Antimicrobial Effect of 4 Disinfectants on Alginate, Polyether, and Polyvinyl Siloxane Impression Materials

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Purpose: Dental impressions often carry microorganisms that may cause cross infection from patients to dental staff. The aim of the current study was to determine the effectiveness of 4 different disinfectant solutions on 3 commonly used impression materials—alginate, polyether, and polyvinyl siloxane—to establish a protocol for disinfection of these impression materials after clinical exposure and prior to handling in the dental laboratory. ***Materials and Methods:*** A total of 45 impressions were taken from the maxillary dentate arches of 15 dental staff participants at the Department of Dentistry, Prince Rashid Hospital, Irbid, Jordan. For each participant, 3 successive impressions were recorded in the different impression materials. For each impression, 6 specimens were dissected from 6 different locations and exposed to 6 different regimens: 1 was left untreated, 1 was immersed in sterile water for 10 minutes to serve as a control, and the remaining 4 specimens were exposed to 4 different disinfection treatments (Dimenol, Perform-ID, MD 520, and Haz-tabs). Serial dilutions of the suspension were carried out and counted by the Miles-Misra technique (inoculation on Columbia blood agar for quantification). The dilutions were aerobically incubated at 37°C for 48 hours. ***Results:*** The disinfectants were able to completely eliminate microorganisms carried by the impressions. For those undisinfected specimens, the results showed that untreated alginate impressions appear to carry more microorganisms ($P < .05$) than the other 2 rubber impression materials used in the study. For those specimens immersed in sterile water for 10 minutes (control group), the number of microorganisms eliminated was increased from 62% to 90% compared to those left untreated. ***Conclusion:*** Impression materials may act as a vehicle for the transfer of microorganisms from the patient's mouth to dental personnel. Impressions should be disinfected to eliminate the risk of cross contamination. *Int J Prosthodont 2007;20:299–307.*

The increased awareness of the dangers of cross contamination with hepatitis B virus (HBV) and human immunodeficiency virus (HIV) during dental procedures is having a growing impact on attitudes toward infection control in the dental clinic and laboratory.[1]

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Effective infection control during dental surgery and laboratory work has been mandated to reduce the potential for disease transmission. Dental clinicians, dental assistants, laboratory technicians, and any other employees in dental health care fields must protect themselves against the possibility of infection transmission by implementing conscientious and consistent barrier control.

The principal potential route of transmission from the patient to the dental clinician is through contaminated impressions and prostheses. It has been demonstrated that microorganisms can be recovered from impressions made of dental molds experimentally inoculated with bacteria.[2]

Although currently available guidelines issued by different organizations are in general agreement on the procedures being adopted during the prosthodontic

management of known high-risk patients, some inconsistency exists regarding the recommendations for handling impressions made for patients having no known history of exposure to HBV or HIV.

The British Dental Association maintains that the only safe approach to routine treatment is to assume that every patient may be a carrier of an infectious agent, and thus recommends that impressions be rinsed thoroughly and that technicians wear gloves when handling them.[3] The Federation Dentaire Internationale stated that all patients' prostheses should be cleaned and disinfected before delivery to the laboratory.[4] Similarly, the American Dental Association (ADA) recommends chemical disinfection of all impressions and prostheses.[5]

Disinfection of dental impression materials can be carried out in 2 ways: immersion in or spraying with a disinfectant. Immersion disinfection is based on the assumption that immersion is more likely to expose all surfaces of the impression to the disinfectant for the recommended time.[6] Spraying disinfection onto the surface of an impression reduces the chance of distortion but may not adequately cover areas of undercut.[7]

It has been suggested that dental impressions may transmit a variety of microorganisms from the oral cavity, and that casts poured from impressions may also harbor infectious microorganisms that can be distributed throughout the laboratories when casts or dies are handled.[8–10]

Disinfection is generally a less lethal process than sterilization. It eliminates virtually all recognized pathogenic microorganisms, but not necessarily all microbial forms such as spores.[11] It can be accomplished by using a chemical disinfectant, which must be effective in killing vegetative forms of pathogenic organisms, including influenza, enteroviruses, and tubercle bacillus within 30 minutes.[12]

