

# Comparative evaluation of the effect of electrolyzed oxidizing water on surface detail reproduction, dimensional stability and Surface texture of poly vinyl siloxane impressions

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## Abstract

**Aim:** The aim of this *in vitro* study was to comparatively evaluate the effect of chemical disinfectants on the surface detail reproduction, dimensional stability and surface texture of polyvinyl siloxane (PVS) impressions.

**Materials and Methods:** The impressions were then divided into five groups (fifteen samples per group) and subjected to a ten minutes immersion with 2% glutaraldehyde (Group I), 1% sodium hypochlorite (Group II), freshly prepared electrolyzed oxidizing water (EOW) with different pH values - acidic (Group III), alkali (Group IV) and neutral (Group V). The samples were examined pre and post-immersion under visual observation for surface detail reproduction, travelling microscope for measurement of dimensional stability and surface profilometer (3D) for evaluation of surface texture. A standardized master die was fabricated and seventy-five PVS test samples were made. The samples were subjected to immersion disinfection and studied for surface detail reproduction, dimensional stability and surface texture. *Post-hoc* test, paired *t* test and ANOVA were used to analyze dimensional stability statistically both within and between the test groups.

**Results:** The surface detail reproduction was satisfactory with both pre and post-immersion test samples. A statistically significant dimensional change was observed post-immersion in Groups II, III and V test samples and a statistically insignificant dimensional change was observed in Groups I and IV test samples. There was a negligible change in surface texture post-immersion in Groups I, III, IV and V test samples with a slight increase in surface roughness post-immersion in Group II samples.

**Conclusion:** In this study, all the test disinfectants produced satisfactory surface detail reproduction on Polyvinyl siloxane impressions. 2% glutaraldehyde and electrolyzed oxidizing water (alkali) have resulted in statistically insignificant dimensional change, while 1% sodium hypochlorite, electrolyzed oxidizing water (acidic) and electrolyzed oxidizing water (neutral) have resulted in statistically significant dimensional changes. All the test disinfectants except 1% sodium hypochlorite showed a reduction in surface roughness (Ra) values.

**Keywords:** Addition silicone, disinfection, freshly prepared electrolyzed oxidizing water, glutaraldehyde, sodium hypochlorite

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## INTRODUCTION

Impressions play a key role in the success of prosthesis because prosthesis can be no more accurate than the impression from which it has been made. The transmission of potentially infectious pathogens from mouth using dental impressions and prostheses is a frequent occurrence in a dental operator. Rinsing with water alone does not clear away all the pathogens from the mouth that have adhered to the impression surface. Hence, it is mandatory that every impression should first be rinsed with water to remove saliva, blood and debris followed by disinfection by spraying or immersing or nebulization in a chemical disinfectant.<sup>[1-8]</sup>

An ideal disinfectant should possess an effective antimicrobial activity, yet it should not cause an adverse response to surface features and dimensional accuracy of the impression material and resultant gypsum cast. Disinfection process can be done by spraying or immersion in various chemical disinfectants. According to the previous studies, in immersion disinfection, the disinfectant solution comes into contact with all the surfaces of the impression material and has been recognized as more effective and reliable than disinfection by spraying. However, this procedure may render the impression prone to dimensional changes.<sup>[2,8-13]</sup>

Polyvinyl siloxane (PVS) impression materials have been widely used in a variety of indirect procedures in prosthodontics. Favorable handling properties, good patient acceptance and excellent physical properties make them the material of choice in today's practice.<sup>[14,15]</sup> Glutaraldehyde (GA) and sodium hypochlorite (SH) have been commonly recommended as disinfectants for PVS impressions. According to the previous studies, immersion in 2% GA and 1% SH for 10 min have resulted in successful disinfection of PVS impressions.<sup>[7,8,16-19]</sup>

Electrolyzed oxidizing water (EOW) has been certified for use in Japan, as a medical product and was quickly accepted in the food and poultry industry as an effective and safe disinfectant agent. EOW is environmental friendly as it reverts back into NaCl solution (salt) and water. EOW can be produced as three different solutions differing according to their pH namely acidic, alkali and neutral. The first form developed was the acidic type which was quickly accepted by the food industry in Japan.<sup>[20-22]</sup> EOW was identified as a clinically more effective disinfectant agent for decontamination of healthcare environment.<sup>[23]</sup> In a study by Marais and Brözel EOW was recommended as an effective antimicrobial agent for removing biofilm in dental unit water lines.<sup>[24]</sup> EOW treatment may be used as

an effective method for reducing microbial contamination on food processing surfaces, poultry industries, water treatment procedures, medical and dental facilities. Previous studies have reported EOW as an effective antimicrobial agent for dental impressions.<sup>[6,20-22,25-29]</sup>

