Effect of Chemical Disinfection on Dimensional Stability of Polyether Elastomeric Impression Material

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Polyether is one of a commonly used material for making impressions in prosthetic dentistry because of its properties like, excellent dimensional stability and low polymerisation shrinkage. Impressions should be properly disinfected before sending to laboratory, but disinfection by immersion may cause dimensional changes because of hydrophilic nature of polyether. So this study was designed to evaluate the effect of disinfection on dimensional stability of polyether impression.

Keyword - Polyether, Disinfectants, Dimensional stability.

Polyether developed in Germany in the mid 1960's is one of the most commonly used impression materials in Prosthetic dentistry because of its properties like excellent dimensional stability and low polymerization shrinkage[1]. Since oral environment harbors large number of microorganisms in saliva which may cause transmissible diseases like common cold, peumonia, TB, herpes, hepatitis and AIDS [2], impressions should be properly disinfected before sending to dental laboratory. One of the methods of disinfection is immersion of the polyether in disinfectant solutions, but it may cause dimensional changes owing to its hydrophilic nature. Since dimensional accuracy and reproduction of anatomic detail are important requisites for an impression used in the fabrication of dental castings, it is of interest to investigate the effect of disinfectants on dimensional accuracy. In this study immersion of Polyether impression material in disinfecting solution of 2% acid glutaraldehyde, 5.25 % sodium hypochlorite and 3% iodophore for 15 and 30 minutes was done and its antimicrobial property and dimensional stability were evaluated.

MATERIALS AND METHOD

The Polyether elastomeric impression material (Impregum™ Soft, 3M ESPE AG Dental products Germany) was used for making test samples. Three Antimicrobial agents viz. Glutaraldehyde (LOBA Chemie Pvt. Ltd; Mumbai), Sodium hypochlorite (LOBA Chemie PVT. Ltd; Mumbai), Iodophore (Win-Medicare PVT Ltd; Mumbai) were used for disinfection. Nutrient agar (Himedia Lab Pvt Ltd; Mumbai, India) and Nutrient broth (Himedia Lab Pvt Ltd; Mumbai, India.) were used as Culture medias. Microorganisms used were Lactobacillus(Unisankyo Ltd) and Staphylococcus aureus. Mould (Fig.1) for making test specimens for measuring dimensional changes were indegeniously made.

Cultivation and storage of bacterial strains: Nasal and throat samples were collected from the patients with sore throat and upper respiratory tract infection on sterile swabs for cultivation of staphylococcus ,while sachet of Sporolac powder

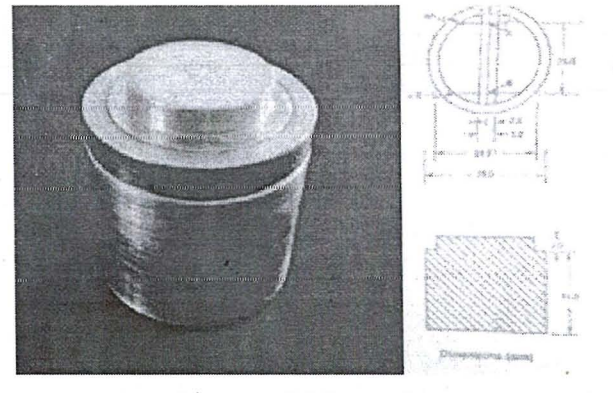


Fig 1: Complete mould for making test specimens for dimensional changes

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were taken for cultivation of Lactobaccilus. Both were mixed separately in nutrient broth and incubated at 37°C for 24 hours, transferred to nutrient agar plate and again incubated at 37°C for 24 hours. These bacterial strains were picked from culture plates and inoculated into nutrient broth tube under strict aseptic conditions .These tubes were stored in a refrigerator at 4- 8° C till further use.

Then a smear was prepared from a single colony of this plate and gram staining and suitable biochemical tests were done to confirm the presence of lactobacillus or staphylococcus

Evaluation of antimicrobial activity: Thin sheets of polyether were made over a mixing pad. From these sheets, pellets were prepared with the help of punching machine .These pellets were autoclaved and dipped in different disinfectants for 10 or 30 minutes and placed in circular manner over petridish. Control was kept in the centre. After 24 hours the inhibition halo zones around the pellets were measured. These pellets were placed on new serum agar plates seated with the 24 hour fresh culture of the same micro-organism. The inhibition halo zones were examined likewise after 1 day, 3 days and 5days

The antimicrobial activity was measured by measuring the inhibitory halo zones around the pellets These halo zones were defined as zones in which the bacteria have lost its power of growth and multiplication, the zones were measured in two perpendicular diameters and mean of that was taken and from that mean diameter of the pellet was subtracted. These halo zones were measured for a period of five days, which is sufficient time period for any impression to be poured.

