

COMPARISON OF MEAN DIMENSIONAL MEASUREMENT OF ALGINATE IMPRESSION USING SODIUM HYPOCHLORITE VERSUS GLUTERALDEHYDE AND BENZALKONIUM CHLORIDE FOR DISINFECTION

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ABSTRACT

Objective: Objective of this study was to compare mean dimensional measurement of alginate impression using disinfectants, sodium hypochlorite and gluteraldehyde + benzalkonium chloride.

Material and Methods: Sampling technique was non-probability consecutive. This study was conducted in the Prosthodontic Department, Sardar Begum Dental College and Hospital, Peshawar from 3rd February 2012 to 3rd August 2012. Alginate impressions were recorded from 72 edentulous patients who were randomly allocated into two groups, A and B by lottery method. Impressions from patients in group A was subjected to immersion disinfection with Gluteraldehyde + benzalkonium chloride (Sterigum) while Alginate impressions obtained from patients in group B was subjected to disinfection with Sodium hypochlorite (Haq chemicals). Impressions were poured with Type III dental stone. Post disinfection measurements were recorded in anteroposterior and mediolateral dimensions.

Results: Results revealed that there was no significant difference in the anteroposterior dimension of casts of both groups (p value=0.091) however, there was statistically significant difference in the mediolateral dimension between the casts of the groups A and B (p value=0.000).

Conclusions: Within the limitations of this study, it can be concluded that no preference can be given to any disinfectant from dimensional stability point of view.

Key words: Immersion Disinfection, Crossinfection control, Sodium Hypochlorite, Gluteraldehyde+Benzalkonim chloride, Mean dimensional measurement

INTRODUCTION

Infection control is mandatory in all fields of medicine including dentistry. There is a great risk of cross infection during different dental procedures which makes standard infection control compulsory^{1,2}. Oral cavity harbors a large number of microorganisms including both opportunistic and pathogenic^{3,4}.

Contamination of working atmosphere by microorganisms from oral flora during clinical practice of dentistry is a risk for health professionals⁵. Impressions, casts, other intra-oral records and patient's oral prosthesis may be contaminated with oral micro-flora or other organisms of varying pathogenicity from patient's saliva and/or blood and aerosols^{6,7}. This may

communicate to the dental personals including dentist, dental assistants, dental technicians and to many other patients^{8,9}. It can also result in transmission of diseases like hepatitis B, tuberculosis, herpes and AIDS^{10,11}. Guidelines have been established by American Dental Association to limit cross-contamination during dental clinical and laboratory procedures⁶.

Recording an impression is the first step in fabrication of any prosthesis including dentures, obturators, crowns, bridges and mouth guards. The impression is used for constructing a cast of a patient's dental arches for diagnosis, treatment planning, fabrication of prosthesis, patient education and record keeping. The cast is usually made from a gypsum based product poured into an impression of the patient's mouth. It is on the gypsum cast that the dentist designs and technician fabricates the fixed or removable prostheses. Thus, the cast and therefore the impression, must fulfill certain criteria (as laid down in international Standards ISO 1563:1990E and ISO4823:1992E) including both accuracy and dimensional stability, if it is to be a use-

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ful representation of the oral structure¹². The detail recording of the information by the impression and its reproduction on the dental gypsum is of utmost importance for the success of any prosthesis or appliance¹⁰. The fabrication of prosthesis carries the risk of oral microorganisms to be transferred through the impression, dental cast and other prosthodontic records to the dental laboratories¹². Therefore; disinfection of the impressions and/or casts is crucial without altering their dimensional stability and accuracy¹³.

Various methods have been devised and tested for the control of cross infection through dental impressions but, there are many reservations over different methods and techniques of disinfection of impression and/or cast, as they may alter their physical properties¹⁴⁻¹⁶. Most commonly used methods for disinfecting alginate impressions are immersion and spraying however, the most reliable method is immersion as the disinfectant solution comes in contact with all the impression surfaces and tray^{17,18}. Different studies had used different immersion times for disinfecting impression¹⁹.

Irreversible Hydrocolloid i.e. Sodium Alginate is most commonly used dental impression material^{20,21}. This material has the property of imbibition of liquid (saliva and blood) and therefore carry significantly higher numbers of bacteria than addition cured silicone rubber (Elastomers) and the disinfection procedures are considerably less effective and/or difficult²².

Infectious diseases in Pakistan are one of the main contributors to the burden of the disease^{23,24}. The level of infection control in dental practice is of concern and there is a need for the maintenance and monitoring of standards for infection control, safety at work, their maintenance and monitoring²⁵.

