Effect of Surfosept and Deconex® 53 Disinfectant Agents On The Accuracy And Dimensional Stability Of Panasil Dental Impression Materials: An In-Vitro Experimental Study

Parviz Amini1, Mostafa Alam1, Arash Ghaffarpasand1, Nasim Khaje Dalooei1, Alireza Hadi1, Kamyar Abbasi1

1 Associate Professor, Department of Prosthodontics, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran.

Abstract

Aim and Objective: Impression materials and BegoStone casts are the main sources of cross-contamination and transmission of dental infections between dental professionals. Considering the influence of disinfection substances on the dimensional stability of impression materials, this study was aimed to compare the effect of Surfosept and Deconex® 53 on the accuracy and dimensional stability of dental addition siliconematerial i.e., Panasil®.

Material and Method: This in-vitro study was performed on 30 casts. The samples were divided into one control group and two experimental groups to be disinfected with Surfosept (1%) and Deconex® 53 (2% using a sequential sampling method (10 per group). The impressions in the experimental groups (i.e., Surfosept and Deconex® 53) were rinsed and dried, the disinfectant was sprayed on the impressions and remained for 30 seconds before pouring with stone. In the control group, the impressions were only rinsed and dried, and were poured in 10 minutes. Cast dimensions were measured by a profile projector device, and the mean values obtained from the experimental groups were compared with those of the control group.

Results: There were no significant differences among the groups regarding the height of the resulting dies without undercut (P=0.62). Moreover, there was no significant difference among the groups regarding the distance between the two dies (P=0.77). However, in terms of the diameter of the dies without undercut, a significant difference was observed among the groups (P<0.005).

Conclusion: In general, no significant difference was encountered between dimensional stability and accuracy of the dental impressions using Surfosept and Deconex® 53 in this study.

Keywords: Dental Disinfectants; Dental Impression Materials; Silicones.

Introduction

Dental materials are exposed to various pathogenic microorganisms which are potentially harmful [1]. The main sources of cross-contamination of dental infections include the impression trays, dental impression materials and BegoStone casts [2]. Chemical disinfection has remained a common practical approach to eliminate microorganisms, since heat or steam sterilization of impressions and occlusal records cannot be performed due to the risk of distortion [3]. However, as all disinfectant solutions can have remarkable effects on the dimensional changes of impression materials, immersion duration is recommended to be short, i.e., less than 30 minutes [4].

There is invaluable evidence to support the transmission of microorganisms through impression materials [5-9]. According to the literature, most of the materials used in dental laboratories contain various infectious microorganisms, such as streptococci [10, 11]. Egusa et al. estimated the prevalence of Streptococci,
Staphylococcus aureus, Methicillin-resistant Staphylococcus, and Candida the impressions taken from the patients’ mouths had 100%, 55.6%, 25%, and 9%, respectively, [12]. Therefore, disinfection of dental impressions can remarkably reduce the number of bacteria and other microorganisms; however, there is no standard method or protocol for proper disinfection of the impression materials [13].

It is of utmost importance to select the suitable material for disinfection and to identify the potential problems with each approach [14-18]. Shelf life, solidification, ease of application, low price, robustness, and resistance to different kinds of stress are among suitable characteristics of impression materials [10, 19-24]. On the other hand, dimensional changes of the impression materials, following the use of disinfectants, are among the main problems in the process of preparation of dental prostheses, which could lead to treatment failure.

Silicones are the most common impression materials used to fabricate fixed dental prosthesis [25]. Recently, the use of addition-silicone impressions is escalated due to its high accuracy [3]. Addition-type silicone impression materials with enhanced hydrophilic properties have the potential to show larger dimensional changes after disinfection, compared to conventional condensation-type materials [26]; however, there is a dearth of research in this regard in the literature.

Deconex® 53 is one of the materials which is commonly used for disinfecting dental instruments. It can be employed to eliminate a wide range of microorganisms, including tuberculosis and viral infection. It can be employed to eliminate the use of disinfectant materials, following the use of dental instruments. This solution contains isopropanol, Didecyldiethyl ammonium propionate. In this study, Deconex® 53 (1%) was used as a disinfectant solution, which is commonly used in hospital settings for disinfecting flexible and rigid endoscopes. It can also be utilized to disinfect dental instruments. The recommended concentration of this substance is 1-2% depending on the expected effect, while a maximum of 4% concentration is used in certain circumstances. This solution is composed of Alkyl propylene diamine guanidinium diacetate, and N-didecyl-N-methyl-poly (oxy-ethyl) ammonium propionate. In this study, Deconex® 53 (1%) was sprayed on the impressions for 30 sec.

