

## Comparative Evaluation of Dimensional Changes of Elastomeric Impression Materials after Disinfection with Glutaraldehyde and Microwave Irradiation

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### How to cite the article:

Vatsal A, Prasad S, Deepamala S, Patil A, Sulochana K, DP Shruthi. Comparative evaluation of dimensional changes of elastomeric impression materials after disinfection with glutaraldehyde and microwave irradiation. J Int Oral Health 2015;7(12):44-46.

### Abstract:

**Background:** Dentist and dental auxiliaries are susceptible to microbial contamination through contaminated impression materials from a patient. Sterilization of impression material can protect them, but this procedure can alter dimensional stability of impression materials. Hence, the present study was aimed to evaluate the dimensional accuracy of impression materials after disinfection with glutaraldehyde and microwave irradiation.

**Materials and Methods:** A total of 60 impressions were made and divided into three groups according to type of sterilization method used (Group 1: Control without use of disinfectant, Group 2: Glutaraldehyde (2%), and Group 3: Microwave irradiation) with 20 in each group. Impression materials in each group were contaminated with *Pseudomonas aeruginosa* and poured with dental stone and subjected for different disinfection procedure. Microbial evaluation was done by the cultural method and dimensional stability for accuracy. Results were statistically analyzed.

**Results:** Significant difference was seen in microbial load between glutaraldehyde and microwave irradiation groups ( $P < 0.001$ ).

**Conclusion:** Microwave irradiation method is effective in reducing microbial count and can be used as an effective disinfectant method.

**Key Words:** Chemical, disinfection, glutaraldehyde, impression materials, microwave

### Introduction

Impression making is routinely performed the procedure in dentistry. Patient's impression can be used to pour a cast for study models or dies preparation for appliance fabrication.<sup>1</sup>

These impressions are a source of reservoir for pathogens containing bacteria, fungi, and viruses, which can be transmitted from patient's saliva to dentist and dental auxiliaries through impression materials, dental casts or models.<sup>1-4</sup> Rinsing impression materials does not remove all microorganisms.<sup>3,5</sup> Hence to avoid cross-contamination of infection, an appropriate disinfection of impression material and dental casts should be followed. The objective of disinfection process is to remove microorganism from impression surface. However, disinfection can produce undesirable side effects like a dimensional change in impression material which may be associated with a chemical or physical interaction between the set material and disinfecting solution.<sup>6</sup> The dimensional accuracy and surface detail reproduction are necessary for a true copy of molded anatomical structures.<sup>7</sup>

Foreign Direct Investment (FDI) (1998) guidelines suggested that all impression materials should be cleaned and disinfected before sending it to the laboratory (FDI Guidelines for Infection Control 1985)<sup>3</sup> Occupational Safety and Health Association guidelines (1991) suggest that dentist and dental laboratory employers should be protected from infection transmission.<sup>5</sup> Various methods (microwave, autoclaving) and chemicals can be used for disinfecting impression materials such as sodium hypochlorite, glutaraldehyde, iodophor, and phenol. Disinfection can be done by spray or immersion method. All the impression materials are not compatible with all types of disinfectants.<sup>1-3</sup> All chemical disinfectant may be harmful to the health of the user. Autoclaving and microwave method is an alternative method of disinfection. The microwave oven method was suggested by researchers at the University of Florida for rapidly sterilize kitchen utensils.<sup>5</sup> There are very few studies related to microwave method of disinfection. Hence, the present study was aimed to evaluate the dimensional accuracy of impression materials after disinfection with glutaraldehyde and microwave irradiation.

### Materials and Methods

Glutaraldehyde (2%) chemical disinfectant and microwave irradiation method were used in the study. The metallic die for making an impression was sterilized by autoclaving for 15 min at 15 lbs pressure and 121°C. According to manufacturer's instructions impressions of metallic die were made by mixing zelgan and loaded onto a stainless steel perforated rim lock tray.

About 60 impressions were made and divided into three groups according to type of sterilization method used (Group 1: control group without use of disinfectant, Group 2: glutaraldehyde (2%), and Group 3: Microwave irradiation) with 20 in each group. Impression materials in each group were contaminated with *Pseudomonas aeruginosa* and poured dental discs were subjected for different disinfection procedure. Microbial evaluation and colony counting was done by the cultural method.

According to ADA specification 19, a solid cylinder of aluminum with 31 mm height was made which had three parts (ruled aluminum block, metal collar, and riser). Three parallel lines (X, Y and Z) were engraved 2.5 mm apart from each other with line passing through the center denoting the diameter of the circular surface on inner surface of this cylinder. Two lines (cd and c, d) were engraved perpendicular to the Y line such that cd and c, d were equidistant from the center and 25 mm apart from each other. The insertion of line cd and line Y was denoted as Point A and that of c, d, and Y as Point B. When the metal collar was placed over the test surface of the aluminum block a mold cavity was observed measuring 30 mm in diameter and 2.5 mm in depth which would be the diameter of the test specimen.<sup>5</sup> Obtained results were tabulated and statistically analyzed using SPSS software version 15 and Chi-square test.

