



RESEARCH ARTICLE

COMPARATIVE EVALUATION OF SURFACE DETAIL REPRODUCTION AND EFFECT OF DISINFECTANT AND LONG-TERM STORAGE ON DIMENSIONAL STABILITY OF VINYL POLYETHER SILICONE WITH POLYVINYL SILOXANE AND POLYETHER IMPRESSION MATERIALS- IN-VITRO STUDY

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Abstract

Objectives: To compare and evaluate the surface detail reproduction and effect of disinfectant and long-term storage for 2 weeks on the dimensional stability of hybrid material Vinyl polyether silicone (VPES) with its parent Polyvinyl siloxane (PVS) and Polyether (PE) impression materials.

Methods: All the samples were divided into three groups: Group A- VPES-D, VPES-N; Group B- PVS-D, PVS-N; Group C- PE-D, PE-N. 40 impressions of each material were made according to ADA/ANSI specification no.19 and twenty impressions of each material were disinfected using 2.45% glutaraldehyde solution. Surface quality measurements were made soon after disinfection using stereo-microscope. Dimensional stability measurements were made using measuring microscope immediately after disinfection and were repeated on the same samples after 7 and 14 days of storage. Data were analysed using chi-square test, One-way Anova test followed by Post hoc Tukey's test.

Results: The non-disinfected groups showed greater mean dimensional change values compared to disinfected groups. VPES-D showed the least dimensional changes and the dimensional stability of all the materials were within 0.5% range after prolonged storage for 14 days except for the PE-N which showed greater dimensional change percentage on 14th day of storage. VPES-D and PE-D produced better impressions with surface quality score 1 compared to PVS-D. Also, 18 samples of VPES-N and PE-N scored 1 and only 17 samples of PVS-N scored 1.

Conclusion: The newer material VPES was observed to be both dimensionally stable and capable of producing good surface detail reproduction.

Introduction:-

Impression materials in dentistry are used to register the form and relation of teeth and surrounding oral tissues. The accuracy of impression material in terms of both dimensional stability and detail reproduction is necessary for the precise fabrication of a well-fitted definitive restoration.^{1,2} The dimensional accuracy of an impression material is influenced by many factors such as periodontal status, oral hygiene, impression technique, impression tray, properties of the impression material, location of the preparation finish line, the ability of the material during seating of the impression to flow on contact with the oral tissues and the ability of the fluid material to wet the moist oral surfaces intimately etc.^{2,3} Any inaccuracies during the replication process and transferring information to dental laboratory will ultimately results in an adverse effect on the precise fit and adaptation of the final indirect restoration.⁴ Nowadays CAD/CAM systems and 3-dimensional imaging systems are widely used for fabrication of indirect restorations. Even though they have technically improved, conventional impressions still play an important role in transferring information to dental laboratory.³

Among the various impression materials commercially available polyvinyl siloxane (PVS) and polyether (PE) impression materials are commonly being used to produce final impressions for indirect restorations such as crowns, fixed partial dentures, veneers, onlays, implant-supported restorations, and removable partial and complete dentures.⁵ PVS impression materials are known for their excellent elastic recovery, good dimensional accuracy, tear strength, handling characteristics and ideal dimensional stability.^{1,4} PVS possess superior dimensional stability primarily because no by-products are released compared to other elastomeric materials. A limitation of PVS impression material is the hydrophobic nature of the material.⁴ To address this problem manufacturers have incorporated surfactants to PVS and marketed these materials as hydrophilized PVS. Whereas PE impression materials are inherently hydrophilic and produces better impressions.

Recently a newer material termed as vinyl polyether silicone (VPES) (EXA'lence; GC Europe NV, Leuven, Belgium) was introduced. This material which is available in a various consistencies and setting times is composed of a combination of PVS and PE and is considered as inherently hydrophilic material that presumably maintains the stability of the parent products. The material chemistry is new and allows the material to be intrinsically hydrophilic, without the need for the addition of surfactants like traditionally PVS materials. The studies had showed that the material possess high tear strength properties, improved elasticity and marginal accuracy. VPES comprises of 5% to 20% polyether which enhances the hydrophilicity of the material, thereby making the final impression more successful where humidity is of concern and larger portion of VPES consists of vinyl dimethylpolysiloxane (10% to 50%) which provides the properties PVS.⁵⁻⁸

Many studies have reported that PVS and PE exhibit good dimensional stability and accuracy at different test and storage conditions.⁴⁻⁷ Elastomeric impression materials undergo contraction upon polymerization due to cross-linking and rearrangement of bonds in polymer chains. The main issues observed with the polyether impression materials are water absorption and loss of volatile substance which probably affects its dimensional stability, a problem which is not observed in PVS due to the absence of polymerization byproducts.^{5,6} Therefore it is recommended to pour PE impressions within 1 hour or within 24 hours.⁵

Dental professionals are exposed to various microorganisms in the blood and saliva of the patient so it is necessary to use effective infection control procedures. According to guidelines, it is suggested that addition silicone impressions can be disinfected by immersion without affecting its accuracy and surface detail reproduction. Surface detail reproduction is observed to be enhanced by the use of 2% acidic glutaraldehyde solution. The duration of disinfection varies and has to be determined according to the information supplied with disinfectant.⁹ Also, the studies have shown that VPS and PE impression materials can be immersed safely in 2.45% of glutaraldehyde disinfection solution for short duration of time ranging from 20-30 minutes without causing any adverse effects on the properties of materials.^{3,6-9} Even though PE expansion occurs following disinfection over a 2 week period, the continued shrinkage of both the disinfected and non-disinfected PVS and PE impressions met the dimensional change measurements within the ADA specification limit i.e; $\leq 0.5\%$.^{10,11}

VPES experienced minimal contraction in vitro after disinfection and prolonged storage for up to 2 weeks.⁷ Also, absorption of disinfectant during disinfection and water during storage in VPES specimens could be expected due to

the PE component, but whether this affects surface quality is not known. Other studies, using different conditions have shown that surface detail quality is affected by fabrication conditions and materials.⁶ Since only limited amount of data is available regarding the surface detail reproduction and the effect of disinfection and prolonged storage on dimensional stability of newer elastomeric impression materials, this study intends to compare and evaluate the surface detail reproduction and the effect of disinfectant and long-term storage for about 2 weeks on the dimensional stability of VPES with PVS and PE impression materials.

