

Antimicrobial effects of SeptiTurbo, Deconex (Solarsept) and 0.525% sodium hypochlorite spray on alginate impression materials

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Objectives Dental impressions are among the potentially infectious items in dentistry. Dental impressions are invariably contaminated with saliva or blood. Such fluids may contain viral or bacterial pathogens including Bacteroides, Fusobacterium, Porphyromonas and Prevotella. The aim of this study was to assess the effects of three different types of disinfectants on alginate impression materials after one, three and five minutes.

Methods In this in vitro experimental study, 126 circular samples of alginate impression materials were contaminated with *Staphylococcus aureus* (*S. aureus*) and *Pseudomonas aeruginosa* and were then disinfected with 0.525% sodium hypochlorite, Deconex (Solarsept) and SeptiTurbo spray. Afterwards, the samples were wrapped in moist paper towels and kept in plastic bags for one, three and five minutes. Number of bacterial colonies was counted 24 hours after incubation. Negative and positive controls were included.

Results After five minutes, 0.525% sodium hypochlorite showed the highest disinfection activity against *S. aureus* as it eradicated over 99.98% of the bacteria. Although the disinfecting agents showed non-significant results in eradicating *S. aureus*, SeptiTurbo was more effective in elimination of *S. aureus*. The disinfection activity of different agents increased with time.

Conclusion This study revealed that alginate can be effectively disinfected with SeptiTurbo and sodium hypochlorite by the spraying technique. This study highlighted the efficacy of SeptiTurbo for eradication of *S. aureus*.

Keywords disinfection, alginates, sodium hypochlorite, anti-infective agents

Introduction

Dentists may be exposed to various microorganisms, originated from blood or saliva of patients. Denture molds contaminating the blood and saliva are major sources of infection.^{1,2} Thus, minimizing the spread of infection by disinfectants is one of the most important biosecurity measures. Increasing evidence shows that most of the dental impressions infected by various microorganisms may cause cross infection from patients to dental staff and also, to patients.^{3,4} The most frequently identified microorganisms are staphylococci, streptococci, Escherichia coli and Pseudomonas species.^{5,6} Since washing the impression materials with tap water only removes 40% of bacteria, American Dental Association advises all dentists to disinfect dental impressions.^{7,8} Although alcohols and aldehydes are the most common chemical disinfectants, some of these compounds cannot eliminate all types of bacteria and viruses; thus, selecting a strong antimicrobial compound is important.^{7,9} Immersion and spraying are two commonly used methods to disinfect dental materials.¹⁰ However, spraying is not capable of disinfecting all surfaces effectively and also cannot cover all undercuts. In disinfection by soaking, the disinfecting agent covers all surfaces of impression materials at once. Contrary to immersion, the spray technique can considerably reduce the amount of distortion.⁷ Based on the results obtained in previous studies,^{7,9} it is concluded that the antimicrobial effects of various disinfectants vary widely. In addition to effective antimicrobial activity, a disinfectant should cause no adverse effect on the surface features of impression materials.¹¹ SeptiTurbo® is an alcohol-based plus quaternary ammonium disinfectant (Behban Shimi co. Tehran, Iran) while Deconex® Solarsept is an alcohol-based disinfectant

(Borerchemie co. Zuchwil, Switzerland). In this study, three different disinfectants namely SeptiTurbo, Deconex (Solarsept) and 0.525% sodium hypochlorite were used to assess their disinfection efficacy against *Staphylococcus aureus* (*S. aureus*) and *Pseudomonas aeruginosa* (*P. aeruginosa*) contaminated dental impressions. The objective of this study was to compare the results with the standard specification to recommend a proper disinfection protocol for alginate impression materials.

Methods

Sample preparation

The present experimental study was carried out with the cooperation of Department of Microbiology of Tehran University of Medical Sciences and Shahed University aiming at evaluation of the antimicrobial efficacy of 0.525% sodium hypochlorite (Golrang, Tehran, Iran), Deconex (Borer chemie, Zuchwil, Switzerland) and SeptiTurbo (Behban Shimi, Tehran, Iran) for disinfection of alginate impression material (Acrogel, Tehran, Iran). In this study, 126 alginate samples were prepared. Six samples were selected as negative controls and were incubated on tryptic soy broth culture for 24 hours. The alginate impressions ($n = 126$) were randomly divided into three test groups (A, B and C, $n = 42$) for disinfection with the three disinfectants using the spraying technique. The control group was not disinfected. The 0.525% sodium hypochlorite, Deconex and SeptiTurbo were used to disinfect groups A, B and C, respectively for one, three and five minutes. Two samples were used as positive controls to detect possible microbial contamination.