### Results

Glutaraldehyde and microwave irradiation disinfection methods compared to control group showed significant reduction of *P. aeruginosa*. A significant difference was seen in microbial load between glutaraldehyde and microwave irradiation groups ( $Z = 5.006, P < 0.001$ ) (Table 1).

The mean difference of dimensional stability was 24.0131, 24.042, and 24.053 for control, glutaraldehyde, and microwave groups, respectively (Table 2). Dimensional stability among test and control groups was not statistically significant (Table 3).

### Discussion

The main purpose of disinfection is eliminating contaminated impression materials and dental casts from microorganisms. This study evaluates the efficacy of glutaraldehyde and microwave irradiation in the elimination of contaminated microorganism; *P. aeruginosa* and reproduction of dimensional accuracy.

In present study glutaraldehyde and microwave irradiation disinfection methods compared to control group showed significant reduction of *P. aeruginosa*. Significant difference was seen in microbial load between glutaraldehyde and microwave irradiation groups ( $Z = 5.006, P < 0.001$ ) (Table 1). The results of the present study are similar to study by Goel *et al.*, and Aksen *et al.*,<sup>5,8</sup> Ahila and Subramaniam concluded that no change in dimensional accuracy after disinfection of various elastomeric

**Table 1: Inter group comparison for *P. aeruginosa*.**

Comparison	Z	P
Control versus microwave	5.344	<0.001
Control versus glutaraldehyde	5.006	<0.001
Glutaraldehyde versus microwave	5.006	<0.001

*P. aeruginosa: Pseudomonas aeruginosa*

**Table 2: Dimensional stability comparison among three groups.**

Group	Mean difference
Control	24.0131
Microwave	24.042
Glutaraldehyde	24.053

**Table 3: Difference in mean dimension comparison among groups.**

Variable	Microwave	Glutaraldehyde
Mean dimension	24.064	24.053
Standard deviation	0.0047	0.0050
Mean difference from control	0.0034	0.0142
Comparison of difference	$T=0.564$ $P=0.568$	

impression materials with glutaraldehyde, povidone, and sodium hypochlorite at different time intervals. They also concluded that glutaraldehyde had least adverse effect on accuracy and surface quality of casts.<sup>3</sup> Bhat *et al.*, concluded that 3 min microwave irradiation at 650 W is effective to reduce the microbial load of dental cast.<sup>9</sup> It was observed in our study that microwave method is equally effective in reducing microbial count compared to glutaraldehyde method (Table 1). Abass *et al.*, found that Immersion the dental stone casts improved the effectiveness of microwave irradiation as a disinfection method. The dimensional accuracy and surface porosity was adversely affected but within the clinical limitation.<sup>10</sup> Anaraki *et al.*, observed from their study that, seven-minute microwave irradiation at 600 W can effectively reduce the microbial load of dental stone casts. Wetting the casts does not seem to alter the efficacy of irradiation.<sup>11</sup>

Use of chemical disinfects can be potentially harmful, time consuming, needs fresh preparation compared autoclaving, or microwave method. Several studies have shown the presence of bacterial contamination even after disinfection.<sup>9,12</sup> Pavarina *et al.*, concluded that washing in water, immersion in 2% glutaraldehyde solution and in 0.5% sodium hypochlorite solution did not show any dimensional alteration in dental casts.<sup>13</sup> Ramakrishnaiah *et al.*, found least dimensional change with microwave methods compared to chemical disinfection.<sup>4</sup> Abdelaziz *et al.*, (2014) concluded that (a) sterilization of rubber impressions made on acrylic trays was usually associated with a degree of dimensional change; (b) microwave energy seems to be a suitable technique for sterilizing rubber impressions; (c) topical surfactant application helped restore wettability of sterilized impressions.<sup>14</sup> Kamble *et al.*, concluded that elastomeric impression materials produced similar dimensional changes when disinfected with chemical, autoclave and microwave method which is in accordance to our study.<sup>15</sup>

Use of microwave disinfection method is a fast easy method. The mean difference of dimensional stability was 24.0131, 24.042 and 24.053 for control, glutaraldehyde and microwave groups respectively (Table 2). Dimensional stability among test and control groups was not statistically significant (Table 3). These results are in collaboration with study by Goel *et al.*,<sup>5</sup> Mallikarjun *et al.*, concluded that microwave sterilization is better compared to glutaraldehyde as it is effective and less time consuming.<sup>16</sup>

Al Kheraif observed no statistically significant increase in the surface roughness when the specimens were subjected to chemical disinfection and autoclave sterilization, but increase in roughness and discoloration was observed in all the materials when specimens were subjected to microwave sterilization. He further concluded that chemical disinfection does not eliminate all disease-causing microorganism's and microwave sterilization leads to a rougher impression surface compared to the chemical or autoclaving method.<sup>17</sup>

### Conclusion

Microwave irradiation method is effective in reducing microbial count and can be used as an effective disinfectant method.

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