Materials and Methods:-

The three elastomeric impression materials evaluated in the study were EXA'lence Monophase regular set (VPES impression material; lot no: 1703221, GC America Inc. Alsip, IL 60803, USA), Aquasil Ultra monophase regular set (PVS impression material; lot no: 00023890, Dentsply Caulk, 38 West Clarke Avenue, Milford, USA), and Impregum Soft medium body (PE impression material; lot no: 4526684, 3M Deutschland GmbH, Carl-Schurz-Str.1, 41453 Neuss, Germany). The impressions were prepared according to ADA/ANSI specification no.19 using a stainless steel ruled block and an impression mold ring.¹¹ Total 120 impression samples were made and were divided into three groups; Group A- VPES non-disinfected (VPES-N) (n=20) (control), VPES disinfected (VPES-D)(n=20); Group B- PVS non-disinfected (PVS-N)(n=20) (control), PVS disinfected (PVS-D) (n=20); Group C- PE non-disinfected (PE-N) (n=20) (control), PE disinfected (PE-D) (n=20).

The surface of the stainless steel ruled block was engraved with three parallel horizontal lines and two vertical ones 25 mm apart (Figure.1). To make the impressions, the ruled block was first preheated for 15 minutes in a 35°C water bath to standardize to mouth temperature and a light coat of petroleum jelly was applied to facilitate removal of ring from the die.⁶ The impression mold ring was placed on the die and the impression material was injected onto the die with a slight overfill. VPES and PVS impression material were mixed using an automix cartridge dispenser (3M ESPE, Seefeld, Germany) and corresponding mixing tips and PE was hand mixed according to manufacturer's instructions. A glass plate was placed on top of the injected material with a 1 kg weight on top of the glass plate and was transferred to the water bath. The ruled block was then carefully removed, and the die was cleaned using an alcohol swab prior to fabrication of the next impression. Thus, a total of 120 impressions were prepared out of which 60 were disinfected using 2.5% buffered glutaraldehyde disinfecting solution (Endox, Becta Laboratories, Gujarat, India) for 30 minutes and the other half were immersed in distilled water (control group) at room temperature for 30 minutes. The impressions were then rinsed for 15 seconds under running water and used for investigation.

Surface detail reproduction:

The evaluation was made soon after the disinfection using a light microscope (Stereo microscope, Leica EZ4, Leica microsystems (Schweiz) AG, Switzerland) under 10X magnification.⁶ The line X between C and C' (Figure.1) on the impressions were used to evaluate the surface detail reproduction and scoring was given according to the ranking system given by Owen.¹²

Score 1:

Line reproduced clearly and sharply over entire length between the marks.

Score 2:

Line clear over more than 50% of length, or line indistinct over less than 50% of length, line appears to be reproduced well over entire length, but not sharply, but is smooth.

Score 3:

Line clear over less than 50% of length, or line indistinct over more than 50% of length, or line visible over entire length but blemished and rough and/or not sharp.

Score 4:

Line not reproduced over entire length; rough, blemished, pitted, etc.

The impressions with a score of 1 were used for dimensional change measurements. Sufficient impressions will be produced to ensure n=20 per groups.

Dimensional stability:

The dimensional stability measurements were made using Tool maker's measuring microscope (Mitutoyo MF/MU series X-axis 400mm, Y-axis 200 mm, Mitutoyo corporation, Kangawa, Japan) with a 30X magnification immediately after disinfection and were repeated on the same impressions after 7 and 14 days of storage under

ambient laboratory conditions according to manufacturer's instructions and was kept on a glass slab dusted with talcum. The line Z of the impression was measured between D and D' (Figure.1) and the percentage of dimensional change was calculated using formula:

$$\Delta L = 100 \times [(L1 - L2)/L1]$$

where L1 is the length of line Z (between D and D') measured on the metal die, and L2 is the length of line Z and all measurements were done in millimetres.

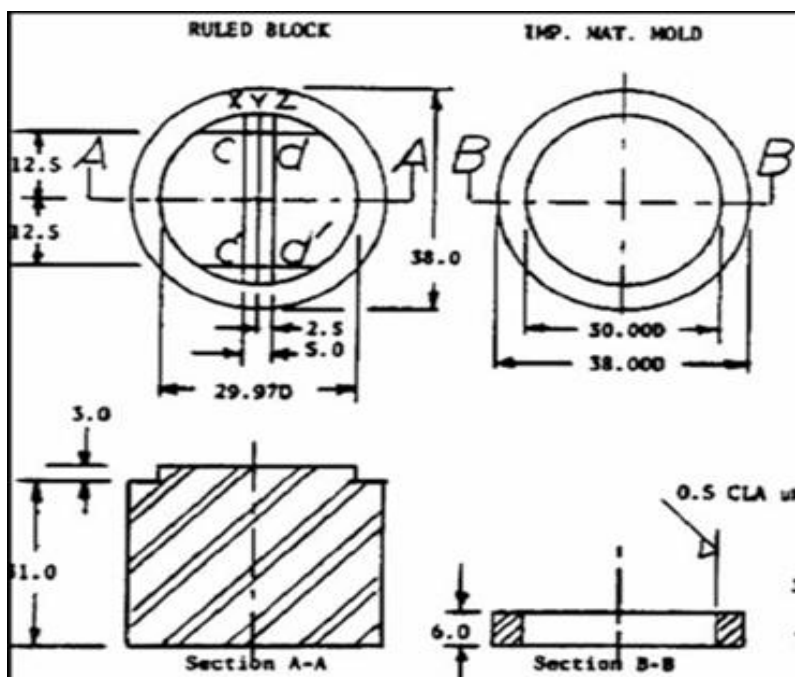


Figure 1:- Schematic representation of impression mold and ruled block.