Impression process and preparation of Bego Stone Samples

In this study, two units of putty were mixed with two units of accelerator. The mixture was placed in a tray and the impression was taken. Initially, the required space for the wash layer was provided with a 1.5 mm metal spacer. The initial setting time, working time, and total setting time lasted 120, 120, and 240 seconds, respectively, at 32°C.

After the solidification of the impression material, the upper and lower sections were separated and the spacer was removed from the putty material. Panasil® (Kettenbach Co, Germany) was injected on the putty material and around the die, and the impression was taken again. After hardening, the material was separated from the tray following the manufacturer’s recommendations. The initial setting time, working time, and the final setting time for the light-body material were 150, 60-90, and 240 sec, respectively.

The impressions were left in the room temperature for 30 min, for the rebound phenomenon to happen. In the next stage, the impression was poured using BegoStone type IV (Wilhelm Herbst Bremen; Germany). According to the guidelines 50 gram of BegoStone was mixed with 10cc water at 23°C for 30 sec, and it was poured into the impression in three minutes utilizing slow vibration. The cast was separated from the impression after one hour (Figure 2).

Impression and Disinfectant Materials

Soft and light Panasil® Putty, which is a addition-type silicone impression materials, were employed in this study. Deconex® 53 is a disinfectant solution, which is commonly used in hospital settings for disinfecting flexible and rigid endoscopes. It can also be utilized to disinfect dental instruments. The recommended concentration of this substance is 1-2% depending on the expected effect, while a maximum of 4% concentration is used in certain circumstances. This solution is composed of Alkyl propylene diamine guanidinium diacetate, and N-didecyl-N-methyl-poly (oxyethyl) ammonium propionate. In this study, Deconex® 53 (1%) was sprayed on the impressions for 30 sec.

Surfosept is an alcohol-based disinfectant which can be used for eliminating bacteria and viruses, such as influenza A virus subtype H1N1, hepatitis C virus, hepatitis B virus, and human immunodeficiency virus. This solution contains isopropanol, Didecyldimethylammonium chloride, ethanol, and other additives.

In the experimental groups (i.e., Surfosept and Deconex® 53), the impression materials were rinsed and dried after taking impressions. Subsequently, the disinfectant was sprayed on the impres-
sions and remained for 30sec before pouring them with stone. In the control group, the impressions were washed and dried, and the dental impressions were poured with stone after 30sec.

**A profile projector**

A profile projector (Tesa Co, Switzerland) with 0.001mm resolution was utilized to compare the dimensions and geometry of the samples. The profile projector, which is known as an optical comparator, is a shadow graph device which uses principles of optics for accurate measurement and dimensional inspection of manufactured samples.

**Dimensional measurements**

5 variables were specified and examined on cast models. These factors which were measured by the profile projector include: the height of the die without undercut (A), the diameter of the die without undercut (B), the distance between two dies (C), the diameter of the die with undercut (D), and the height of the die with undercut (E) (Figure 3).

**Statistical analysis**

The data were analyzed in the IBM SPSS software (version 21). The three groups were compared in terms of the mean of studied variables. One-way ANOVA was used to compare the groups, and in case of a significant difference, the post hoc test (Tukey test) was used to determine the differences among groups. A P-value less than 0.05 was considered statistically significant.

**Results**

The mean height and diameter of the dies with and without undercut and distance between two dies are illustrated in Table 1. There were no significant differences among the control and two experimental groups in terms of the height of the dies without undercut (P=0.62). Comparison of the groups regarding the diameter of the dies without undercut showed a significant difference among them; as a result, the experimental groups had a lower diameter of the dies without undercut (P<0.005). No significant difference was observed among the groups in terms of the distance between two dies (P=0.77). In addition, regarding the height of the dies with undercut, the results revealed no significant differences among groups.
difference (P=0.62). However, there was a significant difference among the groups regarding the diameter of the dies with undercut (P<0.005).

To summarize, there were significant differences between control and two experimental groups considering the diameter of the dies with and without undercut. Nonetheless, no difference was observed among the groups regarding the height of the dies with and without undercut, and the distance between the two dies. Table 2 summarizes the results obtained from the Post hoc test.

