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A Self Disinfecting Irreversible Hydrocolloid Impression Material Mixed with Different Disinfecting Solutions

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ABSTRACT

Background: To compare and examine the anti-microbial effect of an irreversible hydrocolloid impression material mixed with different disinfectants and standard method of soaking impression material in glutaraldehyde.

Materials and Methods: The specimens were prepared and allocated into three groups Group A: Distilled water served as control. Group B: Different concentrations of chlorhexidine (0.02%), povidone (15%), Hiora (15 %) Group C: Glutaraldehyde (2 %) Then impression disks, 10 mm in diameter by 1 mm in thickness, were prepared and placed in nutrient agar which were incubated in the appropriate aerobic and anaerobic environment for 24 to 48 hours.

Results: It was similar for Group A and Group C but insignificant for Group B.

Conclusion: Standard method of disinfecting alginate has shown more anti - microbial effect than alginate mixing with other incorporated disinfectants. It also showed no change in physical properties like setting time.

Keywords: Impression material, Disinfection, Setting time.

INTRODUCTION

Alginate is one of the most popular materials for making an impression of the mouth. Considering the prevalence of some diseases like hepatitis B, immune deficiency syndrome and new wave of drug resistant tuberculosis, the clinicians are required to exercise caution and disinfect this material. Dental impression is certainly one of the ways for transmission of pathogens from the office to other environments.[1]

Guidelines have been established by the American Dental Association (ADA) to limit cross-contamination during dental clinical and laboratory procedures such as impression disinfection.[2] Basing on these guidelines, researchers have proposed many methods of disinfection for irreversible hydrocolloid impression material. Among them, spray and immersion are the two most widely used techniques in clinical practice. However, these conventional strategies present several disadvantages. Although disinfection by immersion or spraying could be effective in reducing the chances of cross-infection, compliance by dental offices/clinics has been uneven.[3] The time period and mode of application of disinfectant depend on the ability of the impression material to withstand

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the process of disinfection without any adverse effect on dimensional stability of the material[4].

The purpose of the study was to compare and examine the anti-microbial effect of an irreversible hydrocolloid impression material mixed with different disinfectants and standard method of soaking impression material in glutaraldehyde.

MATERIALS AND METHODS

In this study, the irreversible hydrocolloid impression material powder (Zelgam) Was mixed with chlorhexidine acetate solution ,Hi-ora and Glutaraldehyde. The antibacterial effect, three-dimensional and setting time of this self-disinfecting impression material were determined.

Methodology:

The specimens were prepared and allocated into three groups

Group A: Distilled water served as control.

Group B: Different concentrations of chlorhexidine(0.02%) (ICPA health products ltd)

Chlorhexidine gluconate sodium diluted to chlorhexidine gluconate 0.2% w/v in pleasantly flavoured aqueous base.

Povidone (15%) (Win Medicare pvt ltd) Povidone-Iodine and Absolute alcohol in a mint flavour aq. base. Hi- Ora(15%), (Himalaya) solution used as the mixing liquid.

Extracts Bibhitaki(terminaliabellirica) Nagavalli(piper betle) Pilu(salvadorapersica)
Powders Peppermint satva (menthapiperita) Yavanisatva(trachyspermumammi)
Oils Gandhapurataila(gaultheria fragnantissima) Ela (eletteriacardamomum
Others sodium benzoate,bronopol,potassiumsorbate

Group C: Soaked in 2 % of Glutaraldehyde (Korsolex)

Composition:
Glutaraldehyde
1,6-dihydroxy 2,5-dioxahexane
Rust inhibitors
Hi-tech cleansors

The agar well technique was used to assess the antibacterial activity of the specimens.[5] First, the irreversible hydrocolloid impression material was mixed using different concentrations of disinfectants into the mixing liquid. Immediately after mixing, the material was placed in a mould and kept under slight pressure (2 kg) for 1 minute. Then impression disks, 10 mm in diameter by 1 mm in thickness, were prepared. Mean weight of the disks was 0.1014 0.003273 g. After that, wells of the same size as the impression disk were cut into nutrient agar plates previously inoculated with the appropriate microorganisms under sterile conditions. Finally, all plates were incubated in the appropriate aerobic and anaerobic environment for 24 to 48 hours.