The values obtained from all the groups were coded and fed in SPSS (IBM version 23) for statistical analysis. Descriptive statistics included mean, median, standard deviation, frequency and percentage. Inferential statistics included chi-square test, One-way ANOVA test followed by Post hoc Tukey's test. The level of significance was set at 0.05 at 95% confidence interval.

Results:-

Surface Detail Reproduction:

Out of 20 samples of VPES-D and 20 samples of PE-D, 19 samples scored 1 (95%) whereas 18 samples of PVS-D scored (90%). Comparing the scores between the non-disinfected groups, 18 samples of VPES-N and PE-N scored 1 and 17 samples of PVS-N scored 1. But statistically significant difference were not observed between the groups ($P \geq 0.001$) (table 1)

Dimensional stability:

The length of line Z between D-D' as measured on the metal die was 25.0010 mm (L1).

The line Z measured on all the samples were smaller than that of the metal die, indicating the contraction of impression materials and the mean dimensional change values were observed to be greater for the non-disinfected group compared to the disinfected groups. Comparing among the disinfected groups VPES-D showed the least dimensional changes on 0 day compared to PVS-D and PE-D. Also, VPES-D showed the least dimensional change on 7th day (0.217140) and 14th day (0.231080) on storage (table 2).

Comparing among the non-disinfected groups VPES-N showed the least dimensional change on day 0 on storage compared to PVS-N and PE-N groups. Even after storage for 7 days and 14 days VPES-N showed the least dimensional change compared to PE-N and PVS-N (0.332740 and 0.365140 respectively). Statistically highly

significant differences were observed between the groups (table 3, table 4). The greater mean dimensional change was observed in PE-N group compared to all the other five groups and the values were seen to be increasing from 0.279040 to 0.489040 and to 0.553040 on day 0, 7 and 14 respectively.

Discussion:-

VPES is a combination of PVS and PE, which consists of 5%-20% PE component and the remaining portion of the material composed of PVS, which is a combination of vinyl dimethylpolysiloxane (10%-50%), methylhydrogen dimethylpolysiloxane (3%-10%), and silicon dioxide (30%-65%). This composition is intended to incorporate the desirable properties such as elastic recovery and tear strength of polyvinyl siloxane and the hydrophilicity of conventional polyether materials which facilitates to make accurate impressions where humidity is of concern.^{4,5,7,13} Because of this unique combination of the two common elastomeric impression materials PE and PVS, this study discusses the VPES behaviour using the established knowledge of the same. The present study evaluated the surface detail reproduction and the effect of disinfectant and long term storage on the dimensional stability of newer VPES elastomeric impression material and was compared with PVS and PE materials.

The common method for testing dimensional stability and surface detail reproduction is by the use of ADA/ANSI specification no.19, an impression mold which helps to make the comparisons easier between different studies.^{5-8,10,14-17} The same mold has been used in the present study. This standard mold produces an impression specimen which allows only 2D measurement to assess the dimensional stability and surface detail reproduction of the impression specimens and hence it does not mimic clinical conditions which includes the use of trays, adhesives and gypsum for making impressions and casts.⁵ Thus the measurements in a 3D manner was not investigated in this study. Comparing the measurements obtained from all the samples using the ADA specification no.19 protocol, it was observed that all the measurements were smaller than that of the metal die, indicating the contraction of impression materials.

Many studies had reported that both PVS and PE impression materials can be safely immersed in glutaraldehyde disinfection solution for a duration of 20-30 minutes without resulting in any adverse effects on the material properties.^{4,5,7} According to the disinfection guidelines, it is suggested that addition silicone impressions can be disinfected by immersion without affecting its accuracy and surface detail reproduction. Surface detail reproduction is observed to be enhanced by the use of 2% acidic glutaraldehyde solution.⁹ The duration of disinfection varies and has to be determined according to the information supplied with disinfectant. In the present study all the impressions were disinfected in 2.45% glutaraldehyde solution for a duration of 30 minutes whereas the non-disinfected ones were kept in distilled water for 30 minutes.

The results had shown that VPES, PE and PVS impressions when disinfected in 2.45% glutaraldehyde solution for a duration of 30 minutes countered the continuous contraction of material thus the mean dimensional change values were observed to be greater for the non-disinfected group compared to the disinfected groups on storage for 7 and 14 days. That is among the disinfected groups VPES-D showed the least dimensional changes on 0 day, 7 days and 14 days of storage compared to PVS-D and PE-D. Whereas PE-D showed the greater dimensional change of all the disinfected specimens. The disinfection solution used was same for all the materials studied and the results of the present study is comparable to the results of previous studies of VPES, PE and PVS in which VPES showed better dimensional stability. Also, the results are comparable to other studies where PE and PVS dimensional stability has been studied after disinfection. According to Nasser et al when the dimensional changes of VPES is considered at immediate pour and over extended periods have shown minimal dimensional changes as shown by cast measurements similar to the PE and PVS materials studied.⁴

Also, Comparing among the non-disinfected groups VPES-N showed the least dimensional change on day 0 compared to PVS-N and PE-N groups. Even after storage for 7 days and 14 days VPES-N showed the least dimensional change compared to PE-N and PVS-N. And it was observed that VPES contracted similarly to PVS and PE for both disinfected and non-disinfected specimens over prolonged storage. The largest mean dimensional change for non-disinfected VPES was a contraction of 0.3327% at 7 days and 0.3651% at 14 days, indicating that a plateau was reached at 1 week during which the majority of dimensional changes occurred. Similar results observed with non-disinfected PVS and PE. That is the dimensional change of PVS-N significantly increased from 0 day to 7 days, but no significant change observed between 7 and 14 days. Whereas the dimensional change of PE-N showed highly significant difference between 0, 7 and 14 days. According to ADA specification no.19 criteria, the dimensional stability possessed by the elastomeric impression materials should not exhibit more than 0.5% in first

