Journal of Coastal Life Medicine
www.jclmm.com
ISSN: 2309-5288(Print)/2309-6152(Online)
Volume 10 No.1 (2022), Page No. 332 – 338
Article History: Received: 02 January 2022, Revised: 10 February 2022, Accepted: 21 February 2022, Publication: 31 March 2022

Influence of steam under pressure sterilization on the dimensional stability of implant impressions.

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Abstract:

Introduction: Dimensionally stable autoclavable impressions are effective in controlling cross-infection and contamination caused by a patient's saliva and other oral secretions, particularly during these pandemic situations. However, impression disinfection is less effective on pathogens than any type of sterilization because it intends to kill disease-producing microorganisms but not bacterial spores.

Materials and Methods: A prefabricated polystyrene model is selected and Nobel biocare® 4.3x10mm implants are placed, Impression copings are placed a verification jig with floss a patterned resin is done and a custom poly tray light cure sheet is adapted and an impression tray is prepared as an open tray impression The impressions were made using the addition cure polyvinyl siloxane impression materials (AFFINIS, Coltene/Whaledent AG, 9450 Alstalten, Switzerland). A polysiloxane tray adhesive was used from the same manufacturer (Coltene adhesive). The spacer was fabricated with a 2 mm thick modelling wax. A polysiloxane tray adhesive (Coltene/ Whaledent) was applied evenly over the inner surface of the tray and extended approximately 3 mm onto the outer surface of the tray along the periphery. The adhesive was allowed to dry for 15 min before the impression was made. The impressions were made with PVS impression material at the viscosities of the putty super soft and light body. All impressions were made by a single operator.

Results: There was no significant difference in the microscopic values when subjecting the copings and analogues to sterilization. The microscopic values demonstrated the consistency and the accuracy of the various components even after sterilization.

Conclusion: According to the present study, it was found that autoclaving of the implant components (Implant coping and analogues) did not change the accuracy of the impression made

Key Words: Sterilization, Implant Impression, Affins®,

INTRODUCTION:

Infections may be transmitted in the dental office and laboratory through direct contact with blood, saliva, and other secretions, indirect contact with operatory equipment, or environmental surfaces, and contact with aerosol when using air/water sprays or high speed or ultrasonic equipment[1]. A set of infection control strategies common to all healthcare delivery settings should reduce the risk of transmission of infectious diseases and standard precautions must be followed routinely[1–4].

The principal potential route of infection transmission from the patient to the dental clinician is through contaminated impressions, casts and prostheses. Disinfection of dental impression materials can be carried out by immersion in or spraying with a disinfectant. When disinfecting impressions, their antibacterial efficacy and their effect on the dimensional stability of impression materials are important[5]. However, impression disinfection is less effective on pathogens than any type of sterilization because it intends to kill disease-producing microorganisms but not bacterial spores[6]. Steam autoclave sterilization is claimed to be effective in controlling the cross-infection and contamination by dreaded microorganisms. Sterilization of impressions by the routine method may also affect the physical properties of the impression materials. Water imbibing materials do not lend themselves to prolonged immersion, nor can they be sterilized by autoclaving and other high-temperature methods, since their physical properties and linear dimensions can be affected by such procedures.

With the advent of new materials and technologies in concern with hygiene and infection control, a polyvinyl siloxane impression material has been developed capable of steam autoclaving at 134 °C for 18 min at 2.0 psi[7]. In this study, the clinical feasibility and overall dimensional stability of this autoclavable impression material were checked.

Dimensionally stable autoclavable impressions are effective in controlling cross-infection and contamination caused by a patient's saliva and other oral secretions, particularly during this pandemic situation. However, impression disinfection

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is less effective on pathogens than any type of sterilization because it intends to kill disease-producing microorganisms but not bacterial spores.

Because of PVS's dimensional accuracy and stability, it is used in implant, operative dentistry and fixed or removable prosthesis[8]. There are numerous factors that can affect the dimensions of subsequent casts on repetitive pouring. These include the process of polymerization[9], temperature[10], and the material used to fabricate the replica or working cast[10]. Although PVS impression materials have demonstrated superior dimensional stability when compared with other elastomeric materials due to the lack of release of byproducts, it had been reported that the time of storage affects the dimensional accuracy just after initial polymerization. Aalaei et al evaluated the dimensional Stability of Two Polyvinyl Siloxane Impression Materials in Different Time Intervals and concluded that Neither Affinis nor Panasil showed a change in dimension greater than 0.27% in comparison to standard die.

Nowadays, there are impression materials available in the market which can withstand high temperatures and can be sterilized; these materials are known as autoclavable impression materials. The latest elastomeric impression materials are quadrafunctionally modified siloxanes with quadrafunctional hydrophilic properties. The quadrafunctional hydrophilic structure of the material is an excellent combination of a cross-linked polymer with an exclusive surface active element. Hence, quadrafunctional hydrophilic impression materials are a combination of properties of polyether impression materials and addition-cured silicone impression materials.

