

**Effect of three different disinfecting agents on the surface detail reproduction of polyvinyl siloxane impression material - An in vitro study**

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**Abstract**

**Background:** The widespread use of Vinyl Polysiloxane (VPS) materials is attributed to their dimensional accuracy and stability. VPS also has excellent elastic recovery and good detail reproducibility. After the impression procedure rinsing with water only does not clear away all the pathogens from the mouth that have adhered to the impression surface. In recent advances, ultraviolet (UV) radiation has proved to be efficacious in killing the microorganisms. Little is known about the effect of this radiation on surface detail reproduction of addition silicone impression materials, hence a study was conducted to evaluate and compare the effect of U.V disinfection with chemical agents on detail reproduction of polyvinyl siloxane impression material.

**Method:** A standardized stainless steel die (according to ADA specification 19) was used for making samples. It consisted of three parts : (a) a ruled block (AA), (b) test material mold (BB) and (c) a riser (CC). The ruled block (AA) had three horizontal lines X, Y, Z and two vertical

lines c d and c´ d´. The lines c d and c´ d´ were separated from each other by 25 mm. Total of 60 samples were made and divided into 4 groups of 15 samples each based on the method of disinfection i.e 1. Control group( no disinfection) 2. 2 % glutaraldehyde, 3. 0.5 % sodium hypochlorite, 4. U.V chamber . After setting, the impression material samples were gently retrieved from the test material mold and the samples were visually inspected for detail reproduction with the help of 10x microscope and scoring was done.

**Results:** No statistically significant difference was found on comparing the four groups.

**Conclusion :** 2 minutes of immersion in 2.4% glutaraldehyde, 0.5 % sodium hypochlorite and 5 minutes radiation in U.V chamber 11 watts and 253.7 nm, all are suitable for disinfection of polyvinyl siloxane impression material without causing any significant change in the surface detail reproduction.

**Keywords:** Surface detail reproduction, Polyvinyl siloxane, U.V chamber, Glutaraldehyde, Sodium hypochlorite.

**Introduction**

The widespread use of addition reaction silicone impression materials, also known as vinyl polysiloxane (VPS) materials, is attributed to their dimensional accuracy and stability.<sup>1,2</sup> Other advantages of VPS materials include excellent elastic recovery, ease of handling, ability to produce multiple casts from one impression, and good detail reproducibility.<sup>2,3</sup>

The transmission of potentially infectious pathogens from mouth using dental impressions and prostheses is a frequent occurrence in a dental operatory. 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>4</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.<sup>5</sup> According to the previous studies, immersion in 2% Glutaraldehyde and 1% Sodium hypochlorite for 10 min have resulted in successful disinfection of PVS impressions.<sup>6,7</sup> In recent advances, ultraviolet (UV) radiation has also proved to be efficacious in killing the microorganisms.

Little is known about the effect of these disinfecting agents on detail reproduction of addition silicone impression materials, thus the purpose of this study is to evaluate and compare the effect of disinfection on detail reproduction of polyvinyl siloxane impression material by chemical as well as U.V radiation method. The null hypothesis for the present study is that there is no effect

of chemical and U.V disinfection on surface detail reproduction of polyvinyl siloxane impression material.

**Method**

A standardized stainless-steel die (according to ADA specification 19) was used for making samples. It consisted of three parts: (a) a ruled block (AA), (b) test material mold (BB) and (c) a riser (CC). The ruled block (AA) had three horizontal lines X, Y, Z and two vertical lines c d and c' d'. The lines c d and c' d' were separated from each other by 25 mm. The test material mold (BB) was a cylinder of inner diameter 30 mm and depth of 6 mm to place the impression material. The riser (CC) was a stainless disk of diameter 29.9 mm and thickness of 3 mm.