24 hours.^{8,10,15} The dimensional stability of all the materials studied in this study were within 0.5% range after prolonged storage for 14 days except for the PE-N which showed greater dimensional change percentage on 14th day of storage. According to Thongammachat et al addition silicone impression material showed better dimensional stability upto 720 hours (30 days) and due to the distortion of PE over time, it is advised to pour the impression made with PE to be poured within one day.¹⁸

The result of the present study is consistent with other studies which reported that VPES showed least dimensional change on storage and the disinfected specimens showed least dimensional changes compared to non-disinfected specimens.^{5,9} VPES which composed of the PE component, it is possible that the material would have absorbed a little amount of disinfectant and which would have provided a sealing effect to the material thereby preventing the shrinkage due to evaporation which cannot be applied to the non-disinfected groups. In a study it has been reported that PVS and PE impression materials subjected to disinfection for long duration has resulted in significant dimensional changes.¹⁹ Davis BA et al had reported that when PE disinfected for a longer period of 24 hours resulted in increased absorbance of disinfectant while other three addition silicone and one polyether did not significantly contracted after 30 minutes of disinfection.²⁰ Chen SY et al concluded that there exists significant interaction effect between the materials and duration of storage on the dimensional accuracy of the impressions and observed that among all the materials investigated the addition silicone materials Aquasil and Exaflex had shown greater stability and accuracy.²¹ Whereas in other studies, no significant difference in dimensional change was observed between the disinfected and non-disinfected specimens.^{3,22}

Lepe et al showed that even though all the tested specimens of PVS and PE imbibed a small amount of disinfectant, the two PE materials showed highest percentage of imbibition and dimensional change. It was also observed that both PE and PVS exhibited some rate of imbibition when the impressions were disinfected in glutaraldehyde solution and PE lost 0.4% mass in air indicative of loss of volatile components from the same.²³ Also studies have showed that both PVS and PE exhibited some amount of imbibition during disinfection and the more hydrophilic PE tends to absorb more water compared to PVS.²⁰ Another study showed that PVS not affected by storage, whereas PE absorbed water and released volatile components which could explain the possible contraction seen in VPES.²⁴ Therefore, it can be explained that imbibition of water from the disinfection solution could have resulted in lesser contraction of disinfected samples compared to non-disinfected samples, while the continuous polymerization could have led to equally increased contraction of all samples over time. Polyvinylsiloxane (addition polymerization) silicones are the most stable of elastomers currently available. Polyether rubber is intermediate in stability to polysulfide or silicone systems and polyvinylsiloxane when impression techniques involve adhesive bonding to custom-formed trays.²⁵

Another parameter evaluated in the study is the surface detail reproduction of the specimens. The results have showed that VPES-D and PE-D produced better impressions with score 1 compared to VPS-D which scored 18 out of 20. Comparing the scores between the non-disinfected groups, 18 samples of VPES-N and PE-N scored 1 and 17 samples of PVS-N scored 1. But statistically significant difference were not observed between the groups. VPES which is inherently hydrophilic due to the PE content may have resulted in good surface detail reproduction. The hydrophilic materials exhibits lower contact angle and flows better in areas which are humid, such as subgingival areas and moist teeth surfaces.^{5,6,8,34,26} This is due to the differences in the chemical composition of PE which contains carbonyl (C=O) and ether (C-O-C) functional groups which attracts water into the back bone whereas polyvinyl siloxanes contain hydrophobic aliphatic hydrocarbon groups. Also, they present higher precision and shows reduced risk of trapping air bubbles on the stone casts.^{1,34} Studies have shown that polyether produced more accurate impressions compared to PVS.^{1,27}

Contact angle is a measure of the wettability of a solid by a liquid and solids which exhibits hydrophilicity will have contact angles of less than 90 degrees. Hydrophilic impression materials are desirable because when poured in gypsum they produce cast free of air bubbles or voids.^{13,28} A disinfectant treatment that alters the surface chemistry of an impression material may change the hydrophilicity of the impression material, thereby rendering the impression more wettable or less wettable by a slurry of gypsum. In the past, polysulfide has been shown to be mildly hydrophilic. The hydrophilicity of polysulfide was increased by all disinfectant solutions used in this study.²⁸ The mechanism of action probably involves surfactant solution in the wetting liquid that lowers the liquid surface tension to promote wetting.²⁹ This surfactant, or detergent, presumably becomes adsorbed on the impression surface and goes into solution in the wetting liquid, thereby lowering the contact angle. It is also possible that the disinfectants increase the surface roughness of the impression material to the extent that wettability is improved.²⁸

Walker et al concluded that although disinfection does not appear to adversely affect dimensional accuracy or stability of the more recent PVS and PE materials, the results suggested that not all disinfectant solutions produce optimal impression surface quality with the newly formulated PE.¹⁰

Also, hydrophilic PVS materials remain hydrophobic in the un-polymerized, liquid state and will not adequately wet surfaces covered with moisture. Although the additive surfactants have improved the polymerized PVS material's wettability with dental gypsum materials, it appears that the impression material still cannot accurately reproduce detail in the presence of moisture. So it has been suggested that the clinician using these materials should maintain strict moisture control during impression making.^{8,13} Another study has shown that vinylsiloxane ether monophase impressions and vinylsiloxane ether dual-viscosity impressions displayed acceptable accuracy for clinical use with immersion disinfection, since the results for vinyl siloxane ether were comparable to the results for representative polyether and vinyl polysiloxane materials and concluded that the disinfection of the impressions by immersion had no negative effects on the impression.³ Walker et al showed that different disinfectants had different surface quality effect on PE, this investigation did not find that 30 minutes immersion in glutaraldehyde had any adverse effect on surface detail reproduction of impressions.