Although there are numerous studies that assess the dimensional accuracy of autoclaved impressions, there are very few studies regarding the effect of an autoclave on implant impressions. There are some studies regarding fixed dental prostheses but these studies do not simulate the same conditions of an implant impression. The aim of this study is to check The influence of Steam Autoclaving on the Dimensional stability of implant impression material.

MATERIALS AND METHODS:

In this in vitro study, the dimensional stability of PVS impression material before and after sterilization was compared. The used materials were Affinis® (Coltene Whaledent Co., Switzerland). A prefabricated polystyrene model is selected and Nobel biocare® 4.3x10mm implants are placed as shown in Fig 1, Impression copings are placed and a verification jig with floss and a patterned resin is done and a custom poly tray light cure sheet is adapted and an impression tray is prepared as an open tray impression The impressions were made using the addition cure polyvinyl siloxane impression materials (AFFINIS, Coltene/Whaledent AG, 9450 Alstalten, Switzerland). A polysiloxane tray adhesive was used from the same manufacturer (Coltene adhesive). The spacer was fabricated with a 2 mm thick modelling wax. A polysiloxane tray adhesive (Coltene/ Whaledent) was applied evenly over the inner surface of the tray and extended approximately 3 mm onto the outer surface of the tray along the periphery. The adhesive was allowed to dry for 15 min before the impression was made. The impressions were made with PVS impression material at the viscosities of the putty super soft and light body. All impressions were made by a single operator. The impression was removed after setting and was packed in a sterile pouch and given for Autoclaving at 134 °C for 18 min at 2.0 psi whereafter the cast was fabricated and the dimensional accuracy was analysed by SEM microscope.

STATISTICAL ANALYSIS:

Descriptive statistics were used to evaluate before and after Autoclaving of Impression and Student T-test was performed and the p-value was determined to evaluate the significance of the variables. The activity between different groups was evaluated and statistics were carried out using SPSS Software version 23.0 by IBM India. The results were obtained in the form of tables and graphs.

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RESULTS AND DISCUSSION:

To protect the dental clinicians, a standard protocol for disinfection and sterilization of dental impressions is recommended[11]. A survey documented by U.S. dental laboratory directors in 2000 revealed that the majority of impressions were made of PVS (57%) or polyether (27%) materials. Only 44% of the respondents said that they knew if the received impressions were disinfected or not. Whereas 23% had no idea about the methods used for disinfection and 47% did not know about the length of time involved in disinfection. About 45% of the respondents stated that they received inadequate information regarding the disinfection procedure. Thus, it shows that there was a definite lack of communication between team members, and also, the problem was not only associated with the material being used for making impressions but the disinfection technique which was being used[12]. The widespread use of silicone impression materials is vinyl polysiloxane (VPS) materials, used in fixed and removable Prosthodontics where dimensional accuracy and excellent elastic recovery with ease of handling and to produce multiple casts from a single impression with good detail reproducibility[13]. Impressions are disinfected with chemical disinfectants and are sterilized to avoid the risk of cross-contamination and potential transfer of infectious disease from patients to dental professionals and vice versa. Polyvinyl siloxane materials are the only materials that currently tolerate sterilization[13,14]. Johansen[1] reported polyvinyl siloxane immersed in glutaraldehyde for 16 h materials was highly stable. Holtan et al[13,14], sterilized PVS impressions using ethylene oxide gas rather than steam sterilization.Holtan[13,14]reported that the decrease in dimensions was due to shrinkage of the impression material, but his values were greater in magnitude ranging from 58 to 129 **μ**m. Idris[15], Nissan[16], and Sergio Caputi[16,17] assessed the accuracy of PVS impression materials in which gypsum dies were shorter in the occlusal-gingival dimension. Stackhouse[18] reported that the height of the stone model was shorter than the standard model because the vertical component of contraction is in a direction toward the occlusal portion of the preparation where the impression adheres to the tray. Nissan[16] reported a shorter model will produce a casting that is short at the margins. Grajower[19], in their study, concluded that a slight increase in dimension (0.04 mm) of the working die (height and diameter) would be helpful to facilitate cementation

Jaganmohan Reddy[20], reported similar findings where low expansion improved dental stone was used and also quoted that the use of a higher expansion dental stone of 0.28 % would have increased the measurements. The maximum decrease in diameter for CS casts was 10cm and for autoclaved sample casts was 15**μ**m. Tjan[21] stated that a difference of approximately 50**μ**m was acceptable.