Before any disinfection procedure is carried out, a thorough rinsing of the impression is necessary to remove blood, saliva, and debris that may prevent exposure of the impression surface to the disinfectant. Rinsing after disinfection is also necessary to remove residual disinfectant that may affect the surface of the stone cast.[13] It is not sufficient to simply rinse the impressions with water without further disinfection procedures, since viruses seem to be absorbed into the impression materials and are not eliminated simply by rinsing in running water.[14] It has been reported that washing the impression materials with water alone removes only 40% of bacteria and should be regarded as merely a gross decontamination.[15] However, another study reported that washing the impressions with water for 15 seconds reduces contamination by approximately 90%.[16] On the other hand, it has been suggested that impressions must be disinfected immediately after their removal from the mouth without being rinsed or washed to reduce the risk of cross contamination.[17]

A variety of chemicals are marketed as agents suitable for the disinfection of dental impressions. However, not all impression materials are compatible with all types of disinfectants, and some of these disinfectants may affect crucial qualities of the impression material, altering surface detail reproduction, surface roughness, and dimensional stability.

This study aimed to establish a protocol for disinfection of commonly used impression materials after clinical exposure and prior to handling in the dental laboratory.

The purposes of this study were to *(1)* demonstrate the potential for cross infection with microorganisms from 3 impression materials; *(2)* evaluate the effect of simple rinsing of the tested impressions in sterile water on the amount of bacteria; and *(3)* determine the antimicrobial efficacy of 4 disinfectants on 3 of the more commonly used impression materials: alginate, polyether, and polyvinyl siloxane (PVS).

Because disinfectants must be effective in eliminating microbes without negatively affecting the physical properties of the impression materials themselves, a parallel study investigated the effect of the selected disinfection regimens on the dimensional accuracy of impression materials and resultant gypsum casts recovered from these impressions.[18]

Materials and Methods

This study was carried out in the Department of Dentistry, Prince Rashid Hospital, Irbid, Jordan. Forty-five maxillary impressions were taken from 15 dentate dental staff participants (8 men, 7 women; age range: 23 to 38, mean age: 30.0 $\pm$ 3.6 years). For every participant, 3 successive impressions were taken: 1 in alginate, 1 in PVS, and 1 in polyether impression materials (Table 1). To eliminate the risk of removing plaque and associated microorganisms during impression taking, a period of 2 weeks was given between the impressions for every participant.

Preparation of the Impressions

The alginate material was hand mixed to a homogenous consistency for 30 seconds using a plastic spatula. A perforated plastic impression tray was loaded with the alginate impression material and transferred to the mouth. The impression was separated from the mouth 3 minutes after the start of mixing. The impression was placed in a tightly sealed plastic bag for 10 minutes, which was the standardized time for all alginate impressions because it was needed to take each impression to the microbiology laboratory.

Table 1 Impression Materials Used in the Study

Material	Trade name	Viscosity	Technique	Mixing time (s)	Setting time (min)	Manufacturer
Alginate	Bluemix	Regular	Single mix	30	3	Minerva
Polyether	Impregum F	Regular	Single mix	45	5	3M ESPE
Polyvinyl siloxane	Silapress	Light and putty	Double mix	45	7	Minerva

The polyether impression material was supplied in a single viscosity. According to the manufacturer's instructions, this material should be used with nonperforated, closely fitting custom trays. Custom trays were constructed using autopolymerizing acrylic resin (Meadway, Dental Supplies).

The polyether impression material (base and catalyst) was mixed according to the manufacturer's instructions for 45 seconds. Each custom tray was loaded with the homogenous mix, inserted into the patient's mouth, and allowed to set for 5 minutes before removal. After full setting, each impression was removed from the mouth and stored in a tightly sealed plastic bag for 30 minutes to ensure that polymerization was complete. This time was enough to send the impressions to the microbiology laboratory.

PVS, hydrophilic, addition-cured silicone impressions were taken using the double-mix technique. Perforated, spaced plastic trays, similar to those used with the alginate impressions, were used. To increase the bond between the tray surface and the impression material, a silicone adhesive supplied by the manufacturer was applied in a thin layer onto the trays and left to dry for 5 minutes before taking the impressions.

