

In-Vivo Evaluation of Impression Material Disinfection with Different Disinfectant Agents

Ölçü Maddelerinin Farklı Dezenfektan Ajanlarla Dezenfeksiyonunun In-Vivo olarak Değerlendirilmesi

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ABSTRACT

Aim: The purpose of the study was to evaluate the time dependent effects of disinfection agents on impression materials.

Materials and Methods: 20 children having prosthetic treatment needs participated in the study. 3 dental impressions with 30 min. intervals were taken from each patient with an irreversible hydrocolloid impression. Disinfection agents (7,5% Povidone Iodine (PI), 1% Sodium Hypochloride (SH)) were applied for 3 or 10 min. time schedules. The first impressions (control) were rinsed with 250 cc distilled water. The second impressions (1st group, n=20) were evaluated for 3 min. application time, randomly divided into two groups (n=10) according to disinfectant agents used. The third impressions (2nd group, n=20) disinfected for 10 min. with the same protocol. The microbiological samples were taken and colony forming units were counted.

Results: In the control group Coagulase-Negative Staphylococci, Corynebacterium Diphtheriae, Neisseria, α -Hemolytic Streptococci, Non-Hemolytic Streptococci and Bacillus species were detected. However negative cultures were taken from both 7.5% PI and 1% SH groups in 3 and 10 minutes time schedules.

ÖZET

Amaç: Bu çalışmanın amacı, ölçü malzemeleri üzerinde dezenfeksiyon ajanlarının zamana bağlı etkilerini değerlendirmektir.

Gereçler ve Yöntemler: Protetik tedavi ihtiyacı olan 20 çocuk araştırmaya dâhil edilmiştir. Her hastadan 30 dak. aralıklarla irreversible bir hidrokolloid ölçü materyali ile 3 adet diş ölçüsü alınmıştır. Dezenfeksiyon ajanları (%7,5 Povidon İyot (PI), %1 Sodyum Hipoklorid (SH)) 3 ya da 10 dakikalık zaman çizelgelerinde uygulanmıştır. İlk ölçüler (kontrol) 250 cc, distile su ile yıkanmıştır. İkinci ölçüler (1. grup, n=20) 3 dak. uygulama zamanında, dezenfektan maddelerin kullanımına göre rastgele iki gruba (n = 10) ayrılmıştır. Üçüncü ölçüler (2. grup n=20) aynı protokole 10 dak dezenfekte edilmiştir. Mikrobiyolojik örnekler alınarak koloni oluşturan birimler sayısal olarak hesaplanmıştır.

Bulgular: Kontrol grubunda Coagulase-Negative Staphylococci, Corynebacterium Diphtheriae, Neisseria, α -Hemolytic Streptococci, Non-Hemolytic Streptococci ve Bacillus türleri saptandı. Öte yandan 3 ve 10 dakikalık zaman çizelgelerinde uygulanan % 7.5 PI ve % 1 SH gruplarında negatif kültürler elde edildi.

Conclusions: It is concluded that 3 min. application of either with 7.5% PI or 1% SH was found sufficient for disinfecting impressions.

Sonuçlar: Üç dakikalık % 7,5 PI ve %1 SH uygulamalarının ölçü maddelerinin dezenfeksiyonunda başarılı olduğu sonucuna varılmıştır.

KEYWORDS

Disinfection, dental impressions, cross-contamination.

ANAHTAR KELİMELEER

Dezenfeksiyon, diş ölçüleri, çapraz kontaminasyon

INTRODUCTION

Cross-contamination is one of the most important subjects of the risk factors for dental professionals. Infection can be carried directly by blood or saliva and indirectly by the contaminated equipments, surfaces and airway. Contamination of the working atmosphere during the clinical practice of dental clinics or laboratories creates risks to the health of professionals¹⁻³. It is identified that 21 genera of bacteria is identified to have comprised of comprising about 60 species from the oral cavity. So it can be estimated that there may be over 200 different species that can be isolated from dental plaque alone⁴. Yumul et al.⁵ exhibited a high prevalence of *Staphylococcus aureus*, *Escherichia coli* and *Candida albicans* germ carriers in the oropharyngeal cultures of 4-15 aged children. To minimize the risk of cross contamination in the dental office specific recommendations have been issued by professional agencies^{6,7}. Although the sterilization and disinfection rules were carefully followed in clinical dental practice, carrying pathogen microorganisms from oral cavity to laboratory and clinical areas is generally ignored. Transfer of microorganisms from impressions to the casts is a well known way of cross-contamination in clinical practice⁸.

