ORIGINAL ARTICLE

# Effect of disinfectants on the tear strength of addition silicone impression material – An *in vitro* study

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## ABSTRACT

Addition silicone is a newer type of silicone impression material which has high dimensional stability, accuracy, and flexibility. They are mostly used for fixed restorations such as crowns and bridges. They have high tear strength; however, this strength may be altered upon disinfection. Disinfection of addition silicone prior use is important to reduce the microbial load. The aim of this study is to check whether there is any change in tear strength of addition silicone on disinfection with two commercially available disinfectants. Zhermack Elite HD + Putty material was tested in this study. Base and catalyst material was mixed and the material was cut into strips of dimension 70 mm × 10 mm × 2 mm. Five strips were immersed in sterillium and five strips were immersed in glutaraldehyde solution. These strips were then tested for their tear strength using Instron E3000 Universal Testing Machine. The values obtained were recorded in SPSS software version 22 (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp.) for analysis and the *P* was obtained. The mean tear strength of Group 1, addition silicone immersed in sterillium disinfecting solution was found to be 7.148 ± 2.654 kN/m. The mean tear strength of Group 2, addition silicone immersed in glutaraldehyde disinfectant solution was found to be 7.326 ± 4.062 kN/m. An unpaired Student's *t*-test was done and *P* was found to be 0.235. The tear strength values between the groups was statistically not significant. Hence the tear strength of addition silicone was found to be greater in the glutaraldehyde disinfectant solution group.

**Key words:** Addition silicone, disinfection, glutaraldehyde, innovative technique, sterillium, tear strength

## INTRODUCTION

The dimensional stability, accuracy, and flexibility of elastomeric impression materials, as well as the impression procedures used, have a direct impact on the quality of the dental impression. Silicone materials have long been known for their poor wettability, with contact angles with water frequently exceeding 90°.[1] When tensile loads are applied during impression removal and cast separation from the set impression, impressions should resist tearing. In gingival fissures and interproximal locations, impression materials are particularly prone to ripping. Tears in the impression generate faults, which will impact the final restoration's precision.[2]

Impression materials must have high tear energy as well as suitable elastic rebound. If the material deforms elastically

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before tearing, it may not be an advantage, especially if the deformation is significant enough to result in a poorly fitted crown margin.[3] Dental impression disinfection is crucial in reducing the danger of cross-contamination. According to certain studies, disinfection treatments differ significantly. Because water does not lower the microbiological load of the substance, addition silicone impressions should always be disinfected following water washing. It also has no effect on dimensional stability. The use of 3% hydrogen peroxide and 1% and 5.25% sodium hypochlorite does not significantly affect dimensional stability, but it does reduce the microbial load of the impression by more than 99.9%.[4,5]

Short-term impression disinfection, according to certain research, has no effect on the accuracy of polyether or addition silicone materials. In most cases, impressions are disinfected for longer than is recommended.[6] Alginate was discovered to have three times the number of bacteria as silicone impression material. For both alginate and silicone, chemical disinfection with a glutaraldehyde-based disinfectant was efficient in removing all microbiological forms while maintaining dimensional stability. Disinfectants based on alcohol were ineffective.[7,8] It is recommended that additional silicone be disinfected with Actichlor to keep the wettability of the impression material. Following cleaning, Vacufilm treatment is indicated to improve material wettability and hence lower the possibility of voids in casts.[9] Several experiments have been undertaken in the past to see if disinfection affects qualities such as wettability and contact angle of added silicone. Various research studies have led to good publications from our team.[10-23] The aim of this study is to check whether there is any change in tear strength of addition silicone on disinfection with two commercially available disinfectants.

## MATERIALS AND METHODS

Zhermack Elite HD+ was the putty material used for the study. The material is available as a two-paste component. When the two pastes are mixed in equal lengths, an additional reaction occurs. The material was placed between two glass slides and compressed to form a cuboid strip. The strip was then cut into dimensions of 70 mm length, 10 mm width, and 2 mm height. Ten such strips were made and divided into two groups. The first group consisted of five strips immersed in sterillium. The second group consisted of five strips immersed in a 2% glutaraldehyde solution. Immersion was done for 15–20 min. These strips were then secured in an Instron E3000 Universal Testing Machine. The specimen was gripped by a pneumatic clamp on both sides. Before running the test, it was ensured that the specimen was neither in compression nor tension. The results obtained were tabulated and graphed.