Disinfection of impressions with disinfecting solutions is considered nowadays mandatory for effective infection control. However, chemical disinfection has a major drawback that it may affect the dimensional accuracy of impression material particularly hydrophilic materials²⁶. Therefore, the purpose of this study is to compare the dimensional stability of irreversible hydrocolloid using two chemical disinfectants i.e. 0.5% Sodium hypochlorite and Gluteraldehyde + Benzalkonium chloride (Sterigum).

METHODS AND MATERIALS

The study was designed as randomized controlled trial with non-probability consecutive sampling technique. It was conducted in Prosthodontics Department, Sardar Begum Dental College and Hospital, Peshawar from 3rd February 2012 to 3rd August 2012. Sample size was 72 edentulous patients

(36 in each group) using mean dimensional measurement 24.008 ± 0.046 with sodium hypochlorite and 23.945 ± 0.126 with gluteraldehyde¹⁹ at 95% confidence interval. Sample size was determined by WHO software for sample size determination. The study was conducted after approval from hospitals ethical and research committee. Edentulous patients, 40 years and above either gender were included in the study. The purpose and benefits of the study were explained to the patients in the form of informed consent. Patients were randomly allocated in two groups i.e. A and B by lottery method. Alginate impressions were recorded from these patients (Figure-1). Impressions excluded from the study were those having a crevice or deficiency in the midline of the palatal vault of impression, if it is short in one or more regions of the sulci, especially around the tuberosities or the labial sulcus, tray flange showing through the impression material, impression material detached from the tray, impressions from incompletely seated tray and casts having broken, distorted and entrapped air at metal rod duplicates. The obtained impression was then washed with running tap water for 10 seconds to render them free from saliva or any other fluid from the oral cavity. A standard tripod was constructed having three metal posts at equal distance of 45 millimeters from each other (Figure-2). Alginate impressions obtained from the patients were marked on it using the same standard tripod for all patients (Figure-3). The marks on the alginate impression obtained through standard tripod were designated as A, B and C. After that, Alginate impressions from group A were immersed in gluteraldehyde + benzalkonium chloride for 10 minutes while impressions obtained from patients in group B were immersed in Sodium hypochlorite for 10 minutes. Immediately after removal from the disinfectant, the alginate impressions were again rinsed with running tap water for 10 seconds and was poured with dental stone (DentAmerica) (Figure-4) and measurements were obtained from using a standard digital vernier caliper (Figure-5) in anteroposterior (AB) and mediolateral (BC) dimensions. (Figure-6) All the disinfection procedures were conducted in uniformly maintained temperature of 18-24 oC by airconditioner and the alginate material used was of the same brand i.e. Alginmajor (Major Prodotti Dentari S. p. A, Italy). All the above mentioned information including name, age, gender and address were recorded in a predesigned proforma.

All the data collected was entered and analyzed in SPSS (version 10). Mean + SD were calculated for continuous variables like Age, Anteroposterior dimension AB and Mediolateral dimension BC. Student

independent t-test was applied to compare the Antero-posterior dimension AB and Mediolateral dimension BC in both groups.

RESULTS

The mean age of the patients of the whole study population was 59.56 years ± 7.65 SD. The mean age of patients in group A was 59.14 years ± 8.089 SD while in group B it was 59.97 years ± 7.28 SD. The difference was statistically not significant while applying Student t-test with a p-value of 0.647. The mean anteroposterior dimension of casts in group A was 45.42 years ± 0.299 SD while in group B it was 45.26 years ± 0.465 SD. The difference was statistically not significant while applying student t-test having a p-value of 0.091. The details are giving in Table-1. The mean mediolateral dimension of casts in group A was 44.79 years ± 0.201 SD while in group B it was 45.15 years ± 0.517 SD. The difference was statistically significant while applying student t-test having a p-value of 0.000. The details are giving in Table-2.