PVS putty was used as the first mix, with equal volumes of base paste and catalyst paste proportioned using spoons supplied with the material by the manufacturer and then mixed together for 45 seconds until a homogenous mix was obtained. After loading, the tray was seated and held in the patient's mouth for approximately 5 minutes until the material set. The impression was then removed from the mouth. Light-body PVS was used as a second mix to record fine details of the maxillary teeth and the surrounding tissues. Equal volumes of base paste and catalyst were mixed together using the automixing cartridge system to provide a homogenous mix. The tray was loaded with the light body mix, inserted again into the mouth, and allowed to set for 2 minutes before removal. After full setting, each impression was removed from the mouth and stored in a tightly sealed plastic bag for 30 minutes to ensure that polymerization was complete. The impressions were taken to the microbiology laboratory within this period of time. To reduce the risk of environmental contamination, each impression was placed in a sterile petri dish and contained in a Class 1 safety cabinet.

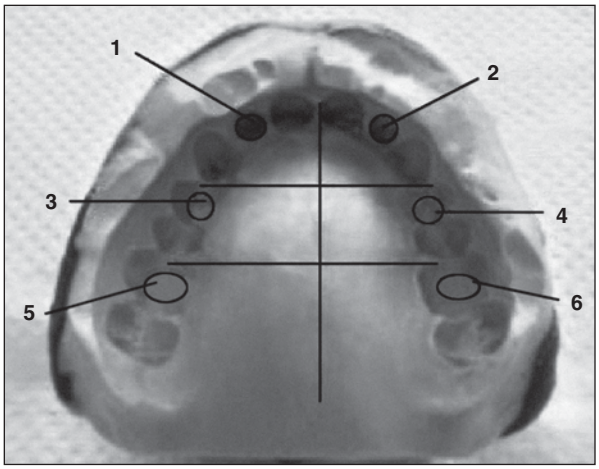

Fig 1 Distribution of specimen sites for each impression: 1 and 2 = imprints of lateral incisors; 3 and 4 = imprints of first premolars; 5 and 6 = imprints of first molars.

Sample Preparation

Sample preparations were obtained 10 minutes after taking the alginate impressions and 30 minutes after taking the polyether and PVS impressions. Each impression was dissected into 6 sections produced by 1 vertical cut along the midline (dissecting it into right and left halves) and 2 horizontal cuts (dissecting it into anterior, middle, and posterior) using a sterile surgical blade. A fresh blade was used to prepare each sample. The 6 specimens were taken from the different sections: 2 specimens from the imprints of the maxillary first molars, 2 specimens from the imprints of the maxillary first premolars, and 2 specimens from the imprints of the maxillary lateral incisors (Fig 1).

Specimens were exposed to 6 different regimens, and the selected specimen sites were changed for each impression to ensure variation between sites and treatments to allow randomization. Each separate section was placed in a sterile universal container clearly labeled with the name of the selected treatment regimen and the source of the sample.

Table 2 Disinfectant Solutions Used in the Study

Solution	Composition	Concentration	Method of disinfection	Time (min)	Manufacturer
Dimenol	Isopropyl alcohol, ampholytic surfactant, excipient	Full strength	Spraying	15	Septodont
Perform-ID	Potassium-peroxomonosulfate, sodium benzoate, tartaric acid	2%	Immersion	10	Schülke and Mayr
Haz-tabs	Sodium dichloroisocyanurate	10,000 ppm available chlorine	Immersion	5	Guest Medical
MD 520	Glutardialdehyde, alkylbenzyl-dimethyl, ammonium chloride, antifoaming complexing agents	Full strength	Immersion	5	Dürr

Table 3 Comparison of the Efficacy of the Different Regimens on the Impression Materials: Mean (SD) No. of Microorganisms

	Impression material		
Treatment	Alginate	Polyvinyl siloxane	Polyether
Undisinfected			
Untreated	6.11×10^7 (1.65×10^7)	8.26×10^5 (1.48×10^5)	1.25×10^6 (1.39×10^5)
Controls	2.35×10^7 (2.17×10^7)	8.50×10^4 (1.25×10^4)	1.85×10^5 (1.42×10^4)
Disinfected			
MD 520	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Perform-ID	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Haz-tabs	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Dimenol	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)

For each impression, the treatment regimens were as follows: 1 specimen was left untreated to evaluate the amount of microorganisms carried by the impression, 1 specimen was stored in sterile water for 10 minutes to serve as a control, and the remaining 4 specimens were subjected to 4 different disinfection treatments. The disinfectants used in this study were Dimenol, Perform-ID, MD 520, and Haz-tabs (Table 2). For the sprayed samples, "contact time" refers to the time after spraying when the samples were stored in a moist, sealed container. Disinfection was performed at room temperature using a fresh solution for each impression. Control specimens were immersed in sterile water for 10 minutes.