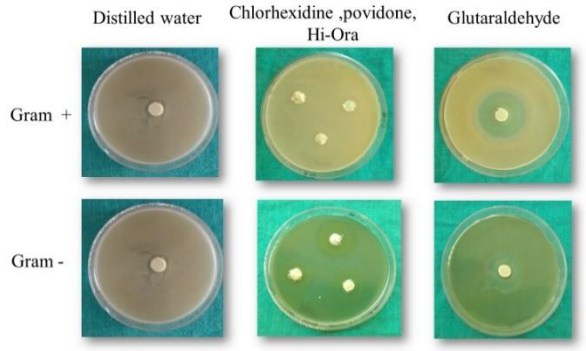
Finally, the inhibition zones on the plates were automatically measured by the accompanying software. The following microorganisms were used: Streptococcus mutans ATCC (American Type Culture Collection, The Global BioresourceCenter) 25175, Actinomycesviscosus ATCC 19246, Porphyromonasgingivalis ATCC 33277, Lactobacillus acidophilus ATCC 4356, Staphylococcus aureus ATCC 12600, Staphylococcus epidermidis ATCC 14990.

Measurement of Setting Time :

Setting time was tested according to the method introduced by Lemon et al.[6] The impression materialwas mixed for 60 seconds and syringed on the surface of a flat glass slab. Sixty seconds after mixing, the flat end of a polished poly (methyl methacrylate) rod measuring 6 mm in diameter and 10 cm in length was placed in contact with the exposed surface of the material and then immediately with drawn. This procedure was repeated at 3-second intervals in the early stages of setting and at 1-second intervals at the later stages until the impression material no longer adhered to the end of the rod. Setting time was established as beginning at the start of the mix and ending at the point atwhich the impression material no longer adhered to the end of the rod.

RESULTS

Well-defined zones of inhibited growth became apparent after this incubation period and allowed for consistent measuring of inhibitory fields. Mean diameters of inhibited zones for each microorganism are presented in Table 1.



Species 0.1 g/L0.2 g/L 0.5 g/L 1.0 g/LControl
Streptococcus mutans 20.3 0.9 27.2 0.2 33.0 0.7 37.2 0.8 0
Actinomycesviscosus12.9 0.1 19.3 0.2 27.0 0.2 30.1 0.80
Porphyromonasgingivalis 18.9 0.6 20.7 0.1 27.3 0.5 28.9 0.5 0
Lactobacillus acidophilus 12.5 0.1 19.3 0.6 28.1 0.5 31.1 1.2 0
Staphylococcus aureus 12.0 0.2 14.5 0.5 18.5 0.5 21.4 0.9 0

It was similar for Group A and Group C but insignificant for Group B.

DISCUSSION

From the prosthodontic point of view, impressions of compromised quality are not acceptable. Anti-microbial agent should possess a broad-spectrum activity against all microbes, should be stable on storage, and should not reduce the normal shelf life of the product. As alginate does not possess any antimicrobial properties, it would require disinfection following exposure to saliva and/or blood

According to Ismail HA et al [7], Chlorhexidine (0.02 %) and Povidone (15%) have shown anti - microbial effect without influencing the physical properties.

According to Wang J et al,[8] spraying on the impression material or soaking impression material in disinfectant proved to result in loss of surface details and dimensional accuracy .They advised the use of alginate mixed with disinfectant solutions and results of their studies showed no anti-microbial effect against the implanted micro-organisms and change in physical properties.