Table-1: Comparison of anteroposterior dimensional change in alginate impressions by disinfectant groups

Disinfectant group	Anteroposterior dimension			
	n	Mean	Std. Deviation	Std. Error Mean
A	36	45.4281	.29944	.04991
B	36	45.2697	.46579	.07763

Table-2: Comparison of mediolateral dimension change in alginate impressions by disinfectant groups

Disinfectant group	Mediolateral dimension			
	n	Mean	Std. Deviation	Std. Error Mean
A	36	44.7983	.20143	.03357
B	36	45.1506	.51755	.08626



Figure-1: Alginate impression recorded from edentulous patient

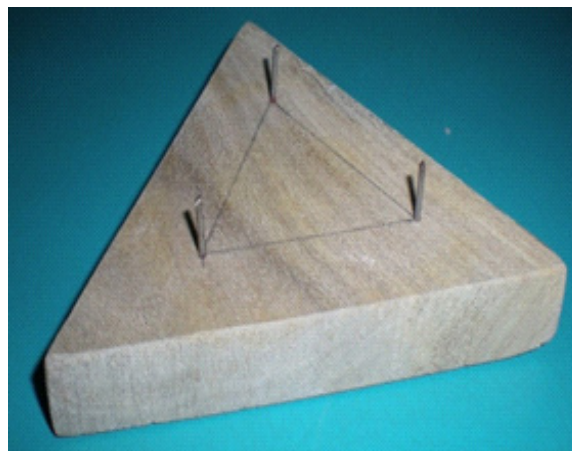


Figure-2: Standard tripod having three metal posts



Figure-3: Marked dental impression with tripod



Figure-4: Cast obtained from disinfectant treated Alginate impression. Arrows indicating marks produced by tripod.

DISCUSSION

Irreversible hydrocolloid is the impression material which when immersed in a liquid, undergoes imbibition. When dental stone is poured in such an impression, cast may be smaller than what is present



Figure-5: Digital Vernier caliper

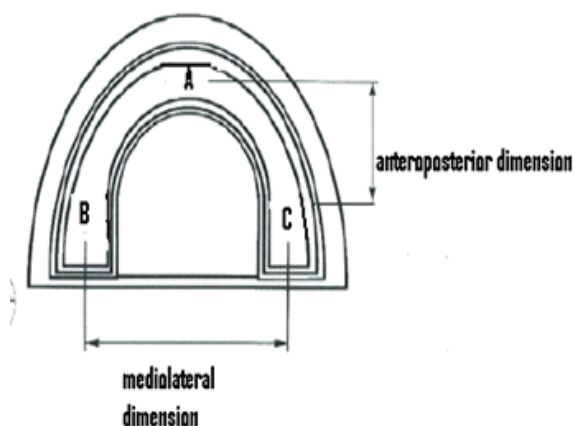


Figure-6: Measurement of Anteroposterior and Mediolateral dimensions

in the mouth²⁷. This study was conducted to compare the effect of immersion disinfection on alginate impressions using Sodium hypochlorite (0.5%) and glutaraldehyde+benzalkonium chloride. The conclusions drawn from studies on dimensional stability of the impression disinfection cannot be compared because the laboratory studies are different considering specimen dimensions, baseline measurements, method of measurement and reporting. A common method accepted by researchers must be established for more precise evaluations and if direct data comparisons are required²⁸.

Two linear dimensions of the casts i.e. Anteroposterior dimension and mediolateral dimensions were recorded with electronic digital caliper. Standard tripod was made to mark the impression before disinfection to keep the pre-disinfection measurements same for both groups. The distance between three metal posts was 45 millimeters. The mean anteroposterior dimension of casts in group A was 45.42 years \pm 0.299 SD while in group B it was 45.26 years \pm 0.465 SD.

The results of the study show that anteroposteriorly mean dimensional measurement of casts of group A (impressions disinfected with glutaraldehyde+benzalkonium chloride) is more than group B (impressions disinfected with sodium hypochlorite) but the difference is not statistically significant. The mean mediolateral dimension of casts in group A was 44.79 years \pm 0.201 SD while in group B it was 45.15 years \pm 0.517 SD. This shows mediolaterally mean dimensional measurement of the casts of group A (impressions disinfected with Glutaraldehyde+benzalkonium chloride) is less than group B (impressions disinfected with sodium hypochlorite) and the difference is statistically significant. The results of our study were similar to those of Rad et al²⁸ in which he recorded irreversible hydrocolloid impressions of metallic laboratory model. Impressions were disinfected, poured with type III dental stone and length and height of cast was recorded. Mean length of the cast obtained after disinfection with 5.25% sodium hypochlorite was 50.331 mm \pm 0.05 SD whereas 20.105 mm \pm 0.20 SD was mean height of the cast. In case of 2% glutaraldehyde group, mean length was 50.384 mm \pm 0.06 SD whereas 20.198 mm \pm 0.09 SD was mean height of the casts. Baseline measurements of length was 50 mm and height was 20 mm. Variations of length in disinfected specimens with 5.25% sodium hypochlorite were statistically significant, but the height variations were not significant whereas in case of glutaraldehyde, variations of height in disinfected specimens were statistically significant, but the length variations were not significant.