The study had some limitations which includes the impressions were made from a metal die made according to ADA/ANSI specification no.19 which allowed only 2D measurement to assess the dimensional stability and surface detail reproduction of the impression specimens and hence it does not mimic clinical conditions. However the use of die helped for easier comparisons among the groups with other similar studies. Also, the study investigated only the effect of glutaraldehyde disinfection solution on the samples and the effect of using other disinfection solution were not investigated in the present study. Finally, this study only examined the dimensional stability and accuracy of the VPES with PVS and PE. However, there is a need to examine the biological, rheological, wetting properties of this new material, to further ascertain equivalence with PE and PVS and to provide additional support for clinical acceptability.

Conclusion:-

Within the limitations of the study the following conclusions were drawn:

1. Both disinfected and non-disinfected groups of VPES, PVS, PE maintained their dimensional stability within the limits specified by ADA/ANSI specification no.19 except for the PE-N group which showed greater dimensional change on 14 days of storage.
2. Comparing among the disinfected and non-disinfected groups, the disinfected groups were observed to be more dimensionally stable.
3. VPES underwent the least dimensional change compared to its parent materials PE and PVS. Also, the disinfected VPES underwent the least dimensional change of the other groups studied.
4. The surface detail reproduction values were observed to be greater for the disinfected VPES and PE compared to PVS.
5. The newer material Vinyl polyether silicone was observed to be both dimensionally stable and capable of producing good surface detail reproduction.

Table 1:- Comparison of surface detail reproduction of the groups VPES-D, VPES-N, PVS-D, PVS-N, PE-D, PE-N.

	Surface detail reproduction						Chi square value	Significance
	PVS-D	PVS-N	PE-D	PE-N	VPES-D	VPES-N		
1	18(90)	17(85)	19(95)	18(90)	19(95)	18(90)	1.701	0.889 (N.S)
2	2(10)	3(15)	1(5)	2(10)	1(5)	2(10)		

*N.S: non-significant

Table 2:- One-way ANOVA test comparing the mean dimensional change percentage of all three disinfected groups on storage for 0, 7 and 14 days.

		Mean	Standard deviation	F value	Significance
0 days	PE	.259350	.0030744	101.019	0.000 (H.S)
	PVS	.230800	.0244319		
	VPES	.195149	.00288707		
7 days	PE	.406980	.0030850	1000.980	.000 (H.S)

14 days	PVS	.268210	.0236775	1181.570	.000 (H.S)
	VPES	.217140	.0028871		
	PE	.471380	.0030850		
	PVS	.378200	.0269646		
	VPES	.231080	.0029607		

*D: Disinfected, *F value: One-way ANOVA test, *H.S: Highly significant

Table 3:- Post-hoc Tukey's test comparing the mean difference of dimensional change percentage values of all three disinfected groups on storage for 0, 7 and 14 days.

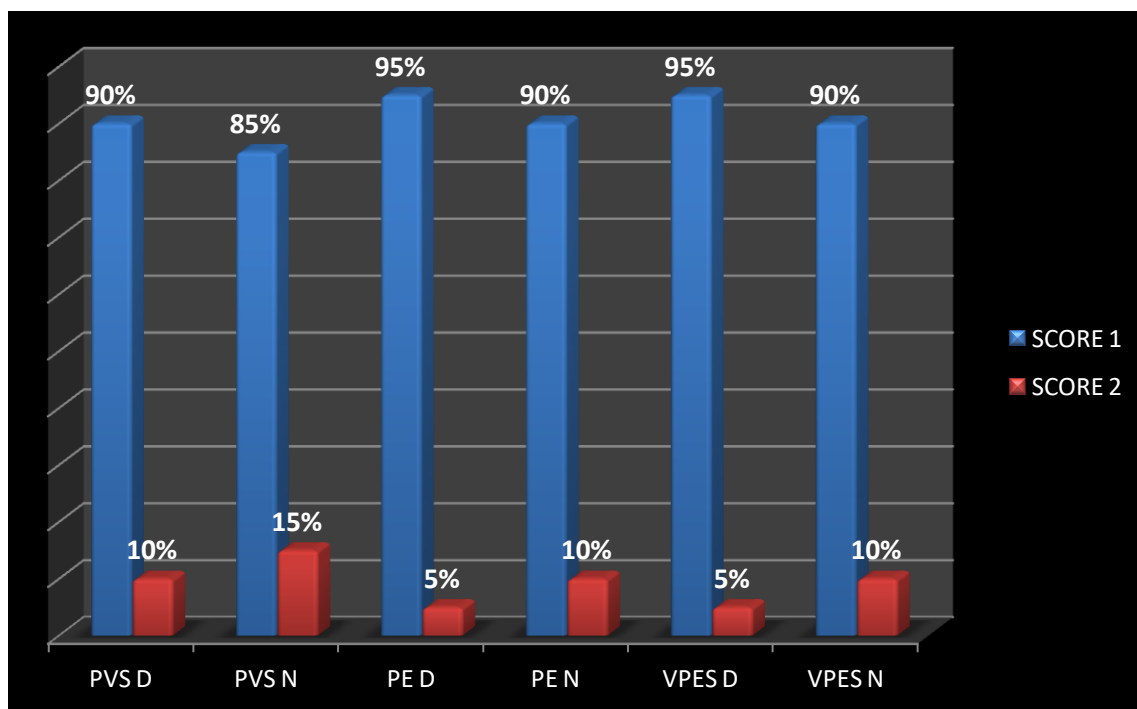
D			Mean difference	Standard error	Significance	95% Confidence interval	
						Lower bound	Upper bound
0 days	PE	PVS	.02855000	.00452660	.000 (H.S)	.0176571	.0394429
		VPES	-.0642100	.00452660	.000 (H.S)	-.0751029	-.0533171
	PVS	VPES	-.0356600	.00452660	.000 (H.S)	-.0465529	-.0247671
7 days	PE	PVS	.1387700	.0043912	.000 (H.S)	.128203	.149337
		VPES	.1898400	.0043912	.000 (H.S)	.179273	.200407
	PVS	VPES	.0510700	.0043912	.000 (H.S)	.040503	.061637
14 days	PE	PVS	.0931800	.0049845	.000 (H.S)	.081185	.105175
		VPES	.2403000	.0049845	.000 (H.S)	.228305	.252295
	PVS	VPES	.1471200	.0049845	.000 (H.S)	.135125	.159115