According to Ahsana M.R[9], 1% sodium hypochlorite and 2% glutaraldehyde significantly reduced microbial count from alginate impression surface. Among them 2% glutaraldehyde showed more antimicrobial effect than 1% sodium hypochlorite. He also concluded rate of bacterial transmission from alginate impression to cast was significantly reduced in case of 1% sodium hypochlorite solution than 2% glutaraldehyde solution.

Madhavan R et al[10]compared the surface hardness of gypsum casts poured using impressions made from self-disinfecting alginate and conventional alginates. Self-disinfecting alginates may be employed in clinical practice as safe and effective materials to overcome the infection control issues without compromising on the properties of the material.

The study of Cserna et al[11] confirmed that the irreversible hydrocolloids with chlorhexidine and quaternary ammonium were effective in reducing surface growth of the bacteria studied; so did the studies of Tobias et al[12] and Rice et al[13]. Some authors have advised the use of agar diffusion method for evaluating the microbial growth[14]. Results of pouring unmodified alginate mix into the agar punctures showed no antibacterial effect against the implanted microorganisms as revealed by the absence of any inhibitory microbe growth zone around the poured alginate. This finding could be explained by the fact that regular alginate set had no antibacterial activity[15].

Samaranayake et al[15] noted that the self-disinfecting impression material containing ammonium chloride showed a total kill of microorganisms immediately after impressions were made. Therefore, in the antibacterial effect test, all specimens were prepared and put into the agar wells within 8 minutes from the start of mixing. Eight representative pathogenic microbes (four aerobes and four anaerobes) were used as indicators of

antimicrobial activity, and the antimicrobial effect of chlorhexidine on most of the microorganisms[16]. Smutans, L acidophilus, and A.viscosus are oral cariogenic bacteria[17] and P.gingivalis is a known periopathogen[18]. S aureus, S epidermidis, E coli, and P aeruginosa are pathogenic bacteria that have been widely used by others[16,19,20] as indicators of the effectiveness of disinfection protocols. The accuracy phase indicated that stone casts were smaller in the MD and IP dimensions than the metal die and larger in the BL and OG dimensions. Although there is no evident reason, it is speculated that it may be related to the tray design[21]. It was also examined in the results that maximal dimensional discrepancy was 0.54% for OG dimension and 0.54% for IP dimension, but all specimens appeared comparable with values reported by other studies[22] and were within clinically acceptable limits for accuracy[23]. In conclusion, the three-dimensional accuracy of the irreversible hydrocolloid was not influenced, even if chlorhexidine solution served as the mixing liquid. The flowability and setting time are important working properties for irreversible hydrocolloid impression material, but they are also the properties that are liable to be influenced by variable factors, including water temperature, relative humidity, and mixing duration. For this reason, in the tests for flowability and setting time, the water temperature (20 2C), relative humidity (50 5%), mixing duration (60 seconds), and powder/water ratio (10 g/23 ml) were kept constant throughout the procedures to reduce errors caused by these factors. The results showed that mixing irreversible hydrocolloid impression material with chlorhexidine solution would not affect the flowability and setting time. It is important to recognize the limitations of in vitro antimicrobial susceptibility testing and the difficulty in correlating in vitro results with the in vivo activity. Therefore, further research is needed to substantiate this self-disinfecting impression material using other in vitro microbial assays, for example, whole plaque or Candida species or even an in vivo test to substantiate the present findings.

In our study, comparing the anti microbial effect using distilled water , chlorhexidine (0.02%), povidone (15%), and Hi-Ora (15 %) ,have shown no anti microbial effect against gram positive organisms and gram negative organisms.

Where as Glutaraldehyde (2%) standard method of disinfecting alginate have shown zones of inhibition with gram positive and gram negative organisms without influencing setting time of alginate.

CONCLUSION

Based on the findings of the study, standard method of disinfecting alginate has shown more anti - microbial effect than alginate mixing with other incorporated disinfectants. It also showed no change in physical properties like setting time.

CONFLICTS OF INTEREST

The authors declare they have no potential conflict of interests regarding this article.

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