To address these cross-contamination concerns, the American Dental Association (ADA) issued guidelines for disinfecting impressions in 1988, 1991, and the last in 1996 recommending the use of an ADA-accepted spray or disinfectant agents no more than 30 minutes depending on the material^{9,10}. The accepted disinfecting technique should not adversely affect the dimensional

stability or surface details of the impression but should be adequate. The spray technique shows a similar antimicrobial activity compared to the immersion method and does not affect the dimensional stability as the process of immersion^{9,11}. However according to Mathyas et al.¹² and Dellinger et al.¹³ there is no difference between these methods related with a disinfecting time of 10 minutes.

ADA guidelines state that the impression should be rinsed to remove saliva, blood and debris, followed by immersion in a disinfecting product, such as hypochloride, iodine, glutaraldehyde or phenol. And the recommended exposure time for most surface disinfectants is 10-15 minutes^{2,14}.

The efficiency of disinfection methods and their adverse effects on the materials are being evaluated since 1974³. Most of the studies on impression disinfection focused on the dimensional changes and surface details^{3,10,14,15}. In an in-vitro study Lu JX et al.¹¹ found no dimension deformation on the Silicone rubber, Irreversible Hydrocolloid and Zinc-oxide-eugenol (ZOE) impression material surfaces disinfected with 7.5 % Povidone Iodine and 1 % Sodium Hypochloride. The use of glutaraldehyde or iodine is indicated for ZOE impression disinfection. For irreversible hydrocolloid impressions hypochloride, iodine or glutaraldehyde is recommended^{14,16}.

Blair et al.¹⁷ stated that disinfection of impression materials have been performed mostly by rinsing with water while practitioners who use a disinfection solution prefer 1 % Sodium Hypochloride for 10 minutes because of its cost effect and easy use. Silva et al.³ revealed that to wash

with water removes most of the contamination but is not enough to eliminate all the contaminants, then concluded using the 1 % concentration of Sodium Hypochloride for 10 minutes has a medium level action. Merchant et al.¹⁸ stated that the 0.5 % concentration of Sodium Hypochloride is enough to disinfect several impression materials. Blair et al.¹⁷ have suggested that all kind of impressions should be immersed in 1 % Sodium Hypochloride for 10 minutes.

Kugel et al.⁹ showed in their study on 400 U.S Dental laboratory that dentists and labs disinfect impressions for longer than recommended durations, besides having a lack of knowledge about the disinfecting procedures for impressions. Al-Omari and Al-Dwairi¹⁹ stated that only 18 percent of the private sector dentists' disinfected impressions before sending to dental labs while dental staffs in hospitals and dental schools are more likely to adhere the Infection Control Programs.

However investigators are in agreement that in-vitro studies have limitations and evaluations according to an ADA specification will not exactly simulate the clinical evaluation²⁰. As most of the studies²¹⁻²³ on impression material cross contamination used in-vitro methodologies, the aim of this study is decided to be to investigate the time dependent effects of disinfection agents on impression materials in-vivo, for realistic evaluation.

MATERIALS AND METHODS

The study was carried out on 20 healthy children, ages between 6-10 years, who had prosthetic treatment needs. Informed consents of the parents were taken before the study. Children included the study were in mixed dentition period, had extracted tooth and did not have more than 4 caries. The children were admitted as caries active patients, because of the extracted and caries effected tooth numbers increased in one year. All extractions and dental treatments were finished before the prosthetic procedures. They were asked not to use any antibiotics and addi-

tional fluoride for two weeks, before the study.

Three dental impressions with 30 minutes intervals were taken from each patient with an irreversible hydrocolloid impression material (CAVEX CA37 Alginate, Harleem, Holland) as a similar microbiological methodology of Meiller et al.²⁴. For both of the experimental groups allocated according to the disinfection agents' application time of 3 or 10 min., the initial dental impressions were rinsed with 250 cc distilled water without any disinfecting procedure, assigned as control group (n=20).

Following a 30 minute time interval the second dental impressions were taken, rinsed with 250 cc distilled water and evaluated as group I for 3 minutes application time (n=20) which was randomly divided into two groups ($n_1=10$) and ($n_2=10$) according to disinfectant agents used. 10 samples were plunged into the vessels containing 7.5 % Povidone Iodine (Polyod, Drogosan, Turkey) solution for 3 minutes whereas 10 samples were plunged into the vessels containing 1 % Sodium Hypochloride solution for 3 minutes before microbiological samples were taken from each impression to determine the cross-contamination risk.

After another 30 minute interval the third dental impressions forming group II for 10 minutes application time (n=20) were taken, rinsed with 250 cc distilled water and disinfected in two groups with the disinfectants used above.

