*Section A-Research paper*
**ISSN 2063-5346**

# The effect of disinfectants on dimensional stability of addition and condensation silicone impressions

**U. Varalakshmi[1], D. Sudha Madhuri[2], Siddharth Swarup[3], Udayagiri Madhusudhana Rao[4], Dharam Hinduja[5], Sunke Anuradha[6]**

**[1]Associate Professor, Department of Prosthodontics Govt.Dental college & Hospital, Vijayawada**

**[2]Professor & HOD, Department Of Prosthodontics, Government Dental College And Hospital Kadapa**

**[3]Dr.D.Y. Patil Dental College and Hospital, Dr. D.Y.Patil Vidyapeeth, Pimpri, Pune.**

**[4]Assistant Professor, Dept of Prosthodontics, Govt. Dental College and Hospital, Kadapa**

**[5]MDS DNB, Prof, Dayanand Sagar College of Dental Sciences**

**[6]3rd year Post Graduate student, Department of Prosthodontics, Government Dental College and Hospital, Kadapa, Andhra Pradesh**

**Corresponding author**

**Dr. U. Varalakshmi, Associate Professor, Department of Prosthodontics Govt. Dental college & Hospital, Vijayawada**

## Abstract

**Background:** To study the effect of disinfectants on dimensional stability of addition and condensation silicone impressions.

**Materials & methods:** A total of 60 samples were enrolled. The 30 samples were of addition silicone and 30 of condensation silicone. The data was collected. A statistical analysis via a three-way mixed ANOVA was performed. The results were analysed using SPSS software.

**Results:** There was a statistically significant simple two-way interaction of material and groups at the T1 level ($p = .02$), but not at the T0 level ($p = .8$). That interaction arises from the statistically significant differences between the control groups of the two materials ($p=0.05$).

**Conclusion:** The dimensional changes of all the samples were significant.

**Keywords:** Impressions, Addition silicone, Disinfectants.

## Introduction

Impression materials are presently still a relevant material for use in restorative dentistry. [1-3] Impressions are used to transfer the information from the patient's mouth to a stone analog cast, which can aid in making a diagnosis and a correct treatment plan, critical to the success of final

prosthetic restoration. [4] The impression material selected by the dentist must provide good dimensional stability and precision in detail reproduction. The material should not suffer changes during the disinfection or sterilization processes and should allow adequate storage stability over time.[5]

Contamination of dental impressions with saliva and blood from the oral cavity occurs readily in dental clinics. Direct interaction between dental clinics and dental laboratories makes contaminated dental impressions difficult items to deal with from the cross infection point of view. Previous reports indicated that contaminated impressions can cross-infect gypsum casts that were poured against them.[6] Until 1991, rinsing impressions under running water was the recommended practice. [7] Guidelines for infection control in dental health care suggested that all dental prostheses and prosthodontic items should be cleaned, disinfected, and rinsed before they are handled in the laboratory using an active hospital disinfectant. [8] Materials selected for dental impressions can significantly influence the accuracy and precision of the impression and, consequently, of the final result. Although both rigid (impression plaster and zinc oxide-eugenol) and elastic materials (agar, alginate, polyether, condensation silicone (C-silicone), addition silicone (A-silicone), and polysulfide) have been widely used for creating dental impressions, elastic ones are often preferred. Nowadays, sodium alginate is used as the basic material for taking impressions before the preparation of diagnostic gypsum casts, individual trays, orthodontic appliances, and splints. However, sodium alginate-based impressions are not recommended for more precise applications because they exhibit dimensional instability as they absorb water and swell, and they also constrict due to syneresis. [9] Dental works of the best quality can be achieved using casts made from elastomeric impressions. [10] Silicones are often preferred by dentists as they are characterized by high flexibility and recovery during removal from the oral cavity, as well as the ability to be poured up to 1 week with only slight changes in their dimensional stability, estimated at 0.3%. [11] Hence, this study was conducted to study the effect of disinfectants on dimensional stability of addition and condensation silicone impressions.

**Materials & methods**

A total of 60 samples were enrolled. The 30 samples were of addition silicone and 30 of condensation silicone. The samples of each material were split to form three groups with 20 samples each: a control group, a hypochlorite group (disinfection) and an autoclave group (sterilization). Samples were stored for six months at 23 °C. The data was collected. A statistical analysis via a three-way mixed ANOVA was performed. The results were analysed using SPSS software.

**Results**

At T0, the autoclave group has the highest average dimensional change (0.36 for condensation silicone and 0.36 for addition silicones) and the control group has the lowest average dimensional change (0.10 for addition silicone and 0.15 for condensation silicone). There was a statistically significant simple two-way interaction of material and groups at the T1 level ($p = .02$), but not at the T0 level ($p = .8$). That interaction arises from the statistically significant differences between the control groups of the two materials ($p=0.05$).

