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ORIGINAL RESEARCH

Comparative evaluation of the anti-microbial efficacy of three different disinfectants by immersion & spray techniques on elastic impression materials

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Abstract

Aim: Dental impressions frequently contain bacteria that can spread from patients to dental personnel, posing a risk of cross infection. This in-vivo study evaluated the microbial load on impressions (dentulous) and the effectiveness of different disinfectants in reducing the microorganisms on impression surfaces following immersion and spray disinfection with three disinfectants for 10 minutes.

Materials and Method: Alginate and Polyvinyl siloxane (PVS) impression materials were used to make a total of 50 dentulous impressions. Sodium Hypochlorite, Glutaraldehyde (as immersion), and Isopropyl alcohol were utilized as disinfectants (as spray).

Results: The microbial load on the irreversible hydrocolloid impression was twice that of the PVS impression, according to the findings. Microbial growth was reduced by all disinfectants.

Conclusions: The most successful treatment was sodium hypochlorite, followed by glutaraldehyde and isopropyl alcohol

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

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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 three commercially available disinfectants- Sodium Hypochlorite, Glutaraldehyde and Isopropyl Alcohol on two commonly used impression materials Alginate and PVS in preventing transmission of infections.

Materials and Methods

Impression materials were used in this study:

1. Irreversible hydrocolloid-Alginate (Zelgan, Dentsply India Ltd).
2. PVS impression material (Imprisil – Pyrax Polymers).
3. PVS impression material (Kulzer, Heraeus Kulzer).

Disinfectants used

1. Sodium hypochlorite-5.25% NaOCL (Molychem, Pvt. Ltd)
2. Glutaraldehyde - 2.45% -CIDEX (Raman & Weil Pvt. Ltd)
3. Isopropyl Alcohol-70 % (Dimenol, Septodont healthcare).

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 feacalis, Streptococcus pneumonia, Streptococcus Group A, Staphylococcus albus, Pseudomonas aeruginosa, E. coli, Lactobacillus, Candida albicans, Diptheroids, 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 25 dentulous patients with irreversible hydrocolloid and 25 dentulous patients with PVS. Impressions were made in perforated sterilized stock metal trays. 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. Four samples were taken from each impression (irreversible hydrocolloid and PVS impressions) in the form of 4 mm diameter disk. These were taken aseptically from the palatal impression surface with the help of sterile cork borer (fig.1&2). Samples from irreversible hydrocolloid were labeled as SA and samples from PVS were labeled as SAS.

Fig 1 Samples taken from irreversible hydrocolloid impression

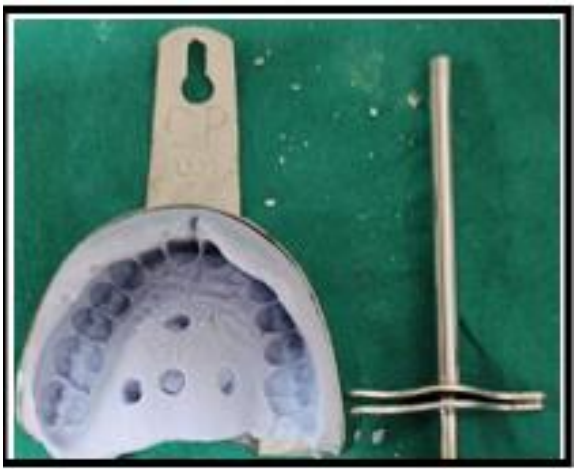

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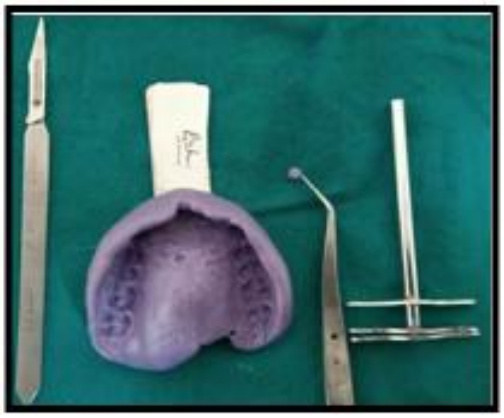
Fig 2 Samples taken from PVS impression



The samples from each impression were randomly divided into 4 groups.