An exact reproduction of surface details is of utmost importance for making an accurate prosthesis. Dimensional stability reflects the ability of the impressions to remain accurate and stable in reproducing the oral structures. Surface detail reproduction and dimensional stability of dental impression material is of utmost importance in achieving the desired fit and function of the future prostheses. In previous studies, various methods have been used to measure the dimensional changes such as Boley's gauge, measuring microscope, traveling microscope, digimatic caliper, toolmaker's microscope, Nikon profile projector and 2D computer scanner.<sup>[7-10,30-39]</sup> Many studies have evaluated the dimensional stability measuring either on full arch cast<sup>[10,30,31,40]</sup> or in a metal die fabricated in accordance with American Dental Association (ADA) Specification No: 19.<sup>[7,9,11,41-44]</sup> Few studies have also evaluated directly on impressions.<sup>[7,11,45,46]</sup> In addition to the measurement of dimensional accuracy, few studies have also examined the surface detail reproduction of the impressions and gypsum casts.<sup>[9,47,48]</sup>

Surface texture on the tissue surface of the impression may also affect the fit of the prostheses. Surface defects may be most commonly caused by the result of change in the properties of the material resulting from the disinfection procedure. Various methods have been employed to assess the surface texture using optical profilometer, surface profilometer (3D), surface profilometer (2D), surface roughness tester and Nikon profile projector.<sup>[13,21,49-51]</sup> Several studies have measured the surface roughness on gypsum casts obtained from impressions.<sup>[13,51]</sup> Data on measurement of surface texture directly on impressions are limited.<sup>[21,50]</sup> Various studies have proved that PVS impression materials have superior surface detail reproduction, long-term dimensional stability and no significant change in surface texture when subjected to immersion in disinfectants such as GA and SH. Wu G *et al.*, in his study had shown that a 10 min immersion in freshly prepared EOW (acidic) showed significant changes in dimension and surface texture in hydrocolloid impressions.<sup>[21]</sup> In another recent study by Jeyapalan *et al.*, a 10 min immersion in freshly prepared EOW (acidic) showed significantly higher antimicrobial efficacy as compared to 2.4% GA and 1% SH in clinically derived PVS impressions.<sup>[6]</sup> However, its effect on the post-immersion dimensional stability, surface detail reproduction and surface texture has not been evaluated.

However, studies comparatively evaluating the effect of immersion disinfection using GA, SH and freshly prepared EOW on surface detail reproduction, dimensional stability and surface texture have not been documented. Studies exploring the effects of acidic, alkaline and neutral pH of EOW on these properties are also lacking.

In light of the above, the aim of the present *in vitro* study was to comparatively evaluate the effect of chemical disinfectants on surface detail reproduction, dimensional stability and surface texture of PVS impressions.

The null hypothesis for the present study was that no significant changes would be observed with respect to surface detail reproduction, dimensional stability and surface texture following immersion in any of the chemical disinfectants employed.

## MATERIALS AND METHODS

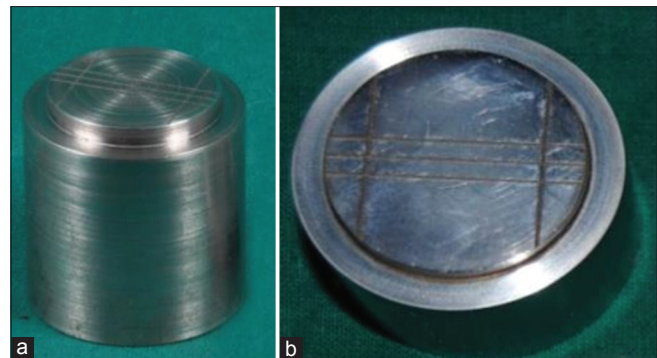
Institutional clearance was obtained from the Institutional review board for the present study and the identity number is 20161261.