Microbiologic Methods

Following exposure to the treatment regimens, each sample of the impression material was drained and then vortexed for 60 seconds to remove any suspended microorganisms contaminating the samples. Serial dilutions of 10^3, 10^4, 10^5, and 10^6 of this suspension were prepared for inoculation on Columbia blood agar for quantification after the method of Miles and Misra.[19] The dilutions were incubated aerobically at 37°C for 48 hours. Colonies were counted under magnification using an Andaman colony counter and calculated according to the formula:

$$N = m \times 1/q \times d$$

where N is the number of microorganisms in the original suspension, m is the applied microorganism number, q is the quantity of inocula inoculated on the dry surface of the agar plate, and d is the reverse logarithm of dilution. Counts were expressed as colony-forming units (cfu) per milliliter of the original vortex suspension.

Statistical Analysis

All statistical analyses were performed with SPSS 10.0 software (SPSS). Analysis of variance (ANOVA) was used to detect the effect of disinfection treatment of the different impression materials on the bacterial counts of the microorganisms for each participant. Two-way ANOVA showed an interaction between the undisinfected specimens (control and untreated) and the impression materials (alginate, polyether, and PVS); thus, 1-way ANOVA was performed at the level of undisinfected specimens for each impression material. Statistical significance was set at $P < .05$.

Results

Table 3 shows the average number of microorganisms retained by specimens dissected from the different impression materials and exposed to the different regimens.

Table 4 Two-Way Analysis of Variance of the Count of Microorganisms Recovered from the Treated Specimens of Different Impressions for Each Participant

	Sum of squares	*df*	Mean square	F*	*P*
Impression	6.55×10^{14}	2	1.39×10^{14}	5.47	.0045
Treatment	7.06×10^{14}	5	2.17×10^{14}	142.86	.000
Residual	3.93×10^{14}	262	1.87×10^{14}		
Total (corrected)	1.75×10^{15}	269			

*All F ratios are based on the residual mean square error.

Table 5 Least Square Means of the Count of Microorganisms for Each Participant (95% Confidence Interval)

	Count (cfu/mL)	Mean	SE
Total	270	4.04×10^{6}	
Material			
Alginate	90	1.41×10^{7}	3.49×10^{6}
Polyether	90	2.31×10^{6}	3.29×10^{4}
Polyvinyl siloxane	90	1.52×10^{5}	3.04×10^{3}
Treatment			
Untreated	45	1.46×10^{7}	2.07×10^{4}
Control	45	5.23×10^{6}	1.59×10^{3}
MD 520	45	0.00	0.00
Perform-ID	45	0.00	0.00
Dimenol	45	0.00	0.00
Haz-tabs	45	0.00	0.00

Table 6a Multiple Range Test of the Count of Microorganisms for Each Participant by Impression Material

Impression	Count (cfu/mL)	LS mean	LS sigma	Homogeneous groups	
Alginate	90	1.41×10^{7}	3.49×10^{6}	X	
Polyether	90	2.31×10^{6}	3.29×10^{5}		X
Polyvinyl siloxane	90	1.52×10^{5}	3.04×10^{5}		X

LS = least square.

Table 6b Between-Group Results of the Multiple Range Test of the Impression Materials

Contrast	Difference	± limits
Alginate–Polyether	$*1.18 \times 10^{7}$	3.16×10^{6}
Alginate–Polyvinyl siloxane	$*1.40 \times 10^{7}$	3.19×10^{6}
Polyether–Polyvinyl siloxane	2.16×10^{6}	2.50×10^{4}

*Statistically significant difference.

The results showed that no growth was observed from any sample of impression materials treated with any disinfectant regimens under investigation. Statistical analysis was therefore unnecessary. This is in marked contrast to those samples in the undisinfected (untreated and control) specimens, where all samples produced growth.

Two-way ANOVA showed a significant difference between the effects of the treatment regimens for each impression material (Table 4).

The analyses were carried out by choosing type III sum of squares where the contribution of each factor was measured by removing the effects of all other factors. These factors showed a statistically significant effect on the count of microorganisms for each participant ($P < .05$; 95% confidence interval) (Table 5).

Multiple range tests were used to determine which means were significantly different from the others regarding the count of microorganisms for each participant by impression material (Tables 6a and 6b) and treatment (Tables 7a and 7b) at a 95.0% confidence interval.