Reason for choosing immersion instead of spraying as a method of disinfection was that spraying method reduces the effectiveness of disinfection, particularly in case of porous hydrophilic hydrocolloids, where microorganisms can penetrate through the body and survive in the impression²⁹. According to Taylor et al, a 10-min imbibition can be beneficial, because it compensates the syneresis-associated shrinkage³⁰. In

this study, irreversible hydrocolloid was evaluated because it is most widely used impression material as it is easy to manipulate, does not require special equipment and is low priced³¹. There are also various types of test blocks which are used for evaluation of dimensional accuracy e.g. full arch casts³², American Dental Association Specification No. 19 mode^{5,19} but in this study impressions were recorded from edentulous patients to make study more realistic. Individual acrylic resin trays were not manufactured for the impressions because of the risk of water absorption and introduction of other variations¹⁹. To avoid these problems, stainless steel trays were used.

In a study by Vadenal et al irreversible hydrocolloid impressions were disinfected by immersion in 1% sodium hypochlorite and 2% gluteraldehyde for 10 minutes. Mean and standard deviation of impressions of sodium hypochlorite group was 24.008 years ± 0.046 SD whereas, mean and standard deviation of impressions of gluteraldehyde group was 23.945 years ± 0.126 SD. Baseline measurements of both groups was 25 mm so, Vadenal et al concluded that 10 minutes immersion in 1% sodium hypochlorite and 2% gluteraldehyde did not influence dimensional stability of impression material¹⁹. In our study, results are different. Though in anteroposterior dimensions, difference between the two groups is not statically significant but in mediolateral dimension difference between the two groups is statically significant. The difference in results might be due to change in methodology of study as in their study measurements are recorded directly on the impressions after disinfection whereas in our study, impressions are first poured with Type III dental stone and then measurements are recorded on the cast. Besides this, there is difference in concentration of disinfectants. Vadenal used 1% sodium hypochlorite and 2% gluteraldehyde whereas we used 0.5% Sodium hypochlorite and sterigum(gluteraldehyde+benzalkonium chloride).

In another study conducted by Wan et al³³ the impressions were recorded of partially edentulous models and inter canine and canine molar distances were measured with digital caliper after disinfection and pouring with dental stone. Two brands of alginate impression material were chosen. Mean intercanine distance of casts after immersion disinfection with 0.5% sodium hypochlorite was 29.274 mm and 29.508 mm (cavex and phase alginate impression materials) respectively whereas before disinfection the intercanine distance was 29.34 mm. Mean canine molar distance of casts after immersion disinfection with 0.5% sodium hypochlorite was 31.538 mm and 31.754 (cavex and phase alginate impression materials) respectively

whereas before disinfection the mean canine molar distance was 31.67 mm. Significant differences were seen in inter canine and canine-molar distance on stone casts of plastic partially edentulous model after immersion in disinfection solution when two different impression materials were compared. Phase impression material showed more dimensional changes after immersion suggesting that spray disinfection method should be applied when phase alginate is used for impression making. So, they concluded that choice of alginate impression material is very important³³. Here, in our study, Alginmajor alginate impression material was studied because this brand is in wide use in our country so it's dimensional changes after immersion disinfection with two effective and easily available disinfectants were studied.

LIMITATIONS

The limitations of the study are as follows:

1. In our study, after disinfection, alginate impression materials are first poured with dental stone and measurements are carried on casts. The dimensional changes thus produced may be because of immersion in disinfectant as well as expansion of the gypsum which was not measured in our study.
2. The sample size was 72 cases, 36 in each group. Further research studies should be conducted with a bigger sample size.
3. Only linear measurements in horizontal plane were recorded, change in dome of palate or other areas in vertical direction were not evaluated.
4. Jaw size of patients was different but tripod used was same for all patients, so, the punch position varied in different jaw sizes.

CONCLUSIONS

The difference in anteroposterior dimensions between the two groups is not statically significant but the difference in mediolateral dimensions is significant, so within the limitations of this study, it can be concluded that no preference can be given to any disinfectant from dimensional stability point of view. Further trials are recommended to evaluate dimensional stability after disinfection with Sodium hypochlorite and Gluteraldehyde+benzalkonium chloride to find solid evidence.

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