### Fabrication of master die

A standardized stainless steel master die (Kutty Metal Works, Chennai) was fabricated according to the ADA Specification No. 19 [Figure 1a]. The die consists of three components: Ruled block, mold and metal riser. The cylindrical ruled block had a height of 31 mm and diameter of 38 mm with a step of 3 mm height and 29.97 mm diameter on its superior surface. Dies were scored with three horizontal lines (A, B and C) and two vertical lines (DE and D'E') on top of the impression surface with the help of Nd-YAG laser treatment [Figure 1b]. The distance between any two adjacent horizontal lines was 2.5 mm and between the two vertical lines was 20 mm. The width of the lines A =  $50 \pm 8 \mu\text{m}$ , B =  $20 \pm 4 \mu\text{m}$ , C =  $75 \pm 8 \mu\text{m}$ , DE =  $75 \pm 8 \mu\text{m}$  and D'E' =  $75 \pm 8 \mu\text{m}$ . All lines have  $90^\circ$  included angle. The point of intersection of the vertical lines on the line A was named as X and X', on the line B was named as Y and Y' and on the line C was named as Z and Z'. The metal mold ring fits to the step of the ruled block. It has an outer diameter of 38 mm, inner diameter of 30 mm and a height of six mm. The mold ring served as a tray for containing the impression material. The metal riser has a diameter of 29.97 mm and a height of three mm and was used to press the impression out of the mold without any visible damage.

### Preparation of test samples

In the present study, addition curing PVS monophasic impression material (Dentsply Caulk, USA) was used



**Figure 1:** (a) Master die. (b) Master die test surface

as the test impression material for making impressions. Before impression making, the stainless steel die was cleaned with a solvent (Hema Pharmaceuticals, Chennai, Tamil Nadu, India) soaked in cotton (Jayamari Enterprises, Chennai, Tamil Nadu, India) to remove any residue and air dried. The mold was lubricated with petroleum jelly (Bharat Pharmaceuticals, Chennai, Tamil Nadu, India) and placed on the test block.

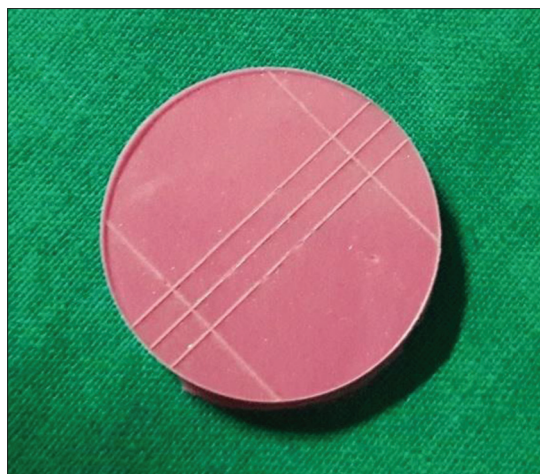
Impressions were made using an auto mixing impression gun to obtain a homogeneous mixture. An intraoral tip was attached to the mixing tip to line the impression surface of the die with the impression material. Both the components of the impression material were pushed in a zigzag manner along the length of the mixing tip and syringed over the test surface of the die. The mold was filled completely with the impression material to ensure a uniform thickness of three mm. A thin polyethylene sheet (DPI, India) was then placed over the mold followed by a rigid flat metal plate. Sufficient force of 1000 g was applied to seat the plate firmly against the mold to permit extrusion of excess material. Once the impression was set, the mold and test block were separated. The impression was gently pressed out of the mold using the riser. The final test sample is obtained [Figure 2]. In this manner, a total of seventy five PVS test samples were made and these were stored in an airtight, clean polypropylene container (Parsons Pvt Ltd., Mumbai, Maharashtra, India).

### Grouping of test samples

The 75 test samples were grouped randomly into five groups of 15 samples each, out of which 10 samples per test group were employed for evaluating the surface detail reproduction and dimensional stability. Five representative samples per test group were employed for evaluating the surface texture. Of these:

Group I samples were immersed in 2% GA (Alan Medical Products, Chennai) for 10 min. Group II samples were





**Figure 2:** Test sample

immersed in 1% SH (Alan Medical Products, Chennai) for 10 min. Group III samples were immersed in freshly prepared EOW (acidic) (Tianno Ti Anode Fabricators Pvt Ltd) for 10 min. Group IV samples were immersed in freshly prepared EOW (alkali) (Tianno Ti Anode Fabricators Pvt Ltd) for 10 min. Group V samples were immersed in freshly prepared EOW (neutral) (Tianno Ti Anode Fabricators Pvt Ltd) for 10 min.

