*;2007;15(4):177-82.
19. WHO: Technical report series 512, Viral hepatitis 1973. New York: WHO1973.
20. Al-Omari WM, Jones JC, Hart P: A microbiological investigation following the disinfection of alginate and addition cured silicone rubber impression materials. *Eur J Prosthodont Restor Dent*; 1998 ;6(3):97-101.
21. Kononen E: Are certain pathogens a part of normal flora in denture bearing edentulous subjects. *Oral Microbiol Immunol*;1991;6:119-22.
22. Jennings KJ, Samaranayake L.: The persistence of microorganisms on impression materials following disinfection. *Int J Prosthodont*; 1991;4:382-7.
23. Look JO, Clay DJ, Gong K, Messer HH: Preliminary results from disinfection of irreversible hydrocolloid impressions. *J Prosthet Dent*; 1990;63:701-7.

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