

## Original Research

### To study the dimensional accuracy of polyvinyl siloxane elastomeric impression material (medium body and combination of medium body and light body) after immersion into disinfectant-An in vitro study

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#### ABSTRACT:

Awareness of the potential for spread of microorganisms and disease in the dental office has increased significantly. Disinfection of impressions is recommended by ADA and CDC to prevent transmission of infections such as hepatitis B, AIDS and tuberculosis. Disinfectant sprays are commonly used to treat impressions, and certain dentists have been reluctant to soak impressions because of fear of distortion. Nevertheless, aerosol treatment of an impression with a disinfectant may not be as effective in destroying microorganisms as a 10-minute soak in a high-level disinfectant. Because the disinfectant solutions used in this study did not affect the accuracy and dimensional stability of polyvinyl siloxane impressions when measured up to 10 minutes after immersion, dentists should be encouraged to disinfect impression materials as a routine procedure for infection control procedures.

**Keywords:** Polyvinyl Siloxane, Sodium Hypochlorite, Glutaraldehyde, Disinfection, dimensional stability.

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#### INTRODUCTION

Disinfection of the impression is essential as impressions can act as a source of cross contamination between dental patients and dental personals. Contamination of dental impressions with varying amounts of blood and saliva is a routine in dental operatory.<sup>6</sup> The impression should be rinsed under running water to remove saliva, blood and debris followed by immersion into a disinfectant such as hypochlorite, iodophors, glutaraldehyde or phenol. Impression disinfecting methods have become a necessity; however such methods must not alter the dimensional accuracy or detailed reproduction of the dental impressions. Dimensional changes may continue to occur in materials long after the apparent setting. The various causes attributed to this could be the continued slow setting or release of stresses set up during setting. Alternatively, they may be due to water absorption by, or loss of constituents from the material. Because dimensional accuracy and reproduction of anatomic detail are important

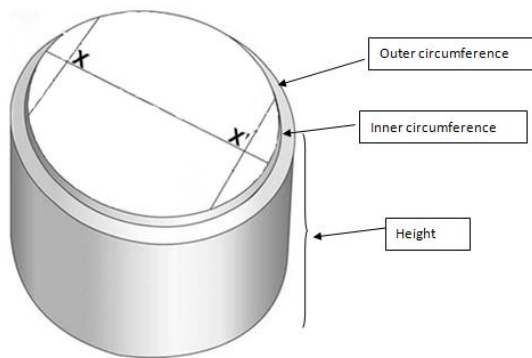
requisites for an impression used in the fabrication of dental castings, it is important to investigate the effect of disinfectants on the accuracy and reproduction of fine details of impressions.<sup>1</sup> Therefore, an evaluation of dimensional accuracy of polyvinyl siloxane (medium body and combination of medium body and light body) elastomeric impression material after immersion into disinfectants is studied in this in vitro study.

#### METHODOLOGY

The dimensional accuracy of the impression material before and after disinfection was assessed indirectly by measuring linear distance between two points (X and X') on the standardized stainless steel die (similar to those described in ADA specification 19, ANSI/ADA 1977).<sup>2</sup>

The dimensions of the die are as follows:(fig. 1)

**FIGURE 1:**



Linear dimension from X-X' – 25mm

Outer circumference – 32mm

Inner circumference – 29.97mm

Height of the die – 31mm

A stainless steel mold was taken to carry and confine the impression material on to the surface of the die while making of the impression. **Using the monophasic technique (Technique 1)** first a tray adhesive was applied to the mold (fig. 2).

**FIGURE 2:**



Then the impression material was dispensed from caulking gun into the mold (fig. 3)

**FIGURE 3:**



and onto the impression surface of the die in a zig-zag pattern with the tip buried in the material so as to minimize the voids.<sup>2</sup> (fig. 4).

**FIGURE 4:**



**Using the combination of medium body and light body (Technique 2)** first a tray adhesive was applied to the mold then light body impression material was applied directly to the impression surface of the die using a caulking gun (fig. 5).

**FIGURE 5:**



The medium body addition silicone impression material was loaded in the impression mold.(fig. 6).