GA and SH used for the present study were commercially obtained. Freshly prepared EOW in all the three concentrations acidic, basic and neutral pH were customized according to the specifications mentioned in the previous studies. EOW is produced by electrolysis of a diluted salt solution (0.05%–0.2%) in an electrolysis chamber where the anode and cathode are separated by a bipolar membrane. Two types of water possessing different characteristics were produced namely an electrolyzed basic aqueous solution with pH 11.6, ORP 795 mV from cathode side and an electrolyzed acidic solution with pH of 2.3–2.7, ORP 1150 mV and 50 ppm free Chlorine from the anode side.

#### Evaluation of surface detail reproduction of test samples

Surface detail reproduction of each test sample was evaluated immediately after removal from the die. The continuity of the appropriate horizontal cross line YY' reproduced on the test sample surface was evaluated under low angle illumination without magnification according to ADA Specification No. 19.

The surface detail reproduction on the pre-immersion test samples were scored as being satisfactory (S) or not satisfactory (NS). The reproduction was considered to be satisfactory if the appropriate cross line (YY') with a width of  $20 \pm 4 \mu\text{m}$  was reproduced continuously for their full

length in at least two of three samples prepared. These scores were tabulated as the preimmersion surface detail reproduction scores for all the test samples.

The test samples were then subjected to their respective disinfectants for duration of 10 min. The samples were observed again for the evaluation of surface detail reproduction similar to the procedure described above. The post-immersion scores were noted and tabulated as post-immersion surface detail reproduction scores for all the test samples.

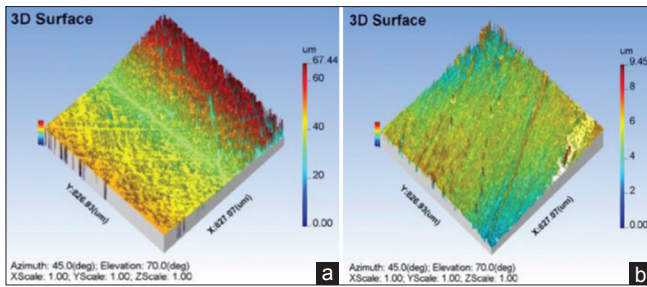
#### Evaluation of dimensional stability of test samples

The preimmersion test samples were measured using a traveling microscope at  $\times 10$  magnification according to ADA specification no. 19. The length of the horizontal cross lines XX', YY' and ZZ' were measured and recorded. The measurements were taken five times by a single operator and the average value of these measurements were calculated and tabulated as the pre-immersion measurements. After the preimmersion measurements were done, the test samples of each group were immersed for 10 min in their respective disinfectants in individual airtight polypropylene containers. Post-immersion measurements were done using travelling microscope at  $\times 10$  magnification similar to the procedure described above.

#### Evaluation of surface texture of test samples

All test samples were subjected to preimmersion profilometric traces using a Surface Profilometer (3D) (Taylor Hobson, USA) consisting of a noncontact profilometer with a lens covering of range  $2.5 \mu\text{m}$ . The surface roughness of each test sample was measured at three points (P, Q and R). Of these, the first point has been randomly selected and the other two points were at a distance of 5 mm from it. The surface texture tracings were performed at a speed of  $200 \mu\text{m/s}$ . The average surface roughness (Ra) values were obtained in micro meter ( $\mu\text{m}$ ) in accordance with ISO 4287:1997 and the 3D surface profile images were also obtained for each test sample and recorded as the pre-immersion surface texture measurements [Figure 3a].

After the pre-immersion measurements were done, the impressions of each group were immersed in their respective disinfectants in individual airtight polypropylene containers. All the 25 test samples were subjected to post immersion profilometric traces using a surface profilometer (3D) in a similar manner as described previously. The surface roughness (Ra) data and images were recorded as the post-immersion surface texture measurements [Figure 3b].



**Figure 3:** (a) Pre-immersion surface texture of Group III test sample. (b) Post-immersion surface texture of Group III test sample

**Data tabulation and analysis**

The data obtained from the pre and post-immersion evaluation of all the test samples of all the test groups for surface detail reproduction, dimensional stability and surface texture were tabulated. Surface detail reproduction was assessed descriptively based on the scores obtained. Dimensional stability was analyzed statistically both within and between the test groups using *post hoc* test, paired *t*-test and ANOVA. Surface texture was analyzed using descriptive analysis. All statistical analysis was performed using SPSS Statistics for Windows (IBM Corp, Armonk, NewYork, USA).