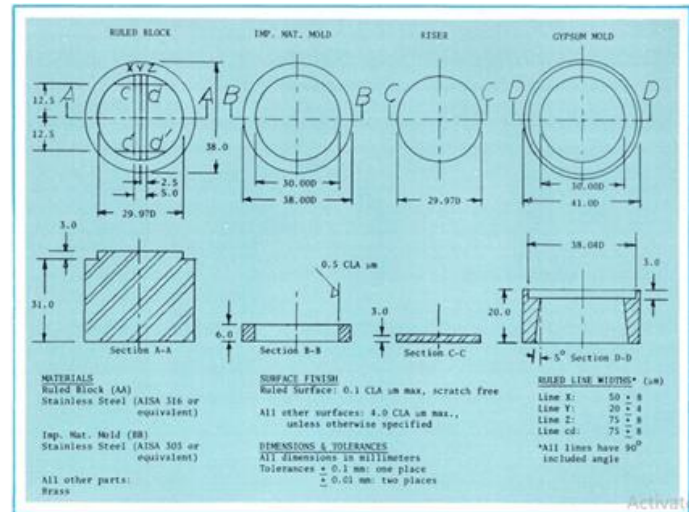


Figure 1

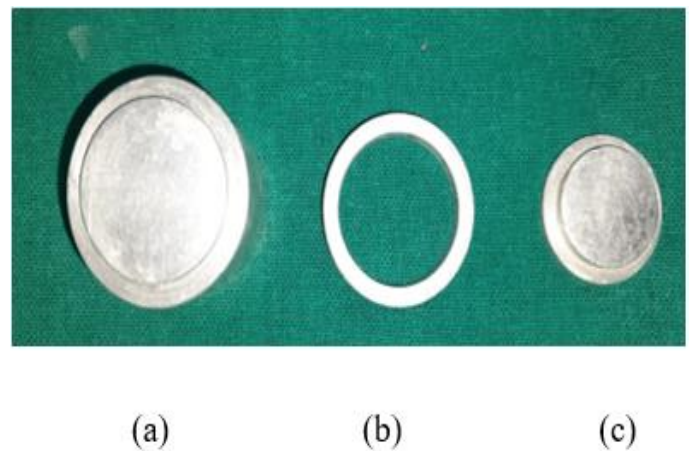


Figure 2: (a) Ruled block (B) Test material mold (C) riser

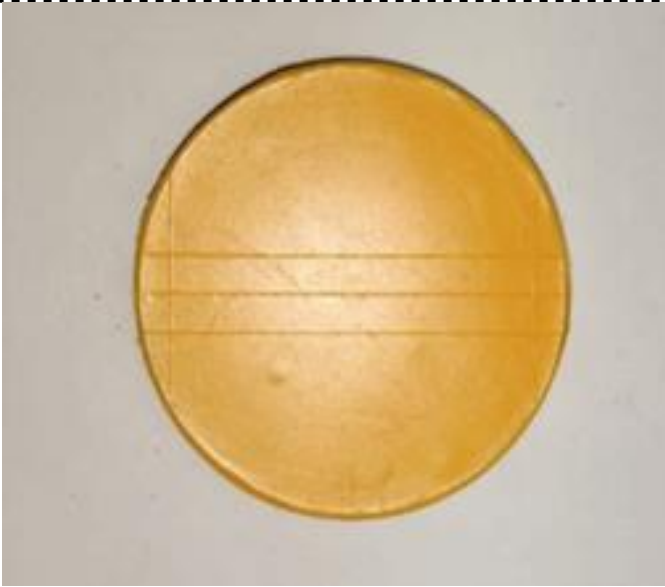


Figure 3: Impression material sample



Figure 4: Polyvinyl siloxane Light body impression material.

Total of 60 samples were made and divided into 4 groups of 15 samples each based on the method of disinfection. To make the test samples, test material mold (BB) was placed on the ruled block (AA). The polyvinyl siloxane impression material having light body consistency was mixed in a auto mixing device and dispensed into the mold. The mold was then immediately covered with a thin sheet of polyethylene followed by a rigid, flat, glass plate. A force of 1000g was applied to seat the plate firmly against the mold. After setting, the impression material samples were gently retrieved form the test

material mold and the samples were visually inspected for detail reproduction with the help of 10x microscope and following scores were given and noted down accordingly:

Score 1: Line reproduced clearly and sharply over entire length between cd and c' d'.

Score 2: Line clear over more than 50% of length.

Score 3: Line clear over less than 50% of length and

Score 4: Line not reproduced over entire length; rough, blemished, pitted.

After evaluation the samples were subjected to the following disinfection procedure:

Group I: control group

Group II: immersion in 2% glutaraldehyde for 10 minutes

Group III: immersion in 0.5% sodium hypochlorite for 10 minutes

Group IV: U.V disinfection in U.V chamber for 5 minutes.

All the samples were again inspected visually for surface detail reproduction by comparing the continuity of the vertical lines using 10x microscope. Same scoring criteria was followed.

Scores of all the samples after disinfection were noted down and data recorded was statistically analyzed.

### Results

Before disinfection all the samples were scored as 1 i.e (Line reproduced clearly and sharply over entire length between cd and c' d') whereas after disinfection slight changes were observed in the detail reproduction which are as follows:

1. Group 1 (Control group) showed no effect as all the 15 samples scored 1.
2. Group-II (U.V chamber)- out of 15 samples, 14 were scored as 1 and 1 sample was scored as 2

- 3. Group 3 (2.4% glutaraldehyde) – 13 samples were scored as 1 and 2 sample was scored as 2
- 4. Group 4 (0.5% sodium hypochlorite) - 13 samples were scored as 1 and rest 2 sample were scored as 2

No statistically significant difference was found on comparing the four groups as p value was 0.494 that is greater than 0.05.