**FIGURE 6:**



Impression molds were then placed on the impression surface of the stainless steel die and the entire assembly was kept under the hydraulic bench press. The impression material was allowed to set under the bench press according to the manufacturer's setting time which is 5 min from start of mixing, plus additional time to allow for room temperature setting and to ensure complete polymerization. The additional time was 3 minutes.<sup>1</sup> After removal the impressions

were kept under the travelling stage microscope (fig. 11)

**FIGURE 11:**



and the linear distance was measured from one crosspoint (X) to the other crosspoint (X'). Then the impressions were immersed in a zip lock plastic bag containing a disinfectant. Total of 40 impressions were made with each technique out of which 20 impressions were immersed in the first disinfectant i.e. 5.25% of sodium hypochlorite (fig.7, 9)

**FIGURE 7:**



**FIGURE 9:**



and the other 20 were immersed in the second disinfectant i.e. 2% glutaraldehyde.(fig. 8,10).

**FIGURE 8:**



**FIGURE 10:**



The impressions were immersed for 10 minutes into their respective disinfectants and then removed and washed under running water. 10 impressions were assigned to the control group, which were not immersed in any of the 2 disinfectants. Then again the linear distance was measured from one crosspoint (X) to the other crosspoint (X') by keeping the impression under travelling stage microscope. This measurement was made three times to the nearest 0.01mm at 30X magnification. A comparative analysis was then performed between linear distance before and after immersion into disinfectants. To eliminate the individual variability all samples were measured by the same individual. A comparative analysis was made between: before and after disinfection with 5.25% of sodium hypochlorite and 2% of glutaraldehyde using technique 1 and technique 2. A comparative analysis was also made between technique 1 and technique 2. The results so obtained were tabulated and analyzed statistically.

## RESULTS

The monophasic was coded as Technique 1 and the combination of medium body and light body was coded as Technique 2. The disinfectant sodium hypochlorite was coded as Disinfectant 1 and Glutaraldehyde was coded as Disinfectant 2. The value of linear dimensions in various groups were subjected to statistical analysis. Continuous data were expressed as mean  $\pm$  standard deviation and inter



group comparisons were made by T-test. A p-value of less than 0.05% was considered as statistically significant. The mean linear dimension values and standard errors for each subgroup were as stated in

Table 1. T-test was used to make statistical analysis of all groups. Each group showed statistically significant result ( $p < 0.05$ ). The comparative analysis has been stated in Table 2.

**TABLE 1. Mean linear dimensional values for experimental groups:**

| TECHNIQUE   | DISINFECTANTS  | GROUPS           | MEAN LINEAR DIMENSIONS $\pm$ SD |
|-------------|----------------|------------------|---------------------------------|
| Technique 1 | Disinfectant 1 | Before immersion | 25.0650 $\pm$ .01147            |
|             |                | After immersion  | 25.0725 $\pm$ .01118            |
| Technique 1 | Disinfectant 2 | Before immersion | 25.0630 $\pm$ .01418            |
|             |                | After immersion  | 25.0760 $\pm$ .01314            |
| Technique 2 | Disinfectant 1 | Before immersion | 25.0620 $\pm$ .01642            |
|             |                | After immersion  | 25.0685 $\pm$ .01531            |
| Technique 2 | Disinfectant 2 | Before immersion | 25.0655 $\pm$ .01572            |
|             |                | After immersion  | 25.0725 $\pm$ .01333            |

**TABLE 2. Statistical analysis of all groups:**

| TECHNIQUE   | GROUPS         | SUBGROUPS                | pVALUE | PERCENT DIMENSIONAL CHANGE | SIGNIFICANT SUMMARY |
|-------------|----------------|--------------------------|--------|----------------------------|---------------------|
| Technique 1 | Disinfectant 1 | Before + After immersion | 0.004  | .03%                       | Significant         |
| Technique 1 | Disinfectant 2 | Before + After immersion | <0.001 | .05%                       | Significant         |
| Technique 2 | Disinfectant 1 | Before + After immersion | 0.008  | .026%                      | Significant         |
| Technique 2 | Disinfectant 2 | Before + After immersion | 0.009  | .028%                      | Significant         |