**RESULTS**

For the evaluation of surface detail reproduction, the data obtained for all the samples were tabulated as satisfactory and nonsatisfactory [Table 1]. The surface detail reproduction of PVS test samples both pre and post-immersion in all the chemical disinfectant groups (Group I, Group II, Group III, Group IV and Group V) yielded overall scores that were considered to be satisfactory based on the reproduction of the YY reference line.

For the evaluation of dimensional stability, the mean values of the dimensions were calculated pre and post immersion for each group and percentage change in dimension was also determined. The overall mean dimension obtained in Group I (GA) for pre and post-immersion were 19.95 mm and 19.97 mm, respectively. The overall mean dimensions obtained in Group II (SH) for pre and post-immersion were 19.94 mm and 19.79 mm, respectively. The overall mean dimension obtained in Group III (EOW-acidic) for pre and post-immersion were 20.03 mm and 19.79 mm, respectively. The overall mean dimension obtained in Group IV (EOW-alkali) for pre and post-immersion were 19.84 mm and 19.85 mm respectively. The overall mean dimension obtained in Group V (EOW-neutral) for pre and post-immersion were 20.03 mm and 19.80 mm, respectively [Table 2]. The mean dimensional change was found to be statistically

**Table 1: Evaluation of the effect on surface detail reproduction of polyvinyl siloxane test samples pre-and post-immersion in disinfectants**

Sample number	Group I		Group II		Group III		Group IV		Group V	
	Pre	Post	Pre	Post	Pre	Post	Pre	Post	Pre	Post
1	S	S	S	S	S	S	S	S	S	S
2	S	S	S	S	S	S	S	S	S	S
3	S	S	S	S	S	S	S	S	S	S
4	S	S	S	S	S	S	S	S	S	S
5	S	S	S	S	S	S	S	S	S	S
6	S	S	S	S	S	S	S	S	S	S
7	S	S	S	S	S	S	S	S	S	S
8	S	S	S	S	S	S	S	S	S	S
9	S	S	S	S	S	S	S	S	S	S
10	S	S	S	S	S	S	S	S	S	S

S: Satisfactory, NS: Not Satisfactory

insignificant for Group I (GA), ( $P = 0.58$ ) and Group IV (EOW-alkali), ( $P = 0.98$ ) whereas Group II (SH), ( $P = 0.050$ ), Group III (EOW-acidic) ( $P = 0.002$ ) and Group V (EOW-neutral) ( $P = 0.001$ ) showed statistically significant change.

The mean percentage change in dimension obtained was -0.09% for Group I (GA), 0.76% for Group II (SH), 1.23% for Group III (EOW-acidic), 0.26% for Group IV (EOW-alkali) and 1.10% for Group V (EOW-neutral) [Table 2]. This indicates mild shrinkage of the test samples post-immersion in Group I (GA) and mild expansion of the test samples post-immersion in Group II (SH), Group III (EOW-acidic), Group IV (EOW-alkali) and Group V (EOW-neutral). Elastomeric impression materials should not display a dimensional change of more than 0.5%. The percentage change in dimension obtained for Group I (GA) and Group IV (EOW-alkali) were within clinically acceptable limits. The percentage change in dimensions obtained for Group II (SH), Group III (EOW-acidic) and Group V (EOW-neutral) were more than the clinically acceptable limits. On comparing the percentage change in dimensions of PVS impressions post-immersion between the groups, statistically significant dimensional changes were observed between Group III (EOW-acidic) and Group I (GA) ( $P = 0.033$ ) and between Group III (EOW-acidic) and Group IV (EOW-alkali) ( $P = 0.049$ ) [Table 3].