Table 1: Comparison of surface detail reproduction of the groups after disinfection.

	Score 1	Score 2	Score 3	Score 4	Chi square value	Significance
Group-I (Control)	15(100%)	0(0%)	0(0%)	0(0%)	2.4	0.494
Group-II (U.V chamber)	14(93.3%)	1(6.7%)	0(0%)	0(0%)		
Group-III (2.4% glutaraldehyde)	13(86.7%)	2(13.3%)	0(0%)	0(0%)		
Group-IV (0.5% sodium hypochlorite)	13(86.7%)	2(13.3%)	0(0%)	0(0%)		

p>0.05- no statistically significant difference

reproduction of polyvinyl siloxane by using chemical and ultraviolet radiation was accepted. No statistically significant difference was found between the disinfection with different disinfecting agents used in the study.

**Discussion**

Dental practitioners encounter potentially harmful microorganisms, and patients are the most frequent source of these microorganisms. Studies indicate that the surface of impressions taken out of the mouth is covered abundantly with bacteria.<sup>8,9</sup> To remove this bacterial load over the impression surface the most commonly used disinfecting agents are the chemical agents. For disinfection, ADA recommends soaking elastomeric impression materials in disinfectant solutions for <30 min.<sup>10</sup> Solutions like 2% glutaraldehyde, 0.5% sodium hypochlorite have been widely used for this purpose.

The results were in accordance with a similar study conducted by Nasar and Chow, which showed that disinfection by 2.5% glutaraldehyde did not cause any significant change on the detail reproduction of VPS<sup>12</sup>. Another study conducted by Khatri et al. showed no statistically significant difference after 10 minutes immersion in 2.4% glutaraldehyde and 0.5% sodium hypochlorite respectively. All three materials produced good surface detail reproduction according to scores when observed separately.<sup>13</sup> Johansen et al. also conducted a similar study in which the reproduction of surface quality of addition silicone impression material was unaffected after disinfection with glutaraldehyde and iodophor. It stated that Polyether and addition silicone impressions can be disinfected by immersion with any of these disinfectants without a loss of accuracy or surface detail reproduction.<sup>14</sup>

In the present study two chemical agents 2% glutaraldehyde and 0.5% sodium hypochlorite were used. Ultraviolet chamber having a tube of 11-watt tube and wavelength 253.7 nm was also used for disinfecting the impression material surface as in recent advances, ultraviolet (UV) radiation has also proved to be efficacious in killing variety of microorganisms. UV light of 200-280 nm wavelength is lethal to bacteria, bacterial spores, viruses, mold, mold spores, yeast, and algae<sup>11</sup>. Based on the results of the study, the null hypothesis i.e., there is no effect of disinfection on surface detail

Shambhu et al. performed a study to evaluate and compare surface detail reproduction on alginate



impression material after disinfection with U.V radiation and the results were statistically insignificant.<sup>15</sup>

From the result of the present study it was revealed that none of the disinfecting agent used caused significant alteration of the surface detail reproduction of the polyvinylsiloxane impression material. Disinfection with 2% glutaraldehyde and 0.5% sodium hypochlorite had a minimum effect on surface detail reproduction as 2 out of 15 samples from both of the groups were scored as 2 i.e, the line was clear over more than 50% of length but not entirely, whereas with U.V disinfection only 1 sample out of 15 was scored as 2. On comparing the chemical and ultraviolet disinfection, U.V method showed less changes in surface detail reproduction but difference between the two was statistically insignificant.

#### **Clinical significance**

The impression surface after recording the impression consists of variety of pathogens that are hazardous for the dentist and laboratory staff. To remove this bacterial load it is mandatory to disinfect the impression surface. With the removal of bacterial load it is necessary that the physical properties such as detail reproduction and dimensional stability of impression material should not be hampered. Chemical agents like glutaraldehyde and hypochlorite and ultraviolet radiation, all are recommended for the disinfection purpose. In the present study the use of chemical as well as ultraviolet radiation which is a new method of disinfection these days has proved to have no significant effect on the surface detail reproduction. Therefore both of these can be readily used in daily dental practice to disinfect the Polyvinyl siloxane impression material.

Limitations of the present study is that the effect of ultraviolet radiation on mechanical and physical properties of polyvinyl siloxane impression material still needs to be evaluated

#### **Conclusion**

From this present study it is stated that 2 minutes of immersion in 2.4% glutaraldehyde, 0.5 % sodium hypochlorite and 5 minutes radiation in U.V chamber 11 watts and 253.7 nm, all are suitable for disinfection of polyvinyl siloxane impression material without causing any significant change in the surface detail reproduction.

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