Evaluation of physical properties: 120 specimens of identical dimensions were obtained by using the indigenously made mould as per ADA Specification No. 19 . These specimens were immersed in different antimicrobials groups A (5.25% NaOCl), Group B (2% Glutaraldehyde), Group C (Iodophore) for 10 minutes or 30 minutes. Dimensional changes were evaluated by measuring the distance between cross lines cd and cd' under travelling microscope at 30X magnification

Analysis of variance (ANOVA) was used to compare the within group and between groups variances amongst the study groups. Student 't' Test was used to calculate the significance of two means.

RESULTS

Dimensional changes: The mean linear dimensions after 10 minutes of treatment for Group A (5.25% NaOCl) and Group C (iodophor) had same value (22.96) whereas Group B

Table 1: Analysis of Variance of dimensional change in different groups (after 10 minutes of treatment)

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	0.046	2	0.023	7.667	0.002
Within Groups	0.162	57	0.003		
Total	0.208	59			

Table 2: Analysis of Variance for variance in dimensional change in different groups

	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	0.046	2	0.023	7.667	0.003
Within Groups	0.145	57	0.003		
Total	0.191	59			

(2%glutaraldehyde) had the maximum value (23.01). In Group A the mean change from control was 0.038±0.04 (range -0.13 - 0.12), in Group B it was 0.09±0.05 (range 0.0-0.23) and in Group C it was 0.04±0.06 (range 0.02-0.23).While comparing the mean dimensional change from control, statistically significant differences were seen for all the groups (table 1). The mean linear dimensions after 30 minutes of treatment for Group A and Group C had same mean value (22.99) whereas Group B had the maximum mean value (23.02). In Group A the mean change as compare to control was 0.068±0.04 (range -0.01 - 0.12), in Group B it was 0.091±0.051 (range 0.1-0.23) and in Group C it was 0.067±0.027 (range 0.01-0.19).While comparing the mean dimensional change from control, statistically significant differences were seen for all the groups (table 2).

On the basis of above analysis the dimensional change in different groups at different time intervals could be summarized as: **Group B > Group A = Group C.**

Antimicrobial Activity: At 24 hours the mean antimicrobial efficacy of different groups treated for both 10 and 30minutes showed largest zones of inhibitions for Group A > B > C for both streptococcus and

Table 3: Mean Antimicrobial Efficacy of Different Groups (treated for 10 minutes) against different species at 24 hours

S.No.	Bacterial species	Mean Zone of Inhibition					
		Group A		Group B		Group C	
		Mean	SD	Mean	SD	Mean	SD
1.	*S. aureus*	7.050	0.510	6.400	0.995	5.250	0.639
2.	*Lactobacillus*	7.475	0.678	7.425	0.545	4.975	0.499

Table 4: Mean Antimicrobial Efficacy of Different Groups (treated for 30 minutes) against different species at 24 hours

S.No.	Bacterial species	Mean Zone of Inhibition					
		Group A		Group B		Group C	
1.	*S. aureus*	8.88	0.74	7.88	0.70	7.23	0.62
2.	*Lactobacillus*	9.10	0.68	9.08	0.59	6.38	0.65

Table 5: Analysis of Variance of different groups (treated for 10 minutes) against different species at 24 hr

Species		Sum of Squares	df	Mean Square	F	Sig.
S. aureus	Between Groups	23.433	2	11.717	8.481	0.001
	Within Groups	78.750	57	1.382		
	Total	102.183	59			
Lactobacillus	Between Groups	81.700	2	40.850	121.829	0.000
	Within Groups	19.113	57	0.335		
	Total	100.813	59			

lactobacillus (table 3,4). Statistically significant difference were seen between Group A and Group C and Group B and Group C for both the microbial species with the largest mean zone of inhibition in Group A followed by Group B and then Group C when treated for 10 or 30 minutes (table 5,6)

At 3days, multiple comparison revealed no statistically significant difference between groups for both the microbial species but the largest mean zone of inhibition was seen in Group B followed by Group A and then Group C when treated for 10 or 30 minutes (table 7,8)