## DISCUSSION

Addition silicones are available in four consistencies (viscosities), i.e. low, medium, heavy and putty. These consistencies, in various combinations can be used for impression making. To make an accurate impression, it is necessary to recognize that the viscosity of impression materials is related to its ability to record detail, as the lower the viscosity the greater the flow into spaces of fine detail. Medium body addition silicones can be used both as the syringe and the tray material. This allows the number of consistencies to be reduced. This change is possible because the material possess the quality of shear thinning, where the viscosity decreases as the shear rate is increased.<sup>3</sup> Two disinfectant solutions i.e. Sodium hypochlorite (5.25%) and Glutaraldehyde (2%) were used as they are commonly available, cost effective and high level disinfectants effective against a wide range of microorganisms. Disinfection of the impressions can be done by either immersing their impressions in the disinfectant solution or by spraying the surfaces of impressions with disinfectant. Immersion of an impression in a disinfectant will disinfect not only the internal surface of the impression but also external surfaces, including the tray and the adhesive to which the impression is attached.<sup>4</sup>

In a busy dental practice where multiple impressions are entering the disinfectant bath throughout the day, impressions cannot be disinfected for longer time periods. The chemical disinfectants studied were all shown to be effective against the Hepatitis B virus in 10 minutes exposure time. Impressions immersed in

sodium hypochlorite showed a slight expansion irrespective of the technique. This was in accordance with a study conducted by **Thouati et al** who also demonstrated 0.11% expansion with addition silicone impression material when immersed in sodium hypochlorite. But in contrast **Walker et al** demonstrated increasing shrinkage over the 2-week measurement period in addition silicone impression material after immersion into sodium hypochlorite for 10 minutes. They attributed this shrinkage to the absence of the use of tray adhesive in their protocol.<sup>2</sup> An intergroup comparison showed that least dimensional change was demonstrated in the combination of medium body and light body when immersed in sodium hypochlorite for 10 minutes. The second least dimensional change was found with the combination of medium body and light body when immersed in glutaraldehyde for 10 minutes. The third least dimensional change was found with monophasic addition silicone when immersed in sodium hypochlorite for 10 minutes. Monophasic addition silicone when immersed in glutaraldehyde exhibited greatest dimensional change. These differences may be due to the differences in the techniques used. This can be attributed to a study done by **Chen and Liang** on the factors affecting the accuracy of elastomeric impression materials which mentioned that the dimensional accuracy is influenced more by the technique used rather than by the material itself. According to ADA specification 19 criteria, elastomeric impression material should not exhibit more than 0.05% dimensional change within the first

24 hours. No statistical significant difference was found when dimensional changes due to immersion into the disinfectants, within the two techniques were analysed. This can be due to the fact that the dimensional accuracy was being measured as a function of disinfectant protocol and measurement time.

These results showed that the disinfectants studied did not have any adverse effect on the dimensional stability of the addition silicone impression material. These results were in agreement with studies in the literature that used the most varied media and times of immersion. For example, **Tullner et al** did not observe any negative effect after immersing polysulfide, polyether, addition reaction silicone impressions in 5.25% sodium hypochlorite, or neutral glutaraldehyde. Similar results were obtained by **Langenwaller et al** who studied the same materials immersed in sodium hypochlorite, glutaraldehyde or twice deionized water. **Minagi et al** also observed that silicones were insensitive to immersion in glutaraldehyde, presenting less than 0.03% dimensional changes, although the authors warn that these small differences should be compensated for in the casting process. It is important to draw attention to the fact that dimensional changes were determined only in one plane. Three dimensional studies should be performed to determine the security of the disinfectant treatment.<sup>5</sup>

## CONCLUSION

Under the limitations of this study following conclusions were drawn:

1. High level disinfectant solutions (sodium hypochlorite and glutaraldehyde) that belong to different chemical groups (glutaraldehyde and chlorine phenols) at different concentrations (5.25% and 2% respectively) did not affect the accuracy and dimensional stability of polyvinyl

siloxane impression materials after immersion for 10 minutes.

2. There was no statistical significant difference between the two techniques i.e. monophasic and combination of medium and light body used for making impressions in this study.
3. Because of the predictable accuracy and dimensional stability, polyvinyl siloxane are dependable impression materials for disinfection/sterilization purposes.
4. Post disinfection dimensional analysis indicated no clinically significant results, so the dentists must be encouraged to disinfect addition silicone impressions as a routine procedure in their daily clinical practice to avoid cross contamination to dental personals.

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