## RESULTS

The mean tear strength of Group 1, addition silicone immersed in sterillium disinfecting solution was found to be 7.148 ± 2.654 kN/m. The mean tear strength of Group 2, addition silicone immersed in glutaraldehyde disinfecting solution was found to be 7.326 ± 4.062 kN/m. Unpaired Student's *t*-test was done and the *P* value on comparison between the sterillium group and glutaraldehyde group was found to be 0.235 (>0.05 and hence not statistically significant). [Table 1 and Figure 1]. Hence, the tear strength of addition silicone is more in glutaraldehyde solution than in sterillium solution. However, this difference is not statistically significant.

## DISCUSSION

The tensile strength of Zhermack Elite HD+ addition silicone material was increased after disinfection with sterillium and glutaraldehyde, according to our findings. In glutaraldehyde, the rise in strength was larger than in sterillium. As a result, this rise is not statistically significant. Hand sanitizers containing sterillium are extensively used. Its antibacterial activity as well as user acceptability have been proven. It possessed a broad range of antibacterial action. Due to the high level of popularity among health-care professionals, it has the potential to greatly increase hand hygiene compliance and hence reduce the incidence of nosocomial infection.[24]

**Table 1: Mean and standard deviation for sterillium and glutaraldehyde test samples**

| Groups | *n* | Mean | SD | *P* |
|---|---|---|---|---|
| Sterillium | 5 | 7.14800 | 2.654512 | 0.235 |
| Glutaraldehyde | 5 | 7.32600 | 4.062001 | |

SD: Standard deviation

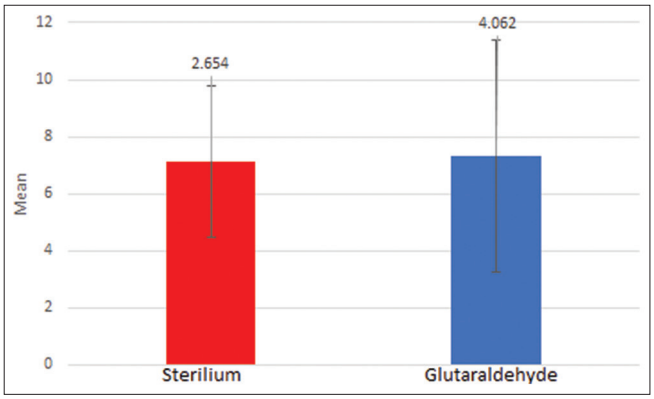


**Figure 1:** Graph showing the mean post immersion tear strength values of sterillium and glutaraldehyde. The X-axis shows samples tested and Y-axis shows tear strength value. Red represents sterillium while blue represents glutaraldehyde. The mean post immersion strength of glutaraldehyde (7.32) was found to be more than that of sterillium (7.14). The difference was not statistically significant (Unpaired Student's *t*-test; *P* = 0.235 - statistically not significant)

Immersion of dental impressions in 2% glutaraldehyde has been found to be an effective viral contamination disinfection technique.[25] As a result, for a successful clinical outcome of the surgery, impression materials must have maximal tear strength. Silicone impression materials are thought to be acceptable for fixed prostheses. Due to their heat resistance, addition cured silicones have been proposed as one of the few materials that might withstand steam autoclaving.[26]

Viscosity and the speed at which the material is loaded and taken out of the mouth both have a significant impact on tear strength.[27] In addition, some residues of impression material left in the sulcus may cause inflammatory reactions. As a result, for a successful clinical outcome of the surgery, impression materials must have maximal tear strength. The capacity of addition silicone to stay dimensionally stable under disinfection methods has also been demonstrated in studies.[28]

For the past 20 years, silicones have been used as impression materials. They are more convenient to work with than polysulfides because they are easier to mix and handle, and have a super elastic recovery and less permanent deformation. Silicones can make a good impression when used carefully, but the huge dimensional shift and short working period prompted the development of alternative materials to mitigate these shortcomings. In comparison to traditional condensation silicones, the new form of silicone is set by an addition reaction and has enhanced dimension stability.[29] The fact that we only tested the material with two disinfecting solutions is one of the study's shortcomings. In addition, we solely conducted *in vitro* research. There were no *in vivo* investigations conducted. The effect of saliva was not considered. This research is useful because it allows us to identify the disinfectant that has the least impact on the tear strength of added silicone material, making it stronger and more resistant to fracture during removal.

## CONCLUSION

The tear strength of addition silicone is high. On disinfection with sterillium and glutaraldehyde, the tear strength was found to increase. The increase in tear strength was found to be higher with glutaraldehyde disinfecting solution.

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### Conflicts of interest

There are no conflicts of interest.

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