One-way ANOVA was performed to compare the mean values of the counts of microorganisms for the undisinfected control and untreated specimens for each impression material (Table 8).

Comparing the microbial concentration in 15 subjects, the results showed that alginate specimens in the control group had a marked reduction (38.5%) in microbial growth compared with the untreated specimens. Similarly, 14.8% of the average number of microbial growth was retained by polyether impression specimens in the control group. PVS impression control specimens retained the lowest number (10.3%) of microbial growths.

The results also demonstrated a significant difference in the level of contamination in the control groups between alginate and PVS and between alginate and polyether impression materials. Alginate produced between 71 and 926 (mean: 286) times more microor-

Table 7a Multiple Range Test of the Count of Microorganisms for Each Participant by Treatment

Impression	Count	LS mean	LS sigma	Homogeneous groups
Disinfected				
D1	45	0.00	0.00	X
D2	45	0.00	0.00	X
D3	45	0.00	0.00	X
D4	45	0.00	0.00	X
Undisinfected				
Untreated	45	1.46×10^7	2.07×10^4	X
Controls	45	5.23×10^6	1.59×10^3	X

LS = least square.

Table 7b Between-Group Results of the Multiple Range Test of the Treatment Regimens

Contrast	Difference	± limits
Between disinfectants	0.00	0.00
D1, D2, D3, D4–Untreated	$*-1.46 \times 10^7$	2.07×10^4
D1, D2, D3, D4–Controls	$*-5.23 \times 10^6$	1.59×10^3
Untreated–Controls	$*9.37 \times 10^6$	1.91×10^4

*Statistically significant difference.
D1 = MD 520; D2 = Perform-ID; D3 = Haz-tabs; D4 = Dimenol.

Table 8 One-Way Analysis of Variance of the Count of Microorganisms Recovered from the Undisinfected Specimens of Different Impressions for Each Participant

	Sum of squares	*df*	Mean square	F*	*P*
Alginate					
Between groups	4.35×10^{15}	13	2.17×10^{14}	164.83	.000
Within groups	3.27×10^{15}	1	1.39×10^{14}		
Total (corrected)	7.62×10^{15}	14			
Polyether					
Between groups	5.88×10^{13}	13	4.52×10^{12}	127.841	.0069
Within groups	3.54×10^{10}	1	3.54×10^{10}		
Total (corrected)	5.88×10^{13}	14			
Polyvinyl siloxane					
Between groups	1.02×10^{12}	13	7.84×10^{10}	138.230	.041
Within groups	2.20×10^{11}	1	2.20×10^{11}		
Total (corrected)	1.24×10^{12}	14			

ganisms than PVS and between 37 and 429 (mean: 127) times more microorganisms than polyether impression material ($P < .05$). However, the differences in bacterial growth between polyether and PVS impressions were insignificant. Polyether impression specimens produced between 1.7 and 3.3 (mean: 2.18) times more microorganisms than PVS impression specimens.

Similarly, the untreated specimens showed significant differences between alginate and polyether and between alginate and PVS impression materials. Alginate specimens retained an average of 49 and 74 times more microorganisms than polyether and PVS, respectively. However, similar to the control specimens, the differences between the 2 rubber impression materials were insignificant. Polyether specimens retained only 1.5 times more microorganisms than PVS specimens.

Discussion

This study aimed to determine the effectiveness of 4 different disinfectant solutions on 3 commonly used impression materials: alginate, polyether, and PVS. Samples treated with sterile water served as a positive control. Further, an undisinfected group of samples that received no treatment was used to evaluate the carriage of microorganisms by the different impression materials used in this study.

Each impression was dissected into 6 samples to enable the impressions to be tested under identical conditions. Selected section sites were changed for each impression, thus allowing randomization in an attempt to reduce any inconsistency and variability that may have resulted from comparing disinfectants exposed to a different spectrum and concentration of microorganisms.

It must be recognized, however, that the sampling technique employed allowed both the surface and body of the impression to be subjected to disinfection. Under realistic clinical conditions, the disinfectant will only be active against those bacteria contaminating the surface of the impression, unless it is proven that the disinfectant penetrates the impression.

It has been reported that viruses appear to be absorbed into the impression materials and are not eliminated simply by rinsing in running water.[14] McNeill et al[16] investigated the penetration of disinfectant into the impression materials and reported that the presence of a virus within the body of the impression material was demonstrated by the increased titer of the virus following blending of the impression.

