

Effect of disinfection on the dimensional stability of impression material in fixed dental prosthesis

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Abstract

Dimensional stability and accuracy of an impression after chemical disinfection by immersion in disinfectants are crucial for the accuracy of final prosthetic restorations. Dimensional stability and accuracy of impressions under various conditions are crucial for the accuracy of the final prosthetic restoration. Accuracy of impressions also depends on the correct choice of impression material. Many studies have been conducted on the dimensional stability of the international products from developed countries after disinfection but evaluation of products from developing countries has not been carried out extensively to see their stability. Irreversible hydrocolloid is one of the impression

materials frequently used in the making of a fixed prosthesis. Alginate impressions are used extensively in dentistry for making diagnostic casts, check impressions and making impressions for provisional crowns. A significant effect of 2% glutaraldehyde on dimensional stability of a silicones and polyethers if they are exposed to disinfectant for long (18 h). They advise disinfection of impressions in the recommended period of time that is necessary for disinfection of elastomers. Since dimensional stability and accuracy of impression materials after removal from the mouth and disinfection are important factors in obtaining an accurate final restoration, the aim of this study was to assess the

deformation of elastomeric materials after disinfection in antimicrobial solutions.

Keywords: ADA, Hydrocolloid, Dimensional

Introduction

Impression materials are used in dentistry to reproduce the form and relations of the teeth and surrounding oral tissues. Impressions are used for fabricating diagnostic and master casts. The impression material can act as a vehicle for the transfer of bacteria and fungi. In a healthy patient, the chances of cross contamination are minimal but in the diseased and debilitated patients, chances of cross in front to the dental personnel and patients are high and can pose a serious threat if proper precautions are not taken.

Thus there is a need for an effective system for prevention of cross contamination without causing dimensional changes in the impression.¹ Even though various disinfection treatments are being proposed, chemical disinfection of impressions by immersion in disinfectants is the most reliable and practical method.²

On dimensional stability of disinfected impressions 2–6. Glutaraldehyde, used to be a commonly used disinfectant but iodophors, chlorine, alcohol and phenolic compounds were also tested. The most frequently used were elastomeric impression materials. Specimens were disinfected by spraying or immersing in disinfectant solution for the period to 60 min or longer. Control specimens were left in water, air or poured immediately. In estimating dimensional changes of impressions, measurements were taken either on the impressions or on the casts poured from that impressions.³ Immersion will disinfect both internal and external surfaces of an impression, including a tray and will minimize the risk of inhalation of disinfectant. Two main concerns for disinfectant evaluation are: the efficiency of disinfecting solutions in eliminating

pathogens, and the influence of disinfection treatment on the dimensional stability of dental impression materials.⁴ Irreversible hydrocolloid materials are organic and hydrophilic thus facilitating retention and growth of microorganisms.

It was reported in several studies that disinfection of alginate impressions by immersion did not cause clinically significant changes on the dimensional stability of the resultant casts. Many studies have been conducted on the dimensional stability of the international products from developed countries after disinfection but evaluation of products from developing countries has not been carried out extensively to see their stability. Irreversible hydrocolloid is one of the impression materials frequently used in the making of a fixed prosthesis.⁵⁻⁶ Alginate impressions are used extensively in dentistry for making diagnostic casts, check impressions and making impressions for provisional crowns. The other material taken up in this study is addition silicone impression materials are widely used thanks to their excellent physical properties, favorable handling properties and good patient acceptance. Dimensional stability and accuracy of impressions under various conditions are crucial for the accuracy of the final prosthetic restoration. Accuracy of impressions also depends on the correct choice of impression material.⁷⁻⁹

Dimensional stability

Dimensional stability and accuracy of impression materials after removal from the mouth and disinfection are important factors in obtaining an accurate final restoration. Two main concerns for disinfectant evaluation are: the efficiency of disinfecting solutions in eliminating pathogens, and the influence of disinfection treatment on the dimensional stability of dental impression materials. A significant effect of 2%

glutaraldehyde on dimensional stability of A silicones and polyether's if they are exposed to disinfectant for long (18 h). They advise disinfection of impressions in the recommended period of time that is necessary for disinfection of elastomers. Since dimensional stability and accuracy of impression materials after removal from the mouth and disinfection are important factors in obtaining an accurate final restoration, the aim of this study was to assess the deformation of elastomeric materials after disinfection in antimicrobial solutions.¹⁰⁻¹⁴

Effect of disinfection on the dimensional stability

The guidelines for the proper disinfection protocols in dental offices and laboratories are continuously issued by American Dental Association (ADA), Centers for Disease Control and Prevention, textbooks on dental materials, scientists, manufacturers of impression materials and other. Immersion method with various disinfection solutions and spray disinfection have been tested and proven to be effective for the purpose. Disinfectant systems used were glutaraldehyde, sodium hypochlorite. The stability after disinfection of commonly used alginate and addition silicone of native origin (Algin-Gum & Ad-Sil) was compared with similar impression materials from developed countries (Vignette and Aquasil) and results compared. Irreversible hydrocolloid materials are organic and hydrophilic thus facilitating retention and growth of microorganisms.¹⁵⁻¹⁷ It was reported in several studies that disinfection of alginate impressions by immersion did not cause clinically significant changes on the dimensional stability of the resultant casts

A CAD/CAM manufactured stainless steel die simulating maxilla with four metal studs at canine and molar region was used. Impressions were made and disinfected after rinsing and drying and casts poured.