For evaluation of surface texture, the data obtained from the profilometric traces for pre- and post-immersion of all the representative test samples of each group were tabulated and their mean was calculated. The mean were analyzed based on descriptive statistics. The mean surface roughness of Group I (GA) pre and post-immersion was 0.53 and 0.38 μm, respectively indicating a mild decrease in surface roughness post-immersion. The mean surface roughness of Group II (SH) pre- and post-immersion was 2.15 and

**Table 2: Dimensional change of polyvinyl siloxane test samples post-immersion in different disinfectants within each test group using paired t-test and ANOVA**

Sample	Preimmersion	Post-immersion	P	Percentage change
Group I (GA), mean±SD	19.95±0.17	19.97±0.16	0.58	-0.09
Group II (SH), mean±SD	19.94±0.17	19.79±0.15	0.05*	0.76
Group III (EOW - acidic), mean±SD	20.03±0.10	19.79±0.13	0.002**	1.23
Group IV (EOW - alkali), mean±SD	19.84±0.24	19.85±0.14	0.98	0.26
Group V (EOW - neutral), mean±SD	20.03±0.14	19.80±0.12	0.001**	1.10

\*Significance at 5% level; P<0.051, \*\*Significance at 1% level; P<0.01. SH: Sodium hypochlorite, GA: Glutaraldehyde, EOW: Electrolyzed oxidizing water, SD: Standard deviation

**Table 3: Multiple comparisons of mean percentage dimensional changes of polyvinyl siloxane test samples between test groups using Tukey's post hoc honestly significant difference analysis**

Group	Group	Mean percentage change	P
Group I	Group II	-0.85	0.32
	Group III	-1.33	0.033*
	Group IV	-0.07	1.00
	Group V	-1.20	0.07
	Group II	0.85	0.32
Group II	Group III	-0.48	0.82
	Group IV	0.78	0.40
	Group V	-0.34	0.94
	Group I	1.33	0.033*
	Group III	0.48	0.82
Group III	Group IV	1.26	0.049*
	Group V	0.13	1.00
	Group I	0.07	1.00
	Group II	-0.78	0.40
	Group III	-1.26	0.049*
Group IV	Group V	-1.13	0.10
	Group I	1.20	0.07
	Group II	0.34	0.94
	Group III	-0.13	1.00
	Group IV	1.13	0.10

\*Significance at 5% level; P<0.051

3.23 µm, respectively, indicating a mild increase in surface roughness post-immersion. The mean surface roughness of Group III (EOW – acidic) pre and post-immersion was 3.60 and 3.55 µm, respectively, indicating a mild decrease in surface roughness post-immersion. The mean surface roughness of Group IV (EOW– alkali) pre and post-immersion was 3.60 and 3.52 µm, respectively, indicating a mild decrease in surface roughness post-immersion. The mean surface roughness of Group V (EOW– neutral) pre and post-immersion was 3.59 and 3.53 µm, respectively indicating a mild decrease in surface roughness post-immersion.

## DISCUSSION

The null hypothesis was validated with respect to surface detail reproduction and surface texture and rejected with respect to dimensional stability.

Previous studies have shown that PVS impressions can be successfully disinfected on a 10 min immersion with 2% GA and 1% SH.<sup>[7,8,16-19]</sup> EOW has been studied as an

effective antimicrobial efficacy when used for clinically derived PVS impressions by Jeyapalan *et al.*<sup>[6]</sup> The effect of EOW on the surface detail reproduction, dimensional stability and surface texture of PVS impressions are lacking. Studies evaluating the effects of EOW with different pH on these properties are also lacking. Hence, the present *in vitro* study was conducted to comparatively evaluate the effect of chemical disinfectants, namely 2% GA, 1% SH, freshly prepared EOW (acidic), freshly prepared EOW (alkaline) and freshly prepared EOW (neutral) on the surface detail reproduction, dimensional stability and surface texture of PVS impressions.

Various authors have used various test blocks for the measurement of surface detail reproduction, dimensional stability and surface texture. Many studies have measured these parameters on metallic dies standardized according to ADA Specification No. 19.<sup>[41]</sup> Hence, in the present study, a master die was fabricated in accordance with the above specification. Direct evaluation of impressions was done to avoid the errors associated with cast pouring.