This study demonstrated that the 4 disinfectants used were 100% successful in eliminating microorganisms from the surface of the impressions. However, this is not a new finding: similar results were obtained by several investigators who reported complete removal of microorganisms from different impression materials following exposure to various disinfectant solutions.[9,20–26]

However, it is difficult to directly compare the results of this study with previous studies because of the differences in the brands of impression materials, type and concentration of disinfectant, and length of exposure time.

MD 520 is a formaldehyde-free solution for disinfection of impressions. The manufacturer claims that the disinfectant has broad microbial action, including bacteriocidal, tuberculocidal, fungicidal, and virucidal effects. The main ingredient is glutardialdehyde, which is capable of disinfection in 10 to 30 minutes. However, the manufacturer recommends only 5 minutes of immersion for disinfecting impression materials. The results of this study supported the manufacturer's claims. Glutardialdehyde was able to eliminate the oral microorganisms completely following immersion for 5 minutes. The results of this study agree with a previous study carried out by Drennon et al,[27] who found that a 2.5% solution of glutaraldehyde was 100% effective in killing bacteria on the surface of a slab of polysulfide impression material. In another study, McNeill et al[16] reported that 2% glutaraldehyde with the Hygojet system (MD 520, Dürr) was effective in eliminating bacteria.

The use of chlorine-release tablets (Haz-tabs) to form disinfectant solutions is now well established in hospitals throughout the world. Chlorine is reported as the most effective agent against bacteria, fungi, and viruses including HIV and HBV.[28] Haz-tabs are formed using sodium dichloroisocyanurate, a chlorinating agent shown to be more effective than sodium hypochlorite.[29]

This study showed that sodium dichloroisocyanurate disinfectant solution was able to eliminate the microorganisms completely following immersion for 5 minutes. Several studies investigating the microbiologic effect of chlorine compounds on impression materials reported that sodium hypochlorite was effective in eliminating (or reducing) the number of microorganisms.[15,30–36]

To the authors' knowledge, only 1 study has investigated the antimicrobial effect of sodium dichloroisocyanurate (Haz-tabs) on 2 impression materials. The results showed that a 5-minute immersion of alginate and addition-cured silicone in 10,000 ppm available chlorine was effective in eliminating microorganisms.[25]

In the present study, impressions sprayed with Dimenol for a 15-minute contact time and those immersed in 2% solution of Perform-ID for 10 minutes were found to be completely free of microorganisms. No previous studies investigating the antimicrobial efficacy of either Perform-ID or Dimenol (alcohol-based) disinfectants on impression materials were found in the literature. The manufacturer claims that Dimenol is effective against HBV and HIV.

The differences in carriage of microorganisms between the impression materials were significant. This study showed that alginate, PVS, and polyether impression materials can act as a vehicle for the transfer of microorganisms. This has obvious implications for cross contamination from the clinic to the laboratory. The current findings indicate that alginate impressions retain a higher number of oral bacteria ($n = 61 \times 10^6$) compared to PVS ($n = 83 \times 10^4$) and polyether ($n = 13 \times 10^5$) impression materials.

Following immersion of the impressions in sterile water for 10 minutes, the number of microorganisms was reduced significantly in all impression materials used in this study; however, alginate impressions still retained more microorganisms than the other impression materials. The physical nature of irreversible hydrocolloid impression material may affect a disinfectant's capacity for biocidal activity. Microorganisms in the oral environment can become incorporated into the gelling impression material because of the presence of saliva or other oral fluids. The entrapment of microorganisms in the impression material limits the efficacy of the water rinse, and the alginate gel structure may inhibit penetration by the disinfectant.[15]

The presence of organic material is another factor influencing the efficacy of disinfectants.[37] To remove any organic material, it has been recommended by some authors[3,15,16,38] to rinse impressions under running water for 10 to 15 seconds before disinfection procedures are performed. Although a thorough rinsing of the impression is necessary to remove blood, saliva, and mucosal debris that may prevent exposure of the impression surface to the disinfectant, in this study the specimens were disinfected immediately after they were removed from the patient's mouth. In other words, they were exposed to the disinfectants with any blood, saliva, and mucosal debris still on them. This procedure made disinfection much more difficult; however, it was based on the assumption that proper disinfectants should be powerful enough to remove all pathogenic microorganisms even when the impression is contaminated with blood and saliva.