*D: Disinfected, *H.S: Highly significant

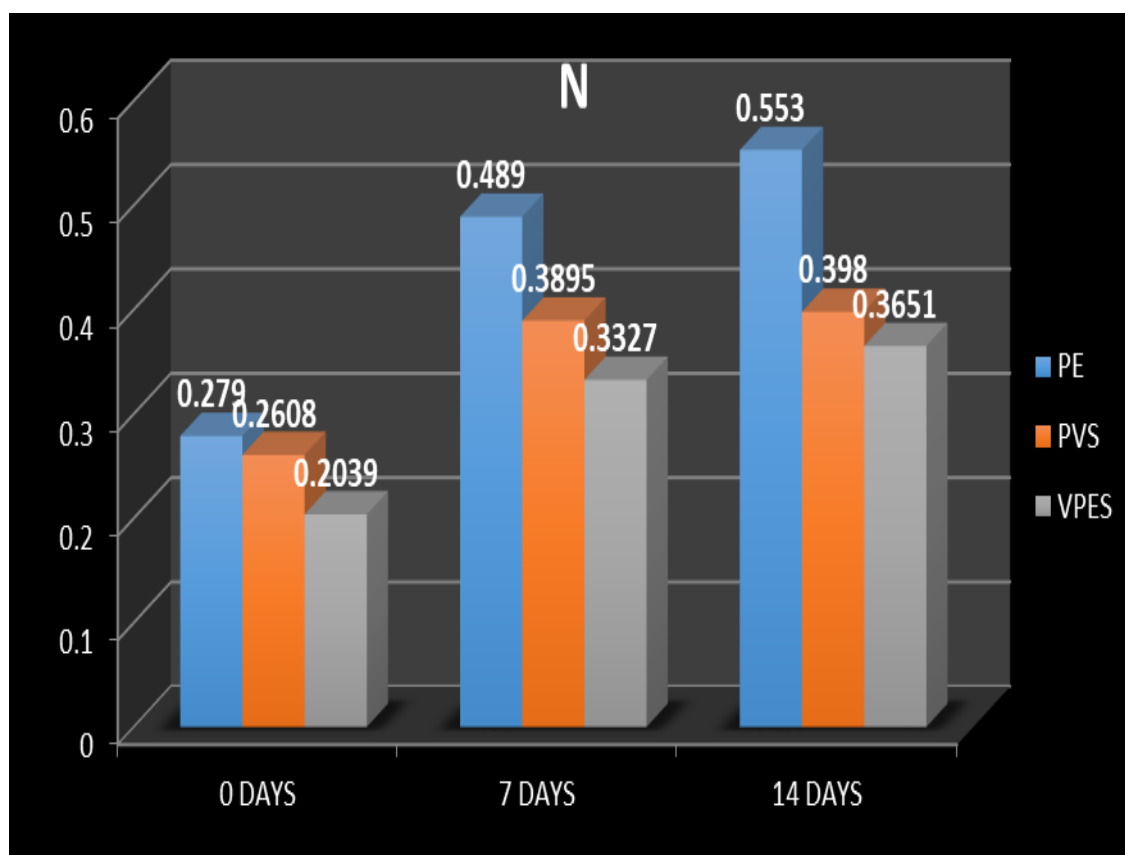
Table 4:- Post-hoc Tukey's test comparing the mean difference of dimensional change percentage values of all three non-disinfected groups on storage for 0, 7 and 14 days.

N			Mean difference	Standard error	Significance	95% Confidence interval	
						Lower bound	Upper bound
0 days	PE	PVS	.0182400*	.0020706	.000 (H.S)	.013257	.023223
		VPES	.0751000*	.0020706	.000 (H.S)	.070117	.080083
	PVS	VPES	.0568600*	.0020706	.000 (H.S)	.051877	.061843
7 days	PE	PVS	.0995200*	.0068754	.000 (H.S)	.082975	.116065
		VPES	.1563000*	.0068754	.000 (H.S)	.139755	.172845
	PVS	VPES	.0567800*	.0068754	.000 (H.S)	.040235	.073325
14 days	PE	PVS	.1550000*	.0019558	.000 (H.S)	.150294	.159706
		VPES	.1879000*	.0019558	.000 (H.S)	.183194	.192606
	PVS	VPES	.0329000*	.0019558	.000 (H.S)	.028194	.037606

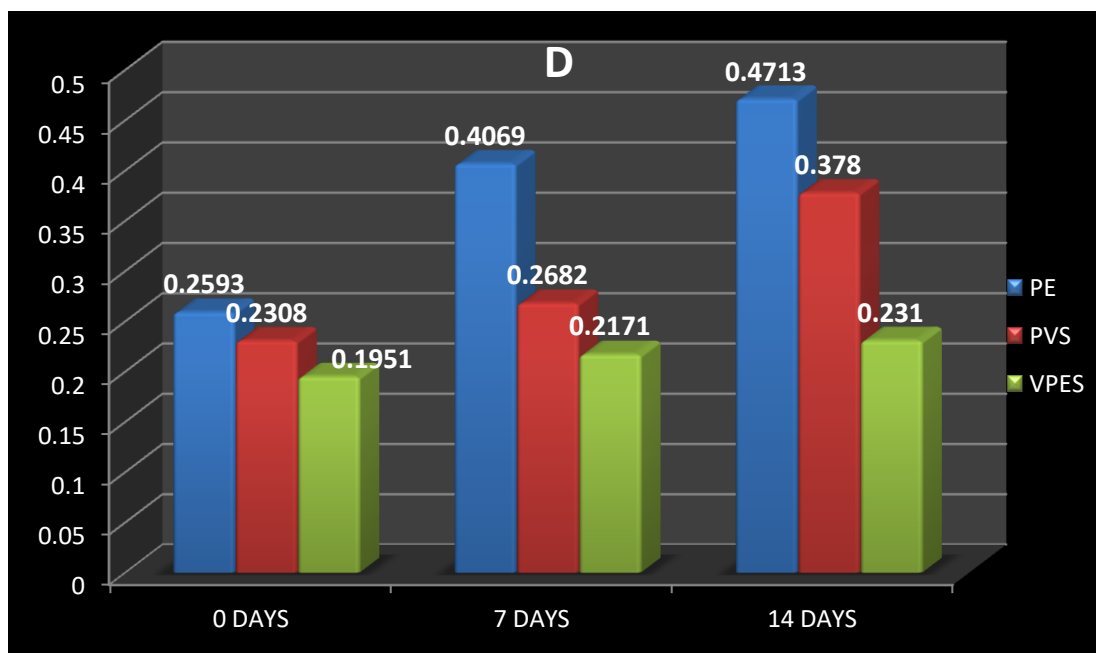
*N: Disinfected, *H.S: Highly significant