This study subjected autoclavable PVS material to sterilization using a conventional steam autoclave at 134 °C for 18 min at 2 psi and evaluated the accuracy thus, it is unlikely that the differences observed for dimensions in this study would have any clinical impact on the fit of fixed prostheses. The results imply that the newly introduced PVS material autoclaved at 134 °C for 18 min at 2 psi will not affect the accuracy or the dimensional stability of the set impression material and this material can be recommended for short-span multiunit restorations rather than when planning for a complete arch fixed restorations, to avoid framework distortion and misfit.

CONCLUSION:

There was no significant difference in the microscopic values when subjecting the copings and analogues to sterilization. The microscopic values demonstrated the consistency and the accuracy of the various components even after sterilization. According to the present study, it was found that autoclaving of the implant components (Implant coping and analogues) did not change the accuracy of the impression made

CONFLICT OF INTEREST:

None

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ACKNOWLEDGEMENT:

This research was done under the supervision of the Department of Research of Saveetha Dental College and Hospitals and White lab. We sincerely show our gratitude to the Blue lab and the corresponding guides who provided insight and expertise that greatly assisted the research.

SOURCE OF FUNDING:

None

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Figures:

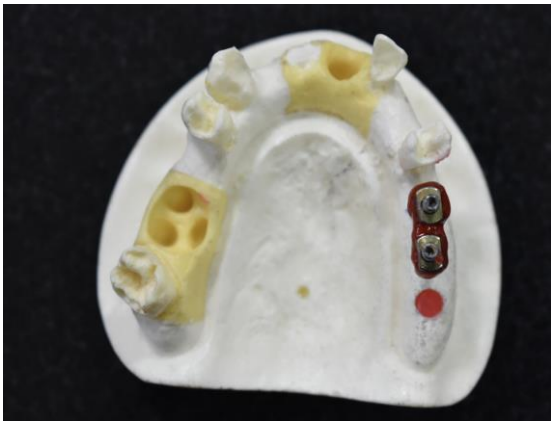

Fig 1: Implants with open tray impression copings

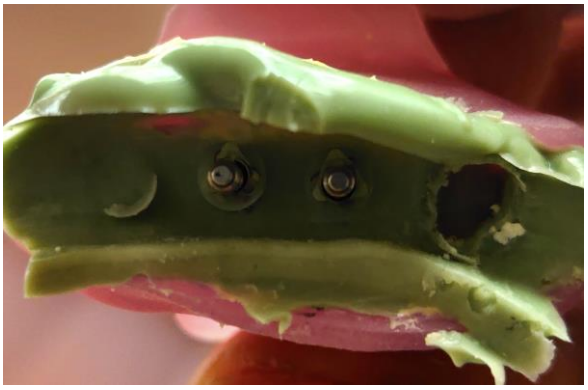

Fig 2: Impression made with Affins Putty

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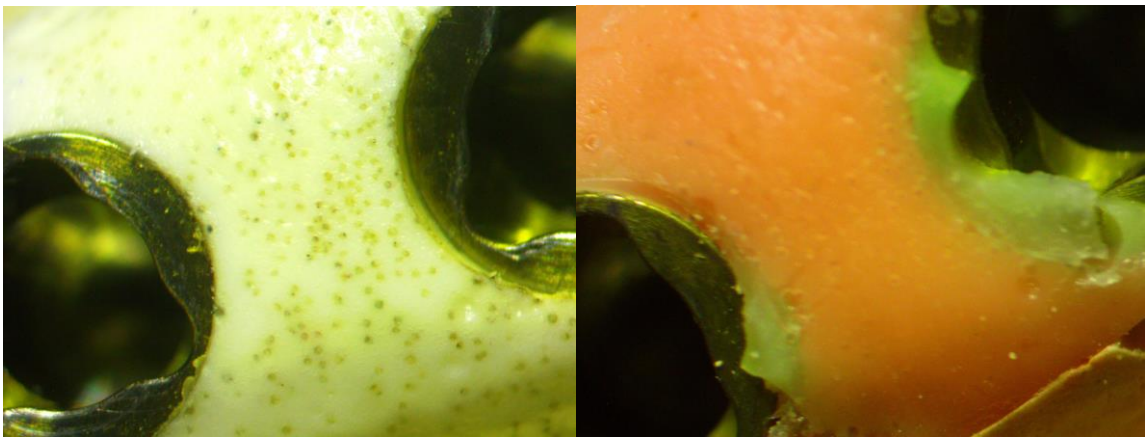

Fig 3:SEM images of model and cast respectively

Tables:

Stereo microscopic measurement values of the distance between the implants		
Control	Non-Autoclaved Impression	Autoclaved Impression
2.276 ± 0.014	2.291±0.033	2.280±0.026
2.276 ± 0.014	2.287±0.029	2.243±0.034
2.276±0.014	2.285±0.024	2.287±0031
2.276±0.014	2.282±0.025	2.279±0.027
2.276±0.014	2.29±0.032	2.277±0.022

Table 1: Mean Values of the impression before and after Autoclaving