The results obtained from this study indicated that the height of the dies with and without undercut and the distance between two dies had higher accuracy and dimensional stability following the use of the disinfecting material, compared to the diameter of the dies with and without undercut.

### Discussion

This study was aimed to determine the effect of two disinfectant materials (i.e., Surfosept and Deconex® 53) on the accuracy and dimensional changes of impression materials and the resulting casts. The dimensional stability of the impression materials can be influenced by several factors, including the contraction during the polymerization, and expansion after immersion in disinfectant solutions [27]. The thermal contraction of addition-type silicone rubber impression materials may lead to a 10-12μm dimensional change in cylindrical stone casts for every 1 mm increase in impression thickness [28].

Addition silicones (i.e., Panasil®) are the impression materials made of polyvinyl siloxane or vinyl polysiloxane. They have maximum dimensional stability and minimum dimensional changes when exposed to disinfectant materials [29]. The polymerization reaction of these materials helps obtain optimal dimensional stability [30]. Low viscosity, high hydrophilicity, excellent fluidity with high thixotropy, and good moisture resistance are the main characteristics of this substance leading to the increasing use of it in recent years. Based on the obtained results, both Surfosept and Deconex® 53 can be used without significant concern, on the impression materials made of Panasil®.

Hiraguchi et al. used Addition-type silicones to assess the dimensional changes of impression materials after immersing in glutaraldehyde (2%) and ortho-phthalaldehyde (0.55%) for 30 min. According to the results of the aforementioned study, no remarkable dimensional changes were observed in casts [28]. This finding was in line with the results obtained from other similar studies [31] in which the use of addition silicone (i.e., Panasil®) was suggested as a suitable impression material.

In contrast to the condensation silicones, addition silicones are based on addition polymerization between divinyl polysiloxane and poly methylhydrosiloxane with a platinum salt as catalyst. Ad-
dilion-type silicone rubber impression materials with enhanced hydrophilic properties contain larger quantities of surfactant, compared to conventional materials [32]. Some evidence indicates no change in the wettability of hydrophilic addition-type silicone rubber impression materials after 18 hour immersion in glutaraldehyde solution (2%); however, it is possible that the surfactant in the impression materials leaches out rendering the impressions less hydrophilic due to long-term immersion in disinfectant solutions. One the other hand, the dimensions of impression may change because of imbibition [28]. Due to the novelty of the addition-type silicone, the type of disinfectant suitable for these materials is not specified. Therefore, the dimensional accuracy of the casts should be investigated in more detail.

The results obtained from this study showed no significant difference between the experimental groups (i.e., Surfosept and Deconex® 53) regarding the dimensional changes, except for the diameter of the dies with and without undercut. It seems that Deconex® 53 tends to be able to absorb water out of the air, which is consistent to the hydrophilic property of an addition silicone material. However, the use of Deconex® 53 with alginate and polyether should be performed with caution since eliminating microorganisms in these material could be compromised [10].

Hamedi rad et al. evaluated the dimensional stability of alginate impressions following disinfection. The samples were divided into four groupsto be disinfected with Sodium Hypochlorite, Micro 10, Glutaraldehyde, and Deconex. They sprayed Micro 10 disinfectant, whereas other disinfectants were applied using immersion technique [33]. In this study, the Deconex disinfectant led to the maximum level of dimensional changes, which does not comply with the findings of our study. This difference may be due to the utilization of adifferent method for disinfection, i.e., immersion technique, in contrast to the present study where the spraying method was used.

In another study conducted by Ghaseemi et al., Deconex, Sodium hypochlorite (25.5%), and Epimax were utilized to disinfec impression materials [10]. According to the results, no significant difference was observed among the impressions in terms of the dimensional changes after disinfection. This finding is consistent with the results obtained from the current study. It seems that the use of Deconex with the spraying method hasmore benefits, compared to the immersion technique. Additionally, the effect of immersion of polyvinylsloaine moldsin sodium hypochlorite (5.25%) led to dimensional changes, such as shrinkage in impression material [34].