DISCUSSION

In this study polyether was chosen because of its properties like excellent dimensional stability and low polymerization shrinkage. But it has been reported

Table 6: Analysis of Variance of different groups (treated for 30 minutes) against different species at 24 hr

Species		Sum of Squares	Df	Mean Square	F	Sig.
S. aureus	Between Groups	27.633	2	13.817	29.047	<0.001
	Within Groups	27.113	57	0.476		
	Total	54.746	59			
Lactobacillus	Between Groups	98.108	2	49.054	119.619	<0.001
	Within Groups	23.375	57	0.410		
	Total	121.483	59			

Table 7: Analysis of Variance of different groups (treated for 10 minutes) against different species at 3 days

Species		Sum of Squares	df	Mean Square	F	Sig.
S. aureus	Between Groups	0.475	2	0.238	0.888	0.417
	Within Groups	15.238	57	0.267		
	Total	15.713	59			
Lactobacillus	Between Groups	0.100	2	0.050	0.191	0.826
	Within Groups	14.900	57	0.261		
	Total	15.000	59			

Table 8: Mean Antimicrobial Efficacy of Different Groups (treated for 30 minutes) against different species at 3 days

S.No.	Bacterial species	Mean Zone of Inhibition					
		Group A		Group B		Group C	
		Mean	SD	Mean	SD	Mean	SD
1.	*S. aureus*	0.83	0.69	0.85	0.76	0.75	0.72
2.	*Lactobacillus*	0.70	0.55	0.75	0.60	0.65	0.56

that Polyether impression material was susceptible to dimensional change if the immersion is longer than 10 minutes, because of its pronounced hydrophilic nature [1,4]. Therefore the present study was undertaken to evaluate the dimensional stability of Polyether elastomeric impression material and antimicrobial properties of Polyether elastomeric impression material after immersion in 5.25% NaOCl, 2% Glutaraldehyde, 3% Iodophore for 10 and 30 minutes.

As compared to any other antimicrobial agent used in this study 5.25% NaOCl produce the biggest inhibitory halo zones when observed at 24 hours followed by 2%Glutaraldehyde and then 3% Iodophore for S. aureus and Lactobacillus. Although NaOCl is medium level disinfectant as compared to Glutaraldehyde which is high level disinfectant [5], in this study NaOCl has produced bigger halo zones, which can be because of its better antimicrobial activities (bactericidal, fungicidal, viricidal and sporadically), while Glutaraldehyde is effective mainly against fungi and viruses and it is less bactericidal except against tubercle bacilli [6].

At 3 days when specimens treated for both 10 minutes and 30 minutes were examined the zones of inhibition were largest in 2%Glutaraldehyde followed by NaOCl and then 3%Iodophore for both the bacterial strains. This can be due to the property of Hypochlorite solution which decays rapidly and should be prepared daily [7]. No Zones of Inhibition were revealed when the culture plates were examined on 5th day

Dimensional changes Statistical evaluation of the data revealed that immersion of polyether impression material in 2%Glutaraldehyde, 5.25% NaOCl and 3% Iodophore solution for 10 and 30 minutes did not produce a significant difference in dimension. From the observations discussed, it may be concluded that Sodium hypochlorite, Glutaraldehyde and Iodophor showed antimicrobial properties for three days after which no antimicrobial property was seen. All the three disinfectants did not have any significant adverse effect on the Dimension stability of Polyether elastomeric impression material. Glutaraldehyde was the most effective disinfectant against the microorganisms taken in this study.

CONCLUSIONS

Within limitations of the study following conclusions were drawn-:

1. All the three disinfectants used did not have any significant adverse effect on the Dimension stability of Polyether elastomeric impression material when immersed for 10 or 30 minutes.
2. Samples immersed in disinfectants for 10 minutes or 30 minutes when observed after 24 hrs showed largest zone of inhibition with 5.25 % NaOCl followed by 2% Glutaraldehyde and then 3% Iodophore for both S. aureus and Lactobacillus..
3. Samples immersed in disinfectants for both 10 minutes or 30 minutes when observed after 3 days showed largest zone of inhibition with 2% Glutaraldehyde follow by 5.25 % NaOCl and 3% Iodophore for both the microbial strains..
4. No Zones of Inhibition were revealed when culture plates were examined on 5th day

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