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Evaluations of dimensional changes after disinfection of elastomeric impression materials with Ozone water, sodium hypochlorite, and autoclave method

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Abstract---To evaluate the dimensional changes after disinfection of elastomeric impression materials with Ozone water, sodium hypochlorite, and autoclave method. A total of 40 impressions were made and divided into 4 groups according to type of sterilization method used (Group 1: Control without use of disinfectant, Group 2: Autoclave, Group 3: sodium hypochlorite, Group 4: ozone water method) with 10 in each group. Impression materials in each group were contaminated with *Pseudomonas aeruginosa* and poured with

dental stone and subjected for different disinfection procedure. Microbial evaluation was done by the cultural method and dimensional stability for accuracy. Results were statistically evaluated. The Significant difference was seen in microbial load with sodium hypochlorite and autoclave method followed by ozone water compared to control group ($P < 0.001$). Autoclave and ozone water methods are effective in reducing microbial count and can be used as an effective disinfectant method.

Keywords---autoclave, disinfection, sodium hypochlorite, impression materials, ozone water.

Introduction

Impression making is an important practice to be carried out in dental treatment, specifically, involving in making a replica of the oral structures. Dental impressions that are exposed to patient's saliva or blood contaminate stone casts and serve as a source of infection to dental personnel who handle or deal with the impressions or casts. ¹ Clinically elastic impression materials can be divided into two large groups 1) hydrocolloid impression materials that include agar-agar and alginate impression materials; 2) synthetic elastomeric impression materials that include polyether, polysulfide, condensation silicone, addition silicone, and vinyl polyether hybrids. ² Most commonly observed microorganisms in oral cavity of patients wearing prosthetic dental appliances; removable orthodontic appliances include *Staphylococcus*, *Streptococcus*, *Lactobacillus*, *Actinomyces*, and *Candida* species. Health care professionals, especially dealing with oral diseases, are more vulnerable to cross infections during treating patients. Hence, infection control is an essential and imperative issue in the dental practice to prevent the spreading of infection from patient to dentist and dental auxiliaries. ¹

Practicing high standards of infection control and safety measures are essential to control cross contamination and occupational exposures to blood and saliva-borne diseases. In 1998, FDI guidelines suggested that all impression materials, before transferring to laboratory, should be disinfected. In 1998, FDI guidelines suggested that all impression materials, before transferring to laboratory, should be disinfected. ¹ Chemical disinfection preferably immersion, seems to be the most reliable and practical method. The spray method is the other chemical disinfection modality which reduces the chance of dimensional changes or distortion. Various chemicals are used for chemical disinfection such as; glutaraldehyde Benzalkonium Chloride, Isopropyl Alcohol, Chlorhexidine and sodium hypochlorite. ¹ The disinfectant solution should show greater efficacy in the reduction of pathogenic microorganisms without interfering with the dimensional stability or ability to replicate particulars of the material. ³

Sodium hypochlorite is a chemical with formula of NaOCl. It is composed of sodium cation and hypochlorite anion. It is water soluble. The concentration of available chlorine and the pH of the solution govern the efficacy of NaOCl as disinfectant. It is assumed that HOCl penetrates into the microbial cell across the cell wall and inhibit the enzyme activity essential for the growth, damage the cell

membrane and DNA. ¹ Ozone is a gaseous inorganic molecule with the chemical formula of O₃. It is less stable than O₂ and easily breaks down to normal dioxygen in the lower atmosphere. Ozone affects the cell membrane, vital proteins, unsaturated lipids, and the intracellular enzymes of microorganisms and may also cause DNA degradation.¹ An autoclave also works at 115°C/10 psi, 121°C/15 psi, and 34°C/30 psi. The standard settings can kill most bacteria, spores, viruses, and fungi at 134°C. ¹ The present study was done to evaluate the dimensional changes after disinfection of elastomeric impression materials with Ozone water, sodium hypochlorite, and autoclave method.

Materials and Method

The present *in vitro* study was done in the department of Prosthodontics. The metallic die for making an impression was sterilized by autoclaving for 15 min at 15 lbs pressure and 121°C. According to manufacturer's instructions impressions of metallic die were made by mixing zelgan and loaded onto a stainless steel perforated rim lock tray. About 40 impressions were made and divided into 4 groups according to type of sterilization method used (Group 1: Control without use of disinfectant, Group 2: Autoclave, Group 3: sodium hypochlorite, Group 4: ozone water method). *Pseudomonas aeruginosa* and poured dental discs were subjected for different disinfection procedure. Microbial evaluation and colony counting was done by the cultural method. According to ADA specification 19, a solid cylinder of aluminum with 31 mm height was made which had three parts (ruled aluminum block, metal collar, and riser). Three parallel lines (X, Y and Z) were engraved 2.5 mm apart from each other with line passing through the center denoting the diameter of the circular surface on inner surface of this cylinder. Two lines (cd and c, d) were engraved perpendicular to the Y line such that cd and c, d were equidistant from the center and 25 mm apart from each other. The insertion of line cd and line Y was denoted as Point A and that of c, d, and Y as Point B. When the metal collar was placed over the test surface of the aluminum block a mold cavity was observed measuring 30 mm in diameter and 2.5 mm in depth which would be the diameter of the test specimen. Obtained results were tabulated and statistically analyzed using SPSS software version 15 and Chi-square test.