Graph 1:- Surface detail reproduction of the groups VPES-D, VPES-N, PVS-D, PVS-N, PE-D, PE-N.



Graph 2:- Mean dimensional change percentage values for VPES-N, PVS-N, PE-N groups on 0, 7 and 14 days.



Graph 3:- Mean dimensional change percentage values for VPES-D, PVS-D, PE-D groups on 0, 7 and 14 days.

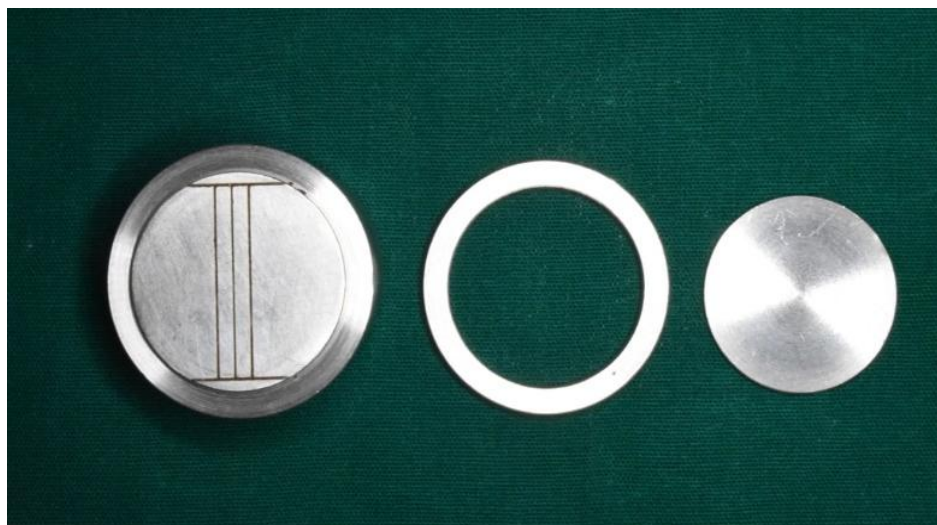


Figure 1:- Stainless steel mold and ruled block according to ADA/ANSI specification no.19 for making samples.



Figure 2:- a) VPES-D, b) PVS-D, c) PE-D samples in disinfection solution.

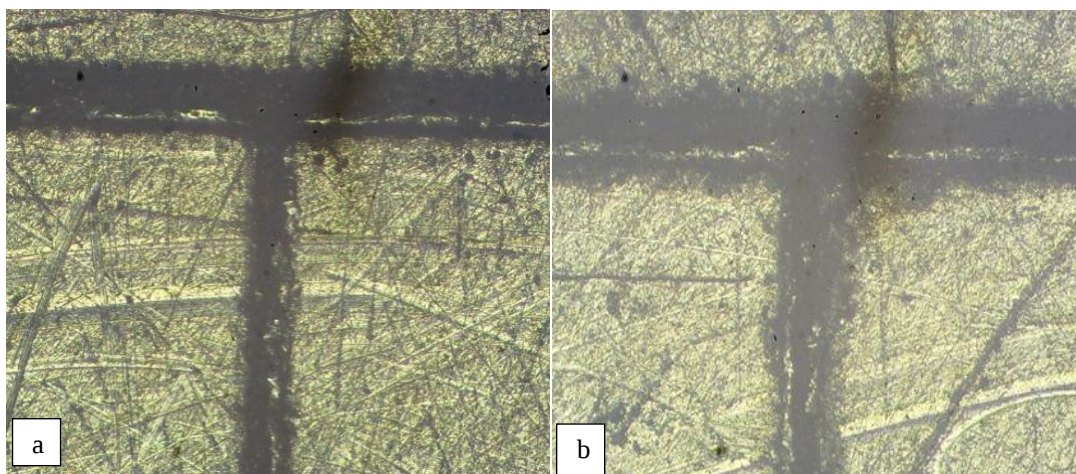


Figure 3:- Toolmaker's measuring microscopic view of a) VPES-D, b) VPES-N specimens.

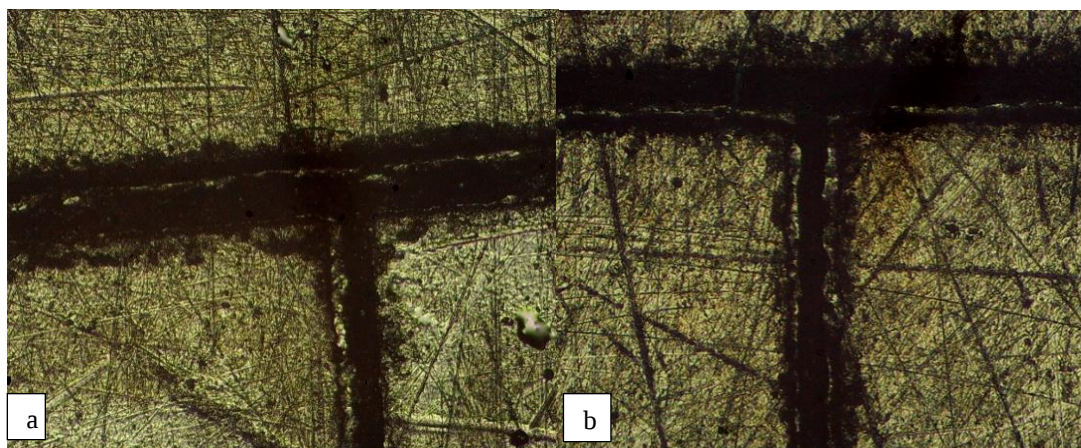


Figure 4:- Toolmaker's measuring microscopic view of a) PVS-D specimens, b) PVS-N specimens.