The cross-arch distance, interabutment distance and the occluso-gingival length of the studs was measured under traveling microscope and observations were recorded and compared. There are many survey/ study were conducted to evaluate the effectiveness of disinfection on the dimensional stability.¹⁸⁻¹⁹

Advances in research

The beginning of disinfecting treatment strongly affects the stability of impression materials and critical changes occur in the first few minutes. In fact, the half of all the changes occurs in the first 4 min. These results agree with the results of Melilli et al. 21. Their findings suggest that immediate disinfection by immersion always induces a significant expansion of the impression material, while the second disinfection, repeated 6 h after the first one, does not cause any significant dimensional change, probably due to chemical stabilization of the material that occurs in the first hours after the impression taking. The mean value of accumulated dimensional changes obtained in this study for A-silicones after disinfection in glutaraldehyde is in accordance with the results of Wadhwanietal. 37 and amounted to 0.10–0.12% for a 30- minute period, and after one hour the change was 0.30– 0.33%. In the present research, the values obtained within 30 min of disinfection of addition silicones in glutaraldehyde (0.12%) correspond to the results of Melillietal 21. They show that immediately after immersion of addition silicone specimens in glutaraldehyde for 5 min, dimensional changes of A-silicones are significant (0.13%), compared to the initial measurement prior to disinfection. For glutaraldehyde (Sterigum) the change, accumulated after a day for all the specimens in the present study was 0.598%. Therefore, pouring casts from impressions may be postponed for a day. The disadvantage of the methods applied in this study was

that it could not be clearly detected whether contraction or expansion of the tested materials occurred, although detection of dimensional changes was precise.²⁰⁻²²

Materials used to fabricate the replica or working cast may also be subject to changes in dimension, such as gypsum expansion with setting. Although accuracy is affected by many factors, it should be realized that the magnitude of some of these changes may not be clinically significant. The results of this study showed that all the disinfection systems showed the dies to be shorter than the master model. Changes in the interabutment and cross arch dimensions of the stone casts were compared with that of metal die for all impression materials studied. The effect of each disinfection system amongst the impression materials is depicted graphically. Expansion was noted amongst all impression materials for interabutment and cross arch measurements. Contraction was generally observed for occluso-gingival dimensions of the canine and molar abutments resulting in shorter dies. For Algin-Gum, Glutaraldehyde immersion showed maximum percentage deviation from the standard values with expansion in the interabutment distance and cross arch measurements. Sodium hypochlorite immersion showed same results as the control group for the interabutment distance but showed expansion for the cross-arch measurements.²³⁻²⁵

Discussion

In numerous studies on impression materials tested for their dimensional stability depending on various factors, many different methods were used. The accuracy of that method depends on the skill of the operator who carries out such measurements and on a translation screw of the microscope. Another drawback is that the tested elastomeric samples do not represent clinically relevant form. This means that in impression making and their removal, deformations of elastomers are not the same as

in real impressions in clinical practice. Modified techniques did not offer any significant advantages as they require fabrication of a test block out of an impression, introducing errors related to dimensional changes that could occur in the cast and measurements still depend on the microscope and micrometer. In a 1983, Clancy et al. 27 examined the dimensional stability of three elastomers as the function of time using specimens from the stainless-steel test block and a mold recommended by ADA spec. No.19 (ISO 4823).²⁶ Impressions were placed under the reflecting microscope and the images were projected on the screen of the image analyzing computer. Measurements were performed on the referent lines on the specimens. There are many factors that affect the dimensional stability of elastomeric impression materials. Among them are contraction during polymerization as a result of volume reduction due to the cross linking and alcohol evaporation, which is typical for C-silicones. Another factor that may change the dimensional stability of elastomers is expansion that may occur after immersion in disinfectant solutions.²⁷ The incomplete elastic recovery of these materials may also lead to dimensional changes

Conclusion

The beginning of activity of disinfectants strongly influences the stability of these impression materials and critical changes occur in the first few minutes. Disinfection of addition and condensation silicone impressions with 5.25% NaOCl leads to great dimensional changes. In the mandatory disinfection of the addition and condensation silicone impressions the usage of NaOCl of the concentration of 5.25% should be avoided. Condensation silicones exposed to 5.25% NaOCl after the second day show dimensional changes more than 1%. Addition silicones are stable, with the

dimensional changes less than 1%. The use of disinfectants that contain benzalkonium chloride and glutaraldehyde (Sterigum) does not significantly change dimensional stability of the tested elastomeric materials. Native alginate produced statistically and clinically significant deviation from for all linear dimensions measured with all the disinfectant groups and the control group. Vignette irreversible hydrocolloid can be immersed in sodium hypochlorite and disinfected with UV rays without compromising the accuracy needed for diagnostic and opposing casts; check impressions and fabrication of provisional crowns. Ad-Sil showed dimensional changes but within clinically acceptable limits. Aquasil was found to be most stable with all the disinfection systems used. New disinfection methods such as Ultraviolet chamber can thus be the recommended method for disinfecting impressions without compromising their dimensional stability. Addition silicone Ad- Sil from developing country showed acceptable results. Conflict of interest We have no conflict of interest to declare. Ethical statement The work has been approved by the appropriate ethical committees related to the institution in which it was performed.

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