Results

Sodium hypochlorite, autoclave and ozone water methods compared to control group showed significant reduction of *P. aeruginosa*. ($P < 0.001$) (Table 1). The mean difference of dimensional stability was 25.513, 25.012, 25.003, 25.023 respectively for control, autoclave, sodium hypochlorite and ozone water groups (Table 2). Table 3 indicates variation in mean dimension among groups. Minimal dimensional changes are found the tested group compared to control.

Discussion

Impression materials are used to replicate the oral structures for the construction of prosthesis. ⁴ Impression materials are often polluted with oral fluid for example saliva and blood. Rinsing with water was the simplest and regularly used method. ³ Various disinfectants have been tried to disinfect impression materials.

Sowjanya Devi et al determined the effect of autoclaving on the dimensional accuracy and surface roughness of two different elastomeric impression materials. They concluded that autoclaving was one of the most effective sterilization procedures and did not significantly affect the surface roughness and dimensional accuracy. ² The results are similar to our findings. Kandasamy et al evaluated the sodium hypochlorite, UV radiation, aloe vera and microwave irradiation for disinfection of impression materials. They concluded that sodium hypochlorite is the better method of sterilization along with microwave irradiation. Whereas UV radiation and Aloe vera were also effective as a disinfectant. ³

Durga Devi and Himabindu assessed the efficacy of various disinfectant systems on dental impression surfaces on reducing microorganisms after disinfection. They concluded that 2% Glutaraldehyde showed higher efficacy in reducing the microflora compared to Dimenol spray and UV radiation. There was complete removal of microorganisms with Microwave radiation. ⁵ Verma et al evaluated the efficacy of disinfectants on irreversible hydrocolloid impressions and their effect on the dimensional accuracy. They concluded that MD 520 system resulted in maximum (95.6%) removal of the visible colonies for all samples investigated. ⁶ Millar and Deb compared the effect of autoclave sterilisation on dimensional stability and tear strength of impression materials. They concluded that addition and condensation-cured silicone impression materials can be steam autoclaved without adverse effects on dimensional accuracy or tear strength. ⁷

Vatsal et al assessed the dimensional accuracy of impression materials after disinfection with glutaraldehyde and microwave irradiation. They concluded that Microwave irradiation method is effective in reducing microbial count and can be used as an effective disinfectant method. ⁸ Mohd et al evaluated the dimensional stability of two elastomeric impression materials, namely polyvinyl siloxane (PVS) and vinyl siloxan ether (VSE), subjected to chemical immersion and microwave irradiation for disinfection. They observed that immersion disinfection method resulted in a higher average percentage of linear dimensional changes than both the microwave irradiation and the control for VSE and PVS impression materials. ⁹ Moreira da Silva and Gonçalves Salvador evaluated the dimensional stability of heavy and light bodied condensation silicones after immersion in disinfectant solution for 10 or 20 minutes. They concluded that 1% sodium hypochlorite and 2% glutaraldehyde can be safely used to disinfect condensation silicone in clinical prosthodontic procedures. ¹⁰

Sruthi et al from a questionnaire base survey found that Knowledge and attitude of dental practitioners towards alginate impression is acceptable. ⁴ Kotwal et al compared various methods of disinfection of impression materials such as glutaraldehyde, ultraviolet (UV) radiation, and autoclave. They concluded that autoclave proved to be better in terms of reduction in bacterial colonies as compared to glutaraldehyde and UV radiation. ¹¹ We found that autoclave is equally effective in disinfecting the impression material compared to sodium hypochlorite. Further studies are needed to verify the results.

Conclusion

Within the limitation it was conclude that autoclave and ozone water disinfection method are effective in disinfecting the impression material with minimal dimensional changes.

Conflict of interest: nil

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Tables

Table 1
Inter group comparison for *P. aeruginosa*

Comparison	Z	P
Control versus autoclave	5.012	<0.001
Control versus sodium hypochlorite	5.003	
Glutaraldehyde versus ozone water	5.213	
<i>P. aeruginosa: Pseudomonas aeruginosa</i>		

Table 2
Dimensional stability among four groups

Group	Mean difference
Control	25.513
Autoclave	25.012
Sodium hypochlorite	25.003
Ozone water	25.023

Table 3
Comparison of variation in mean dimension among groups

Variable	Autoclave	Sodium hypochlorite	Ozone water
Mean dimension	25.012	25.003	25.023
Standard deviation	0.0034	0.0034	0.0078
Mean difference from control	0.0024	0.0124	0.0054
Comparison of difference	$T=0.235$ $P=0.324$		