It has been suggested that disinfected impressions should be rinsed after disinfection to remove residual disinfectant that may affect the surface of the stone cast.[13,38,39] In this study, however, such a procedure was not carried out, because it may have removed microorganisms that survived the disinfection procedures.

It should also be noted that the use of an ultrasonic bath would have been more effective. In this study, however, control specimens of each impression material were immersed in sterile water for 10 minutes to simulate an actual clinical situation in daily working conditions.

In this study, 62% of the contaminating bacteria were removed from alginate, 90% from PVS, and 85% from polyether impression surfaces by soaking the impression in sterile water for 15 seconds. These results are in accordance with earlier studies.[15,16]

Another concern with immersion disinfection is the dimensional stability of impression materials, especially irreversible hydrocolloids (alginate), prior to pouring in gypsum. An immediate pouring of the impression is desirable.[40] However, adequate time should be given to disinfect the impressions before pouring.

To prevent possible distortion of the impressions and according to the manufacturers' instructions, a disinfection time of 10 minutes or less for the immersion disinfection and 15 minutes of contact time for the spraying disinfection were used in this study.

In addition to known pathogens, microorganisms that are generally harmless can be pathogenic in patients debilitated by age or disease, and these individuals are often the same patients with prosthetic needs.[41] However, dental personnel are exposed to a wide variety of pathogenic microorganisms in the blood and saliva of patients. Runnells[42] reported that serious infectious diseases are commonly seen in dentistry as a result of a wide variety of viral and bacterial microorganisms. In addition, he identified 23 infectious diseases that could present in dental surgery.

It has been reported that although elderly patients are more prone to debilitating diseases (ie, diabetes mellitus, hypertension, cardiac disease, etc), they are less likely to be exposed to highly communicable infectious diseases. The risk of younger patients becoming infected with HIV and HBV is therefore much higher.[43]

In this study, dental staff including dental clinicians, dental laboratory technicians, and dental assistants were selected. Although this sample of young personnel may have been healthy, the risk of dental personnel becoming infected with serious infectious diseases is higher than in the general population.[44]

It has been reported that 17.2% of prosthodontists have a positive HBV serologic blood marker, which is 6 to 7 times higher than in the general population. In addition, dental laboratory personnel may be at a relatively high risk of infectious diseases, and 14.2% of dental technicians showed a positive blood marker for HBV.[12]

Bergman[38] reported that the entire dental staff is routinely exposed to numerous viral and bacterial pathogens that have the potential to cause serious illness. Schiff et al[45] showed that dental technicians have a significantly higher prevalence of HBV than the general population. Dental technicians may be at risk of HBV and other infections from laboratory materials that have been in contact with a patient's blood and saliva, although the degree of hazard of infection varies.[43]

Younger populations may be assumed to be free of microorganisms in their mouths; however, the ADA advised that every patient should be treated as though he or she could transmit an infectious disease.[5] They further recommended chemical disinfection of all impressions and prosthetic appliances together with routine sterilization procedures.[46]

At present, it is not possible to detect all patients in high-risk groups for HBV and HIV; however, the Centers for Disease Control introduced a method of infection control in which all human blood and certain human body fluids (saliva in dentistry) are tested as if they are known to be infectious with HIV, HBV, and other blood-borne pathogens.[47]

The microbial floras of the oral cavity consist of a wide range of microorganisms, including bacteria, yeasts, mycoplasma, protozoa, and viruses. The majority of these are either strict aerobes or anaerobes. In this study, blood agar, a nonselective general-purpose culture medium, was used. Because of the limitations of the culture medium employed and the fact that incubation was aerobic, anaerobes and viruses were not grown, although these may have been present on the impression.

Further research is needed to investigate the efficacy of disinfectants against viruses and resistant bacterial species. A wider range of impression materials and ways to improve the culturing technique should also be investigated.

Conclusions

Alginate, PVS, and polyether impressions carry microorganisms from the mouth and can be considered a source of potential cross infection between the patient and dental staff.

All 4 disinfectant solutions tested produced effective disinfection of the impression materials investigated. Simple rinsing of the impressions in sterile water reduced the number of microorganisms significantly, but did not decontaminate the impressions.

Alginate impressions produced significantly higher levels of contamination than PVS and polyether impressions from the same individual ($P < .05$).

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