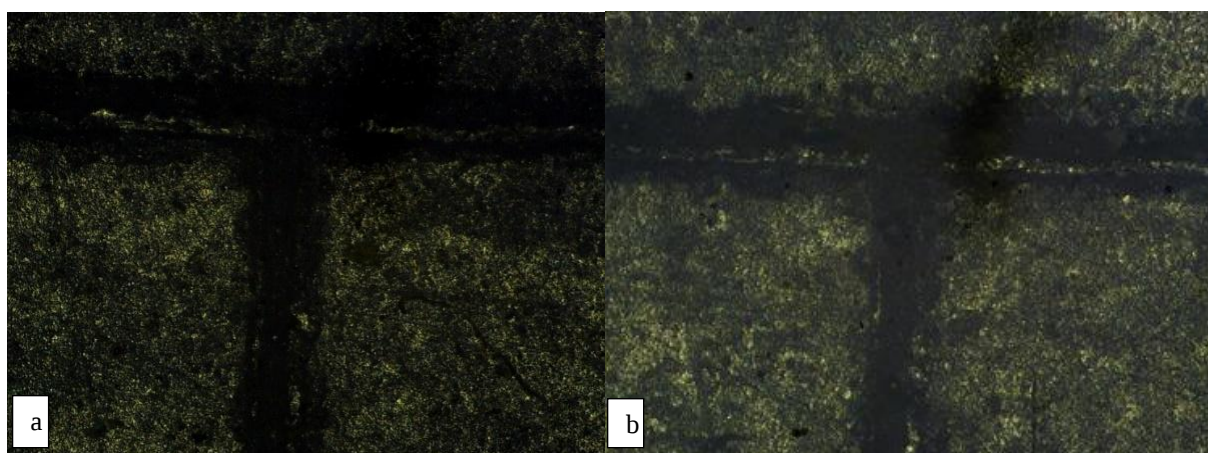


Figure 5:- Toolmaker's measuring microscopic view of a) PE-D specimens, b) PE-N specimens.

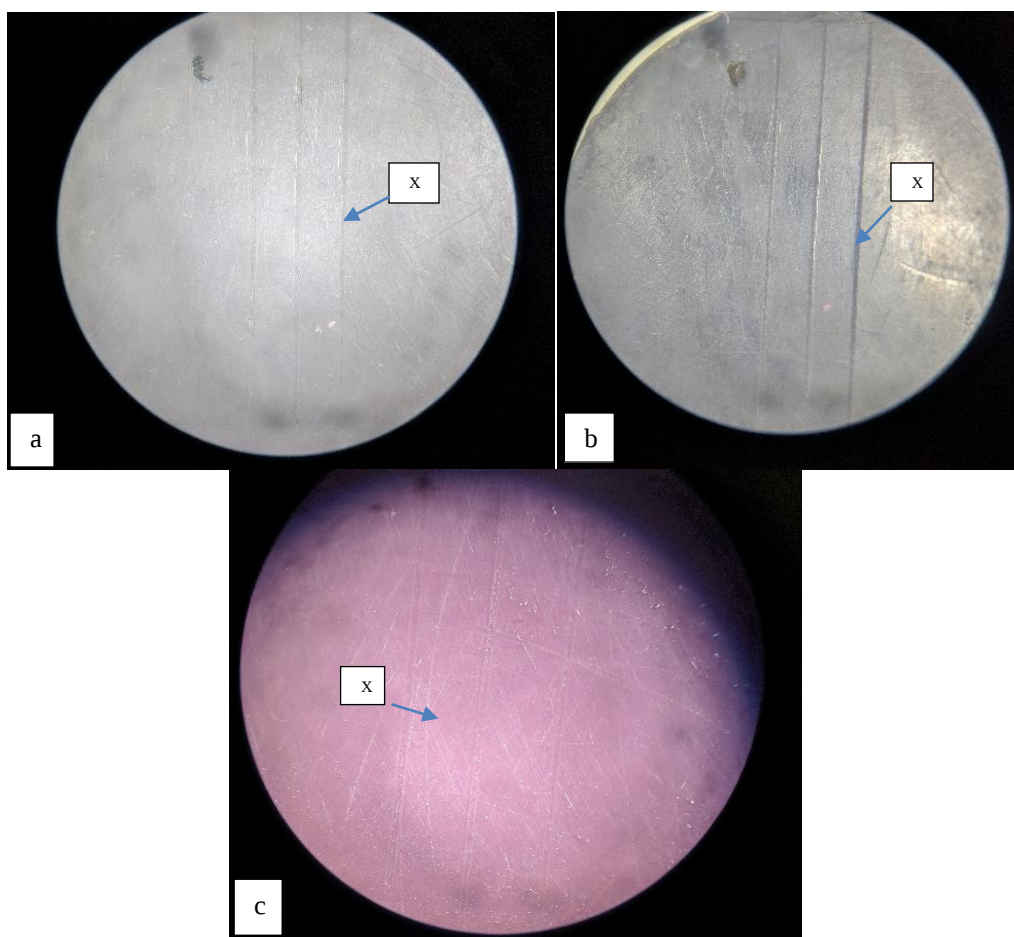


Figure 6:- Stereomicroscopic view of line X which is used for evaluating surface detail reproduction and scoring of a) VPES, b) PE, c) PVS impression specimens.

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