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

Research Article

Parviz Amini[1], Mostafa Alam[2], Arash Ghaffarpasand[3], Nasim Khaje Dalooei[4], Alireza Hadi[5], Kamyar Abbasi[6*]

[1] Associate Professor, Department of Prosthodontics, School of Dentistry, Kerman University of Medical Sciences, Kerman, Iran.
[2] Assistant Professor, Department of Oral & Maxillofacial Surgery, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[3] Postgraduate Resident, Department of Oral & Maxillofacial Surgery, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[4] Dentist, Private Practice, Tehran, Iran.
[5] Assistant Professor, Department of Prosthodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
[6] Assistant Professor, Department of Prosthodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, 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 substanceson the dimensions 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 rinsedand dried,thenthe disinfectant was sprayed on the impressions and remained for 30seconds before pouring with stone. In the control group, the impressions were onlyrinsedand dried, andwere pouredin 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 materialsare exposed to various pathogenic microorganismswhich are potentially harmful [1]. The main sources of cross-contamination of dental infections include the impression trays, dental impression materials and BegoStonecasts [2]. Chemical disinfection has remained a common practical approach to eliminate micro organisms, 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 containvarious infectious microorganisms, such as streptococci [10, 11]. Egusa et al. estimated the prevalence of Streptococci,

***Corresponding Author**:
Kamyar Abbasi,
Assistant Professor, Department of Prosthodontics, School of Dentistry, Shahid Beheshti University of Medical Sciences, Tehran, Iran.
Tel: 00989121232670
E-mail: kamyar.abb@gmail.com

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Staphylococcus aureus, Methicillin-resistant Staphylococcus, and Candidain the impressions taken from the patients' mouthsat 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 protocolfor proper disinfection ofthe impression materials [13].

It is of utmost importance to select the suitable material for disinfectionand 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 ofdisinfectants, 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 materialsusedtofabricatefixed dental prosthesis [25]. Recently, the use of additionsiliconeimpressions is escalateddue 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 thematerials which iscommonly used fordisinfecting dentalinstruments. It can be employed to eliminate a wide range of microorganisms, including tuberculosis and viral envelope [10]. Surfosept (Reza Rad Co, Iran)is another alcohol-baseddisinfectant material which is used for cleaning surfaces and objects. This substance is standardized by the European Medicines Agency (Standards EN 1040).

The effect of Deconex on the dimensional changes of impression materials has been investigated in some studies;however, there is no study assessing the dimensional changes in the casts disinfected by Surfosept material.Asdisinfecting dental impressionsis necessary, there is a need to investigate different disinfection materials and their effects on the characteristics ofimpression materials,especiallytheir dimensional changes. Therefore, this study was aimed to determine the effect of two substances (i.e., Surfosept and Deconex® 53) on the accuracy and dimensional stability of dental impressionsmade of addition silicones (i.e., Panasil®).

Material and Method

This in-vitro experimental study was performed on 30 casts. Samples were divided into one control group and two experimental groups to be disinfected by Surfosept and Deconex® 53 using a sequential sampling method (10 per group).

Impressions

The study included two upper and lowersections simulated based on anintraoral dentate situation (Figure 1). The lowersection had a metal base including two stainless steel dies with three degrees taper per each wall. One of the dieswas trimmed in a horizontal directionat the cervical region (2 mm)to create an undercutwithdepthof 1.5mm and 45 degrees angle. The metal basehad four guide bars to placing the upper section in an specified direction. The die base consisted of a metal plate with dimensions of 30mm width, 60mm height, and 15mm length. The upper section, which acted as a custom impression tray, was made of metal base with holesto provide retention for the impression material, andto reduce inter-section pressure. Additionally, it had 4 holes on 4 sides to holdthe base bars. This section had the same dimensions as the lower section but differed in height (12mm). The die base and the upper and lower sections were made of E.C.N, and the bars and bushes were made of B.O.Z.

Impression process and preparation of Bego Stone Samples

In this study, two units of putty were mixed with two units ofaccelerator. 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 onthe 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 thefinal setting time for the light-bodymaterial were150, 60-90, and 240sec, respectively.

The impressions were left in the room temperature for 30 min,for the rebound phenomenonto happen. In the next stage, the impression was pouredusing BegoStone type IV (Wilhelm Herbst Bremen; Germany). According to the guidelines50 gramof BegoStone was mixed with 10cc water at 23 °Cfor 30sec, andit was poured into the impressionin three minutes utilizingslow vibration. The cast was separatedfrom the impression after one hour (Figure 2).

Impression and Disinfectant Materials

Soft and lightPanasil® Putty, which areaddition-type silicone impression materialswere employed in this study. Deconex® 53 is adisinfectant 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 analcohol-based disinfectant which can be used for eliminating bacteria and viruses, such asinfluenza 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 impressions 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 dimentional 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 ofthe 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 ANOVAwas 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 diesare illustrated in Table 1. There were no significant differences among the control and two experimental groups in terms of the height of the dieswithout 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, regardingthe height of the dieswith undercut, the results revealed no significant

Figure 1. Upper and lower sections simulated based on an intraoral situation.