Table 1: Descriptive and three-way ANOVA analysis between the three variables

| | T0 | T1 | Shrinkage | P- value |
|---|---|---|---|---|
| Addition silicone | | | | |
| Control | 0.10 | 0.48 | 0.40 | 0.05 |

| | | | | |
|---|---|---|---|---|
| Hypochlorite | 0.15 | 0.51 | 0.32 | |
| Autoclave | 0.36 | 0.85 | 0.55 | |
| Condensation silicone | | | | |
| Control | 0.15 | 0.92 | 0.68 | 0.05 |
| Hypochlorite | 0.18 | 0.58 | 0.40 | |
| Autoclave | 0.36 | 0.80 | 0.51 | |
| | 0.8 | 0.02 | | |

**Discussion**

Many studies have evaluated the effect of various disinfectants and methods of disinfecting impression materials, but the results of those studies varied widely. The role of a disinfectant should, ideally, be of a dual purpose, it must be an effective antimicrobial agent, yet cause no adverse response to the dimensional accuracy and surface features of the impression material and the resultant gypsum cast. [12] The dimensional stability of disinfected impressions had been a subject of investigation by many researchers who used a variety of approaches. Some studies used full arch casts while others studied the effects on a die. [13,14] The measuring technique used in determining dimensional changes after disinfection also varied from using a Boley gauge, to the use of measuring microscope. [15] Hence, this study was conducted to study the effect of disinfectants on dimensional stability of addition and condensation silicone impressions.

In the present study, at T0, the autoclave group has the highest average dimensional change (0.36 for condensation silicone and 0.36 for addition silicones) and the control group has the lowest average dimensional change (0.10 for addition silicone and 0.15 for condensation silicone). A study by Sinobad T et al, a total of 120 impressions were made on the model of the upper arch representing three full metal-ceramic crown preparations. Four impression materials were used: two condensation silicones (Oranwash L - Zhermack and Xantopren L Blue - Heraeus Kulzer) and two addition silicones (Elite H-D + regular body - Zhermack and Flexitime correct flow - Heraeus Kulzer). After removal from the model the impressions were immediatel immersed in appropriate disinfectant (glutaraldehyde, benzalkonium chloride - Sterigum and 5.25% NaOC1) for a period of 10 min. The dimensional changes of all the samples were significant both as a function of time and the applied disinfectant. The results show significant differences of the obtained dimensional changes between the group of condensation silicones and the group of addition silicones for the same time, and the same applied disinfectant ($p = 0.026$, $F = 3.95$). [16]

In the present study, there was a statistically significant simple two-way interaction of material and groups at the T1 level ($p = .02$), but not at the T0 level ($p = .8$). That interaction arises from the statistically significant differences between the control groups of the two materials ($p=0.05$). Another study by Martins F et al, ninety samples were obtained from polyether ImpregumTM PentaTM (3M ESPETM, Seefeld, Germany) and 90 of addition silicone ImprintTM 4 PentaTM Putty (3M ESPETM, Seefeld, Germany).The samples of each material were split to form three groups with 30 samples each: a control group, a hypochlorite group (disinfection) and an autoclave group (sterilization). Samples were stored in the Portuguese Institute for Quality for six months at 23 °C. Significant shrinkage of ImpregumTM PentaTM was $0.77 \pm 0.17\%$ in the control group, $0.42 \pm 0.19\%$ in the hypochlorite group and $0.52 \pm 0.28\%$ in the autoclave group. For ImprintTM 4 PentaTM Putty, the control group had a shrinkage of $0.42 \pm 0.12\%$, the hypochlorite group $0.36 \pm 0.09\%$ and the autoclave group $0.59 \pm 0.13\%$. [17] Unlike disinfection, sterilization is a procedure that guarantees the elimination of all microorganisms. [18] There is no universally accepted method of sterilization, but the literature

suggests that the autoclave is considered the most effective method, [19] although its effects on the dimensional stability of the elastomeric impression materials are not sufficiently described in the literature. [20] After disinfection or sterilization, the impressions are cast in stone. The dimensional stability of the impression materials depends on the time elapsed between the completion of the impression and their casting, thus storage time is critical to obtain reliable casts. [21] Apart from good dimensional stability, the ideal impression material should meet other criteria, such as appropriate setting time, flow properties, mechanical strength, accuracy, compatibility with cast materials, safety, ease of manipulation, low cost, and disinfectability. Depending on the application, materials with optimal properties are selected. The analysis of the properties of a dental impression material cannot be limited to the properties of the material itself, in its native form, but must also take into account the impact of time, as well as storage and disinfection conditions, on the material characteristics. Dental impressions must be disinfected in order to limit the risk of cross-contamination and ensure the safety of both patients and dental personnel. Because dental impressions are placed in the oral cavity, where they will be exposed to saliva and blood, and as a result potentially contaminated with pathogens (e.g., streptococci, staphylococci, Escherichia coli, Mycobacterium tuberculosis, hepatitis C virus, and Herpes simplex virus, Candida albicans), [22-24] it is important to disinfect them to prevent the transmission of infectious agents between dental offices and laboratories. [25]

## Conclusion

The dimensional changes of all the samples were significant.

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