All the samples were settled in the sterile vessels with 250 mL 0.5 % Sodium Thiosulphate using as naturalization solution to constitute the microorganisms homogenous means with using vibration machine (PSU 2/2 mini-shaker BOECO, Germany) in 60 seconds. 1 mL of the specimens were taken from the homogen fluids carried into the sterile tubes containing 1 mL sterile saline solution.

Microorganism Counting

Microbiological samples were transferred to the laboratory within an hour. 20 mL of samples

which have been taken with automatic pipettes from the sterile tubes containing homogenous microorganism solution were inoculated in Petri dishes with 5 % Sheep Blood Agar and incubated at 37°C for 48 hours. After incubation, colonies were quantified with a stereoscopic microscope (Stemi SV6) and their macroscopic characteristics were recorded. Grown bacteria and morphology of the colonies were classified by using conventional methods according to catalase and coagulase examination reports. And the results were expressed as colony forming units (CFUs) $\text{CFU} \times 10^3/\text{mL}$.

RESULTS

In Group I and Group II control samples of 10^2 - 10^5 growing microorganism colonies were detected. According to the results of the colony quantification microorganisms like *Coagulase-Negative Staphylococci* (CONS), *Corynebacterium Diptheriae*, *Neisseria*, α -Hemolytic *Streptococci*, *Non-Hemolytic Streptococci* and *Bacillus Spieces* were observed (Table I,II). Growth of microorganism cultures of control group samples was shown in Figure I,II,III and Figure IV.

For both Group I and Group II experimental samples, no microorganism colony growth

TABLE I

<i>Microbiological findings for Group I (3 dk).</i>																			
	CONS			Diptheroid			Neisseria			α -Hemolytic Streptococci			Non-Hemolytic Streptococci			Bacillus types			
	C	PI	SH	C	PI	SH	C	PI	SH	C	PI	SH	C	PI	SH	C	PI	SH	
1.Patient	++			+															
2.Patient							+	+											
3.Patient	+																		
4.Patient										+									
5.Patient	+++																		
6.Patient	+																		
7.Patient																			
8.Patient	+																		
9.Patient	+																		
10.Patient	+									++									

(C=Control, PI=Povidone Iodine, SH=Sodium Hypochloride)

TABLE II

Microbiological findings for Group II (10 dk).																		
	CONS			Diptheroid			Neisseria			α-Hemolytic Streptococci			Non-Hemolytic Streptococci			Bacillus types		
	C	PI	SH	C	PI	SH	C	PI	SH	C	PI	SH	C	PI	SH	C	PI	SH
1.Patient																		
2.Patient	+			+						+								
3.Patient	+++			+														
4.Patient													+					
5.Patient	+												+++					
6.Patient				+														
7.Patient													+					
8.Patient				+						++			+			++		
9.Patient	++			+														
10.Patient	+									+								

(C=Control, PI=Povidone Iodine, SH=Sodium Hypochloride)



FIGURE 1

Samples of growth microorganism cultures



FIGURE 3

Samples of growth microorganism cultures



FIGURE 2

Samples of growth microorganism cultures

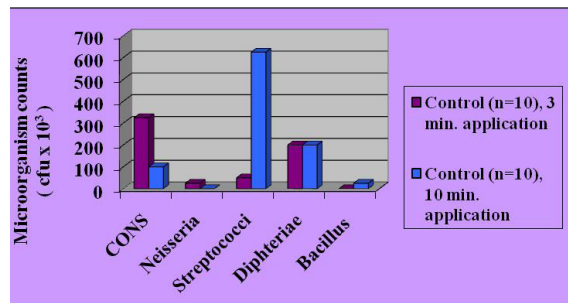


FIGURE 4

Means of the microorganism counts for the control group samples according to disinfectant application time

was observed. Because there was no countable growing microorganisms were detected in experimental groups, no statistical analyses were performed.

DISCUSSION

Dental professionals are normally exposed either directly or indirectly to a variety of microorganisms during routine practice. The concept of universal precaution is advocated because not all patients but especially children with infectious

diseases can not be identified by any medical history or physical examination. Therefore it is important to prevent cross-contamination at every dental step of procedures. Dental impressions can act as a vehicle for the transmission of infectious agents to dental personnel¹⁷. Several studies have exhibited that the laboratories and departments of Pedodontics and Orthodontics could use different solutions and regimes for disinfecting the same impression materials and disinfect impressions for longer than the recommended durations^{9,17}.