- Immersion in sterile water (Group A and E)- control group
- Immersion in 5.25% Sodium Hypochlorite (Group B and F)
- Immersion in 2.45% Glutaraldehyde. (Group C and G).
- Spray disinfection using 70% Isopropyl Alcohol.(Group D and H)

Each sample was transferred immediately to individual airtight sterile labeled test tubes containing respective disinfectant. After the disinfection procedures (10 mins @ room temperature), the disinfectants were discarded and only the samples were stored in their respective test tubes. Test tubes containing samples were transferred to the Microbiological lab without further delay and microbial analysis was done (fig 3&4). Each sample was emulsified with 10 ml of the normal saline taken in test tube and shook for 5 minutes and 0.01 ml of this suspension was taken in a micropipette and individually plated and streaked using calibrated wire loop on Blood agar medium. Plates were incubated in an incubator for 24 hours @ 37 `C for aerobic microorganisms. The plates were studied under the optical microscope for the presence of microorganisms. Number of colonies was counted by visual observation. Organisms were confirmed by doing the Gram staining and biochemical reaction. The data obtained was compiled and statistical analysis was done. All statistical analysis for test of significance was performed using One-way ANOVA followed by multiple comparisons between test groups using HSD Post-hoc tests.

Fig 3. Petri dishes with culture media

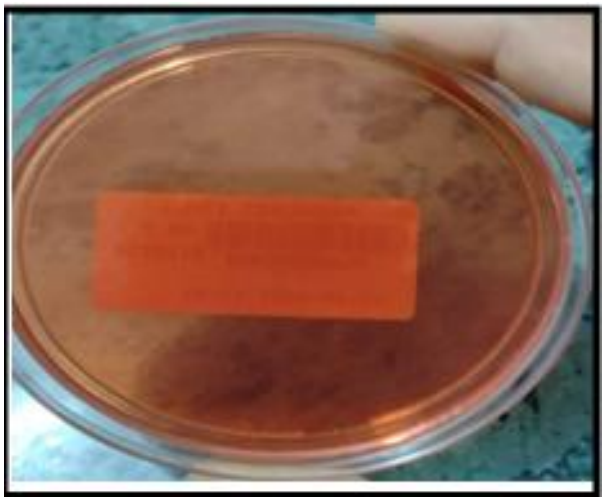


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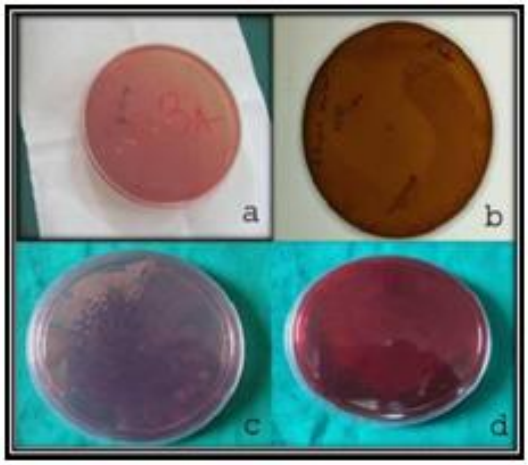
Fig 4. Culture media showing microbial colonies after inoculation



Results

Sodium hypochlorite showed highest and statistically significant antimicrobial efficacy as compared to Glutaraldehyde and Iso propyl alcohol. 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 < 0.001. Comparatively fewer microorganisms adhere to PVS impressions compared to hydrocolloid impressions. 5.25%Sodium hypochlorite exhibiting highest mean log10 count reduction value greater than 6 which was statistically significant and a kill rate of 100% on both alginate and PVS impressions.

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. [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 al2007 [18] recommended 10 minutes immersion time. The results are in concurrence with study done by Samaranayake et al 1991 revealed that retention of microorganisms on irreversible

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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 et al 1990 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. Among the three disinfectants studied, 5.25 % Sodium hypochlorite showed highest and statistically significant antimicrobial efficacy as compared to 2.45 % glutaraldehyde and 70% Iso propyl alcohol on both Alginate and PVS impression.
2. Fewer microorganisms adhere to PVS impressions as compared to hydrocolloid impressions.
3. Sodium hypochlorite remains the gold standard and shown to be the most effective disinfectant on both alginate and PVS impression material in 10 minutes by immersion method.

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