Bacterial suspension preparation

By transferring one or two colonies of bacteria to TSB medium, the suspension was adjusted to 0.5 McFarland standard turbidity using a 600 nm spectrophotometer, which equaled 1.5×10^8 colony-forming units (CFUs)/mL.

Sample contamination

To evaluate the disinfection efficacy of the afore-mentioned substances, the samples were separately contaminated with microbial suspensions of *S. aureus* (ATCC 25923) and *Pseudomonas aeruginosa* (ATCC 27859).

Sample disinfection and microbiological assessments

Following exposure to microbial agents, all samples were rinsed with sterile distilled water for 15 seconds. In order to disinfect all samples, either 0.525% sodium hypochlorite, Deconex or SeptiTurbo was sprayed on each sample (10 puffs within 15 seconds). To remain moist, samples were placed in plastic bags containing a sterile moist cotton cloth for one, three and 10 minutes. After washing the samples with sterile distilled water for 15 seconds, they were immersed in 2% trypsin solution for 60 minutes. Using 100 μ L sampler, the samples were transferred to Mueller-Hinton agar. Twenty-four hours after incubation, *P. aeruginosa* and *S. aureus* bacterial colonies grown on the culture were counted. SPSS software version 20 (SPSS Inc., IL, USA) was used for data analysis and non-parametric Kruskal-Wallis test was used to compare the efficacy of different disinfectants.

Results

At one minute, the Kruskal-Wallis test results showed a significant reduction in *P. aeruginosa* colony count ($P < 0.001$).

At three minutes, the Kruskal-Wallis test results showed a significant reduction in *P. aeruginosa* colony count ($P < 0.001$).

At five minutes, the Kruskal-Wallis test results showed a significant reduction in *P. aeruginosa* colony count ($P < 0.001$).

As shown in Table 1, the disinfection efficacy of the three disinfectants against *P. aeruginosa* was significantly different after one, three and five minutes of exposure.

It was observed that 0.525% sodium hypochlorite was significantly more efficient in eradicating *P. aeruginosa* compared to the two other disinfectant agents. Also, SeptiTurbo showed a significantly higher disinfection efficacy in eliminating *P. aeruginosa* compared to Deconex.

Table 1. Kruskal-Wallis test results for bacterial disinfection efficacy of three different disinfectants against *Pseudomonas aeruginosa*

Time	0.5% Sodium Hypochlorite	SeptiTurbo	Deconex	P value
One minute	11.14(1.95) bc	104.28(17.42) ab	196.85(26.53) a	$P < 0.001$
Three minutes	3.14(0.89) bc	11(3.69) ab	29.42(9.89) a	$P < 0.001$
Five minutes	0.42(0.53) bc	2.14(1.21) ab	12.71(2.92) a	$P < 0.001$

The results of testing the bacterial disinfection efficacy of the three disinfectant materials at each time point were compared shown by English letters. The groups with different letters had significant differences.

Table 2. Kruskal-Wallis test results for bacterial disinfection efficacy of the three disinfectants against *Staphylococcus aureus*

Time	0.5% sodium hypochlorite	SeptiTurbo	Deconex	P value
One minute	16.28(2.21) ac	8(2.38) b	16(2.3) a	0.001
Three minutes	4.71(1.25) ac	2.71(1.38) bc	7.85(2.79) a	0.003
Five minutes	0.85(0.69)	1.14(0.89)	1.85(0.89)	$P > 0.05$

The results of testing the bacterial disinfection efficacy of the three disinfectant materials at each time point were compared shown by English letters. The groups with different letters had significant differences.

Table 3. Percentage of bacterial growth inhibition by different disinfectants after one, three and five minutes

Disinfectants	Time (minutes)	<i>Pseudomonas aeruginosa</i>	<i>Staphylococcus aureus</i>
Deconex	1	94.48%	99.55%
	3	99.17%	99.78%
	5	99.64%	99.94%
SeptiTurbo	1	97.08%	99.77%
	3	99.692%	99.92%
	5	99.94%	99.96%
0.525% sodium hypochlorite	1	99.68%	99.54%
	3	99.91%	99.86%
	5	99.98%	99.96%

The results of comparison of the bacterial disinfection efficacy of the three disinfectants at each time point are shown in Table 2.