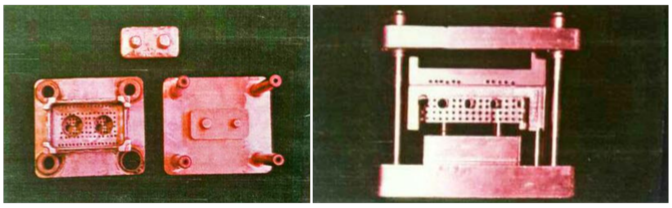

Figure 2. Impression steps: impression obtained from dies (top image), poured impression with BegoStone (bottom left), resulting casts (bottom right).

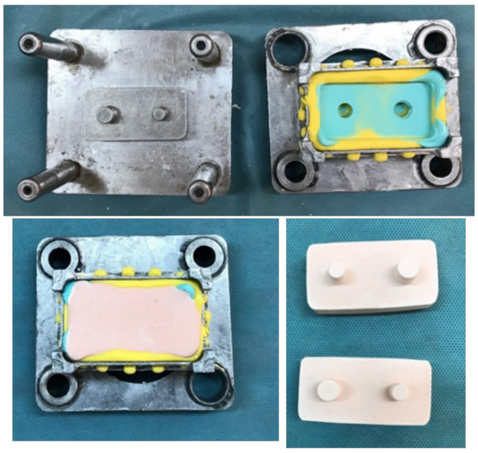

Figure 3. The height of the die without undercut (A), the diameter of the die without undercut (B), the distance between two dies (C), the diameter of the die with undercut (D), and the height of the die with undercut (E).

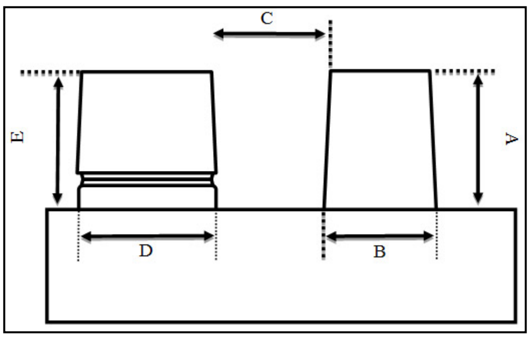

Table 1. The mean height and diameter of the die with and without undercut and distance between two dies.

Dimensions	Surfosept		Deconex		Control		F	P-value
	Mean	SD	Mean	SD	Mean	SD		
Height of the die without undercut (mm)	10.012	0.009	10.014	0.007	10.015	0.005	0.43	0.62
Height of the die with an undercut (mm)	10.012		10.014		10.015			0.62
Diameter of the die without undercut (mm)	8.016	0.005	8.012	0.004	8.035	0.005	62.723	>0.005
Diameter of the die with undercut (mm)	10.04	0.005	10.028	0.004	10.055	0.009	48.921	>0.005
Distance between two dies	21.739	0.033	21.749	0.023	21.75	0.055	0.258	0.77

Table 2. The mean difference of height and diameter of the die with and without undercut and distance between two dies.

Dimensions	Control -Surfosept		P-value	Control-Deconex		P-value	Surfosept- Deconex		P-value
	Mean difference	SD		Mean difference	SD		Mean difference	SD	
Height of the die without undercut (mm)	0.003	0.003	0.635	0.001	0.003	0.95	-0.002	0.003	0.81
Diameter of the die without undercut (mm)	0.019	0.002	>0.005	0.023	0.002	>0.005	0.004	0.002	0.18
Diameter of the die with undercut (mm)	0.015	0.003	>0.005	0.027	0.003	>0.005	0.012	0.003	>0.005
Distance between two dies	0.012	0.018	0.792	0.001	0.018	0.99	-0.010	0.018	0.82

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 dieswith 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,onthe impression materials made of Panasil®.

Hiraguchi et al. used Addition-type siliconesto assessthe dimensional changesof 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 findingwas in line with the results obtained from other similar studies [31] in which the use of addition silicone (i.e., Panasil®) was suggestedasa suitableimpression material.

In contrast to the condensation silicones, addition silicones are based on addition polymerization between divinylpolysiloxane and polymethylhydrosiloxane with a platinum salt as catalyst.Addition-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 cautionsince 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 Deconexdis infectant 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 Ghasemi et al., Deconex, Sodium hypochlorite (25.5%), and Epimax were utilized to disinfect impression materials [10]. According to the results, no significant difference was observed among the impressionsin 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 immersiontechnique. Additionally, the effect of immersion of polyvinylsiloxane 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 differencesbetween 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 impressionsfor8-10 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.

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