Although the ADA and dental literature provide guidance about how specific impressions should be disinfected, there is not a definite and universal answer to the easiest way of impression disinfection. The results of many studies exhibited that washing impressions is not sufficient to clear away the saliva and blood contaminants^{14,16,19}. Effective infection control procedures should be established to reduce cross-contamination including the disinfection of all impressions prior to delivery to dental laboratories. Conventionally used impression materials such as reversible and irreversible hydrocolloids, polyethers and some addition silicone materials are more hydrophilic in nature¹⁰. Investigators revealed that hydrophilic reversible and irreversible hydrocolloids were the most bacteria retaining materials after impression, and have a significantly higher risk level of contamination^{3,22-25}. For irreversible hydrocolloid impressions generally hypochloride, iodine or glutaraldehyde is recommended^{13,17,9,16,19,22}. In-vitro studies with these disinfectant agents show relatively few problems like loss of dimensional accuracy and surface details in connection with impression disinfection^{3,15,17,26}. In the light of the above studies 7.5 % Povidone Iodine and 1 % Sodium Hypochloride were selected for this study as their dimensional accuracy and disinfection activity were known.

However the results of experiments clearly indicated that the effect of disinfectant agents on dimensional accuracy of all kind of impressions is related with contact time. The ADA recommends a ten-minute immersion in a 1:10 dilution (0.525 %) of Sodium Hypochloride solution for disinfection of irreversible hydrocolloid impressions²². At last years The British Dental Association (BDA), in calibration with the British Dental Trade Association (BDTA) and the Dental Laboratories Association (DLA), have changed their recommendations for impression disinfections according to contact time. An exposure time of 10 minutes is recommended when using 1 % Sodium Hypochloride with reversible hydrocolloids, polyether or irreversible hydrocolloids. Impressions should be washed in tap water, dipped in

1 % Sodium Hypochloride, rinsed again, given a second dip in hypochloride, kept 10 minutes under hypochloride-dampened gauze, and finally given a second rinse in tap water. While many dental hospitals consider that impression disinfection is the laboratory's task, the BDA-BDTA-DLA recommendations clearly share the responsibility with the dentist¹⁷. However the protocol could be unpractical for busy clinics as it has many steps and relatively long time period. In this study looking for a more practical alternative, the effectiveness of well known disinfectants on two different time scales was evaluated. Reducing the immersion time can also minimize changes in physical properties like dimensional stability and surface integrity of impressions

In most studies microbial cross contamination was evaluated with the selected microorganisms and the effect of disinfectant related with time on in-vitro models²⁰⁻²². Memarian et al.²² stated that sodium hypochloride concentrations of 0.6 % and higher can disinfect microorganisms like *Streptococcus sanguis*, *Streptococcus pyogenes*, *Streptococcus agalactiae*, *Staphylococcus aureus*, *Staphylococcus epidermidis* and *Pseudomonas aeruginosa* on irreversible hydrocolloid impressions in 2 minutes. However they were inoculated on in-vitro impression model with selected microorganisms from the Persian Type Culture Collection (PTCC). Schwartz et al.²⁷ have also reported a 99.99 % reduction of bacteria on irreversible hydrocolloid impressions when the contaminated materials were immersed in a 0.5 % Sodium Hypochloride for 10 minutes. Best et al.²⁸ have reported 80 % reduction of *M.tuberculosis* when a 1 % Sodium Hypochloride was used for one minute. Jennings et al.²⁹ have reported reduced CFUs of *Pseudomonas aeruginosa* and *Candida albicans* when contaminated impression materials were disinfected with a 0.0125 % solution of Sodium Hypochloride for 30 seconds. But in fact there are more microorganism species present on the buccal mucosa, oropharyngeal mucosa, oral surfaces and saliva than the selected ones of the above studies^{4,5}.

Our results were in agreement with Blair et al.¹⁷ and Memarian et al.²² who observed that washing the impressions only with tap water did not clear away the saliva and blood contaminants and could cause cross-contamination. According to the results of our study, 10^2 - 10^5 growing microorganism colonies such as *Coagulase-Negative Staphylococci* (CONS), *Corynebacterium Diphtheriae*, *Neisseria*, *α -Hemolytic Streptococci*, *Non-Hemolytic Streptococci* and *Bacillus types* were observed in control samples, whereas no growing bacteria colonies were detected when 7.5 % Povidone Iodine or 1 % Sodium Hypochloride were used for impression disinfection. The study exhibited that detected microorganisms can create a risk for cross contamination during laboratorial stages by using an in-vivo realistic methodology.

CONCLUSIONS

The study showed that to rinse impression materials only with water before casting is not an effective method for preventing cross-contamination. Such a short time of 3 min. application of either with 7.5% PI or 1% SH was found sufficient for disinfecting impressions. In routine dental practice the disinfection process of impression materials in a short period of 3 minutes can be a practical, easy and an effective method for clinicians.

Clinical Significance: Disinfecting impressions in a short period of 3 minutes as being a very practical method will stop the cross-contamination and spreading of the infections in dental profession.

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