Evaluation of the surface detail reproduction of the test samples were done according to ADA Specification No. 19. The reproduction was considered to be satisfactory if the appropriate cross line with a width of 20 ± 4 µm was reproduced continuously for their full length in at least two of three samples prepared. The above mentioned criteria were evaluated as specified for elastomeric impression materials. Since elastomeric impression materials can reproduce fine details, when compared to hydrocolloid impression materials, reproduction of this fine line was advocated for elastomers.<sup>[41]</sup> Hence, the results are qualitatively interpreted using descriptive analysis.<sup>[41]</sup>

In the present study, the dimensional changes of the test samples pre- and post-immersion were measured using traveling microscope (×10 magnification) by measuring the distance between the horizontal cross lines on the ruled metal block as specified in ADA specification No: 19.<sup>[41]</sup> The mean values of the dimensions were calculated pre and post immersion for each group. The percentage change



in dimension was also determined as specified in ADA Specification No: 19. Elastomeric impression materials should not display a dimensional change of more than 0.5%.<sup>[41]</sup>

According to the previous studies, many methods have been used to evaluate the surface roughness of the impressions and gypsum casts. Although surface profilometer (2D) is routinely used for the quantitative assessment of surface texture, the concept of using non-contact surface profilometer (3D) has been developed recently. Hence, in the present study, the surface texture of the test samples pre and post-immersion in their respective disinfectants was evaluated using a noncontact surface profilometer (3D). Representative test samples from each test group were subjected to surface texture analysis and the results subjected to qualitative interpretation by applying descriptive analysis.

The results of the surface detail reproduction of the present study is in line with the study by Fatima *et al.* which showed satisfactory surface detail reproduction for PVS impressions.

When compared against the test die.<sup>[48]</sup> According to Amin *et al.*, stone cast obtained from PVS impression material after disinfection with 2% GA and 1% SH showed satisfactory surface detail reproduction.<sup>[9]</sup> Further studies are needed in order to evaluate the surface detail reproduction of PVS impressions when treated with different disinfectant agents.

Previous studies have shown that PVS impression materials do not undergo significant dimensional change post-immersion in 2% GA and 1% SH for 10 min.<sup>[30,43,45]</sup> Although the results for Group I (GA) were in line with those obtained in previous studies, the results for Group II (SH) were in variance and showed a statistically significant change in dimension. The result of this present study was in line with the results of Thouati *et al.* in which 5.25% of SH was used on PVS impressions for a period of 30 min.<sup>[34]</sup> However, in this present study, only a 10 min immersion in 1% SH was employed. Wu *et al.* studied the dimensional stability of irreversible hydrocolloids by immersion in 1% SH and freshly prepared EOW (acidic) and concluded that immersion in 1% SH and EOW (acidic) caused significant dimensional changes.<sup>[21]</sup> Studies evaluating the dimensional stability of PVS impressions post-immersion in different pH values of EOW are lacking. Sinobad *et al.* in his study stated that the beginning of disinfecting treatment may strongly affect the stability of impression materials and critical changes occur in the first few minutes.<sup>[33]</sup> The dimensional changes observed with SH, EOW (acidic)

and EOW (neutral) may be attributed to this and may also be due to changes in study environment. Even though dimensional changes observed with SH are mild, larger sample sizes are required to arrive at a conclusion. Further studies are needed to evaluate the dimensional stability of PVS impressions immersed in EOW with different pH to arrive at an appropriate conclusion.

Since studies on surface texture evaluation of PVS impressions are sparse, direct correlations cannot be drawn for comparing the results obtained in the present study. However, the results obtained in the present study are indicative of a favorable response, that is, hardly any changes were obtained except for SH where a mild roughness is observed. However, further studies involving larger sample sizes are required before arriving at definite conclusions with respect to surface roughness.

From the results obtained from and within the limitations of the present study, it can be concluded that, surface detail reproduction and surface texture remains unaffected following immersions in all five disinfectants employed, whereas dimensional stability can be significantly affected by immersion in 1% SH, EOW (acidic) and EOW (neutral). The present study had certain limitations. The sample size was small and a larger sample size may affect the study results differently. Further studies with larger test samples with test conditions mimicking the oral situation and also comparatively evaluating other impression materials are recommended to enhance the results obtained with the present study.

## CONCLUSION

In this study, all the test disinfectants produced satisfactory surface detail reproduction on PVS impressions.

With respect to dimensional changes, 2% Glutaraldehyde and freshly prepared electrolyzed oxidizing water (alkali) have resulted in statistically insignificant change in dimensional stability, while 1% Sodium Hypochlorite, electrolyzed oxidizing water (acidic) and electrolyzed oxidizing water (neutral) have resulted in statistically significant dimensional changes.

All the test disinfectants except 1% SH showed a reduction in surface roughness (Ra) values.

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Nil.

## Conflicts of interest

There are no conflicts of interest.

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