At one minute, the Kruskal-Wallis test results showed a significant reduction in *S. aureus* colony count ($P < 0.001$).

At three minutes, the Kruskal-Wallis test results showed a significant reduction in *S. aureus* colony count ($P < 0.003$).

At five minutes, the Kruskal-Wallis test results showed no significant reduction in *S. aureus* colony count ($P > 0.05$).

However, statistically significant differences in antibacterial efficacy were noted only at durations of less than five minutes. The anti-bacterial efficacy of SeptiTurbo against *S. aureus* at three minutes was more than that of other disinfectants, and this difference was significant at one minute ($P < 0.05$).

Table 2 shows the bacterial disinfection efficacy of the three disinfectants after one, three and five minutes for *S. aureus*. As shown, there was no significant difference in the disinfection efficacy of the above-mentioned disinfectants at five minutes for *S. aureus*. At one and three minutes, there was a significant difference for all three disinfectants for *S. aureus*.

Table 3 shows the bacterial disinfection efficacy of the disinfectants for prevention of bacterial growth.

Discussion

In dental practice, dentists and dental staff are exposed to a large number of microorganisms, which are potentially harmful. Studies indicate that the surface of dental impressions is

contaminated with bacteria.^{12,13} Disinfection of impression materials is essential to control cross-contamination.¹⁴ Each saliva droplet contains more than 50,000 bacteria.¹⁵ Also, based on an experimental study conducted by Egusa et al,¹⁶ impressions contained many microorganisms such as streptococci, *S. aureus*, methicillin-resistant *S. aureus*, and *P. aeruginosa* with the percentage rates of 100%, 25%, 9% and 5.6%, respectively. These are potential pathogens that can be spread and transferred. The main reason for selection of *P. aeruginosa* and *S. aureus* in the current study was that these microorganisms are common opportunists, which can be easily spread.¹⁷ As impressions and occlusal records are thermal sensitive, chemical disinfection is still the common practicable procedure to eradicate microorganisms.⁹ Based on the study carried out by Badrian et al.,¹⁸ it was demonstrated that sodium hypochlorite can completely (99.99%) prevent the growth of *S. aureus*, and these results are in accordance with the results of the present study, as this disinfectant eliminated 99.98% of *S. aureus* count after five minutes. Also, Ghahramanloo et al.¹⁹ observed higher efficiency of sodium hypochlorite, compared to Deconex, in disinfecting alginate impressions, which were contaminated with the same microorganism as in the present study. In the study by Badrian et al,¹⁸ Deconex was shown to exert its effect mainly on *P. aeruginosa* so that after three and five minutes, 99.17% and 99.64% of *P. aeruginosa* were eliminated, respectively. Contrary to the results of the present study, in the study by Ghahramanloo et al,¹⁹ this agent was seen to be capable of eradicating only 70.4% of the tested bacteria. This difference in

antimicrobial activity can be explained by the use of a more resistant type of bacteria. Also, it was demonstrated that the disinfection capacity of Deconex increased with time. In a study by Hoseini et al,²⁰ it was reported that Deconex was quite effective against *P. aeruginosa* and *S. aureus*. In our study, for the first time, the antimicrobial activity of SeptiTurbo for impression materials was investigated. SeptiTurbo is a broad-spectrum alcohol plus quaternary ammonium compound-based product. The most important feature of SeptiTurbo is that it is highly biocompatible and does not make bacteria resistant to disinfectants. According to our results, SeptiTurbo disinfected the samples after three and five minutes with the percentage rates of 99.69% and 99.94%, respectively. Also, with increase in the contact time, its disinfection efficacy increased.

Conclusion

Based on the results of the present study, use of all three disinfectants by the spraying technique was effective for reducing the microbial load. The disinfection efficacy increased over time. Among different types of the disinfecting agents, SeptiTurbo and 0.525% sodium hypochlorite showed promising results after five minutes as they prevented *S. aureus* count by 99.96%.

Conflict of Interest

"None Declared." ■

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