Similarly, a study was conducted by Sabouri et al. on 30 impressions to determine the effect of disinfectants on dimensional changes of impression materials. In this study, 20 impressions were disinfected by sodium hypochlorite and acid glutaraldehyde (10 impressions per group) and 10 impressions were considered as a control group. They rinsed impressions with cold water and stored them at room temperature for 30 and 20 min in the disinfected and control groups, respectively. Similar to our study, the height and diameters of the dies and the distance between the dies were measured in three groups. They showed no significant differences between the disinfected and control groups regarding the dimensional changes [35].

Based on the American Dental Association guideline, the immersion of impression materials in disinfectant solutions should not be longer than 30 min [12]. In our study, the disinfectant solutions were sprayed on impressions for 30 seconds. Carvalhal et al. performed a study to determine the effects of disinfectant solutions on the dimensional changes of the impression materials. Four elastomeric impression materials (i.e., Xantopren, Express, Permlastic, and Soft Impregum) were used to compare the effect of immersion time on the dimensional changes of casts made with each of these material. Dimensional changes were reported in all materials over time, except for immersion periods lower than 20 min [36]. In another study, Sodium hypochlorite (25.5%), Deconex, and Sanosil were employed for disinfecting impressions for 10-10 min periods, and the results were acceptable in terms of accuracy and dimensional stability of the material [10].

**Conclusion**

Based on the obtained results, no difference was reported between the experimental and control groups regarding the height of the dies without undercut. In addition, no difference was reported between the two experimental groups and the control group in terms of the distance between two dies. However, a difference was observed between the experimental and control groups in terms of the diameter of the dies both with and without undercut. In general, no significant difference was observed between Surfosept (1%) and Deconex® 53 (2%) in terms of influencing the dimensions or accuracy of the impression materials.

**Acknowledgments**

The authors would like to thank the authoritiesat Kerman Dental School, Kerman University of Medical Sciences, Kerman, Iran, for their cooperation inconducting this study.

**References**

[1]. Makvandi P, Janaledin R, Jbahri M, Nikfarjam N, Borzacchiello A. Antibacterial quaternary ammonium compounds in dental materials: A systematic review. Dent Mater. 2018 Jun;34(6):851-867. PubMed PMID: 29678327.

[2]. Badran H, Davoudi A, Molazem M, Zare MH. The effect of spraying different disinfectants on condensational silicone impressions; an in vitro study. J Indian Prosthodont Soc. 2015 Jul-Sep;15(3):263-7. doi: 10.4103/0972-4052.161091. PubMed PMID: 26929923.

[3]. Kamble SS, Khandeparker RV, Somasundaram P, Raghav S, Babaji RP, Varghese TJ. Comparative Evaluation of Dimensional Accuracy of Elastomeric Impression Materials when Treated with Autoclave, Microwave, and Chemical Disinfection. J Int Oral Health. 2015 Sep;7(9):22-4. PubMed PMID: 26453611.

[4]. Wu CC, Wei CK, Ho CC, Ding SJ. Enhanced Hydrophilicity and Bio-compatibility of Dental Zirconia Ceramics by Oxygen Plasma Treatment. Materials (Basel). 2015 Feb 16;8(2):684-699. PubMed PMID: 28778765.

[5]. Savabi O, Nejadivandvand F, Bagheri KP, Karimi L, Savabi G. Prevention of Cross-contamination Risk by Disinfection of Irreversible Hydrocolloid Impression Materials with Ozonated Water. Int J Prev Med. 2018 Apr 11;9(4):37. PubMed PMID: 29770172.

[6]. Yazdian M, Rahmani A, Tahmasebi E, Tehybian H, Yazdian A, Mossad S. Current and Advanced Nanomaterials in Dentistry as Regeneration Agents: An Update. Mini Rev Med Chem. 2021;21(7):899-918. PubMed PMID: 33234102.

[7]. Moghadam ET, Yazdian M, Alam M, Tehybian H, Tafazoli A, Tahmasebi E, Ranjbar R, Yazdian A, Seifalian A. Current Natural Bioactive Materials in Bone and Tooth Regeneration in dentistry: A Comprehensive Overview: J Mater Res Technol. 2021;13:2078-2114.

[8]. Yazdian M, Tahbesh H, Houssmand B, Tehybian H, Soufdoost RS, Tahmasebi E, Karimi A, Ghullame S. Fabrication and properties of TCP/ Zeolite/Gelatin scaffold as developed scaffold in bone regeneration: in vitro and in vivo studies. Bioengineering and Biomedical Engineering. 2020 Oct
