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A Comparative Study on the Different Ethyl Alcohol Disinfection Methods on Dental Casts

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ABSTRACT

Student clinicians are expected to encounter microorganisms during the process of the patients' treatment that can cause various diseases. In the Dentistry's Prosthodontics clinic manual, dental students should perform disinfection but no specific method was recommended. This study utilized the True experimental research design to evaluate the effectiveness of two ethyl alcohol disinfection methods (spray and immersion) in the reduction of the bacterial colony count on dental casts and when running tap water is used to rinse the dental casts. Informed consent from the 34 participants was first secured from each of them. They were purposively selected based on their age and if they were partially edentulous with at least ten teeth present in each arch. Sixty eight dental casts were produced after the impression taking of both their maxillary and mandibular arches, 34 of which were for the experimental group and 34 were for the control group. The Streaking Plate Technique was used in determining the bacterial colony count on each dental cast before and after the disinfection. The results were analyzed statistically using one-way ANOVA. Results revealed that both the immersion and spray methods in which 70% ethyl alcohol was used as a disinfectant, were found to be independently effective as compared with tap water rinsing only in reducing the bacterial colony count of each dental cast. However, when the two ethyl alcohol disinfection techniques were compared to each other, results showed that there were no significant statistical differences between them when the ability to reduce the bacterial colony count on dental casts was observed. From the conclusions, it is recommended that the Dentistry students consider using either the immersion or spray method with 70% ethyl alcohol as a disinfectant on dental casts. Further studies may also be done to test different kinds of alcohols with various concentrations.

Keywords: prosthodontics, dental impressions, disinfectant, ethyl alcohol.

INTRODUCTION

Dentistry is one of the many health-related courses where the students, clinicians, clinical consultants and the staff members of the dental clinic are at risk of being infected with potentially infectious microorganisms in this unique working environment. The oral cavity houses a large group of microorganisms making it a possible source of infection. According

to Marsh, Lewis, Rogers, Williams and Wilson (2016), it contains both a higher microbial load and greater bacterial diversity than the rest of the human body. Unsuccessful or insufficient decontamination of the dental casts or impressions that contain disease-causing microorganisms will lead to cross-contamination resulting in cross-infection.

Prosthodontics is one of the fields of dentistry which requires the clinician to produce a positive replica of the teeth known as a dental cast. In order to obtain a dental cast, impression taking of the patient should be performed. When taking an impression of the teeth or an edentulous ridge, the impression material will become contaminated with saliva, blood oral microorganisms and coughed up respiratory pathogens. After pouring the gypsum material onto the dental impression, the microorganisms from the impression will be transferred to the dental cast. Thereafter, the microorganisms on the cast can cause infection or disease to the clinician as well as to the other members of the Prosthodontics Department.

Many disinfecting solutions can be used to disinfect a dental cast, yet the potency or effectiveness of a disinfectant is affected by the temperature, time, pH and its concentration. The death rate of microorganisms is affected by the length of the exposure time. This adequate time should always be allowed for an agent to kill the maximum number of microorganisms. Several types of alcohol are often used due to their antimicrobial activity. These are often used in disinfecting the hands and skin, moreover, they can also be used in dentistry for disinfection of the working area and instruments. Isopropyl and ethyl alcohols are types of alcohols which have similar disinfectant properties and are both used at a concentration of 70%. In this research, ethyl alcohol was used as the disinfectant of dental casts.

LITERATURE REVIEW

There are several ways to make replicas of the teeth and other oral tissues, one is through the use of dental impression materials which is a very common procedure in dentistry (Gladwin & Bagby, 2013). In 2014, Zilinskas confirmed that all gypsum dental casts that are produced from totally disinfected or inadequately disinfected dental casts houses the microorganisms that can be transferred from the surface of the impression material into the dental casts. The contaminated material is brought to the dental laboratories and may then place all the dental professionals and technicians in that particular facility at risk.

According to Anusavice, Sher and Rawls in 2013, construction of a positive replica of a dental structure is an important step in numerous dental procedures. Various types of casts

can be made from gypsum products using a negative likeness of a dental structure called dental impression. McCabe & Walls also stated in 2012 that with the use of models and dies, which should be accurate replicas of the patients' oral tissues, several dental prosthesis and restorations can be easily fabricated outside the patients' mouth.

Pisulkar in 2018 mentioned that the retrieval of microorganisms from dental casts can be a means for cross contamination between dental personnel and patients. In 2014 it was also stated by Zilinskas that dental casts are subjected to numerous forms of contamination, ranging from contacting with a patient's saliva directly, to procedures including manufacture, measurement, planning, laboratory shipping and storage. In 2007, Salih cited that dental professionals are susceptible to a broad variety of microorganisms in the saliva and blood of their patients. In addition to that, Demajo (2016) said that some of these microorganisms can survive outside the oral cavity and when not in contact with oral fluids for a long period, can transfer onto the dental models, further exposing dental laboratory personnel.

Sterilization overall is more lethal to pathogenic organisms in comparison to disinfection as stated by Salih in 2007. The disinfection procedure leads to a decrease in the level of microbial contamination and covers, depending on the treatment time and disinfectant used, a wide range of activity that may draw out from sterility at one extreme to a minimal reduction in microbial contamination at the other extreme. In 2012, Weeks concluded that among the important chemical agents for microbial control are the alcohols wherein ethyl alcohol is the most widely used alcohol which is usually 70% in concentration. It was also mentioned that like those in the cell membranes of microbes, ethyl alcohol dissolves lipids and denatures proteins. It may also be used as an antiseptic on the skin or as a disinfectant by immersing dental casts in it for a minimum of ten minutes. Ethanol is the least toxic of the straight chain alcohols; alcohol dehydrogenase , an enzyme produced by our bodies helps to metabolize ethanol by oxidizing it to acetaldehyde. (Chang & Overby, 2018)

Naveen, Kashinath, Jaydash and Rashmi in 2011 suggested that all "splash and touch" surfaces should be disinfected with an EPA registered and American Dental Association (ADA) accepted disinfectants whenever sterilization is not possible. According to Salih (2007), the ADA and the Centers for Disease Control (CDC) have suggested that to eliminate cross-contamination, the dental casts should be poured against a disinfected impression or to disinfect the resultant cast itself. ADA infection control guidelines recommend the use of disinfectant that require contact time of less than 30 minutes.

METHODS

This study utilized the True experimental research design to evaluate the effectiveness of two ethyl alcohol disinfection methods (spray and immersion) in the reduction of the bacterial colony count on dental casts and when running water is used to rinse the dental casts.

Sampling Technique

Thirty four respondents were invited to participate in the study which was done at the Adventist University of the Philippines (AUP) College of Dentistry and an informed consent was secured from each of them. The respondents were purposively selected based on their age (respondents should be between 18- 59 years old) and if they were partially edentulous with at least ten teeth present in each dental arch. Medically compromised patients were not allowed to participate in the study. After the researchers obtained permission and informed consent from the participants and the dean of the AUP College of Dentistry, they were evaluated with a detailed assessment of their complete medical and dental history. The researchers maintained the confidentiality of all the data of the study including information of the participants' oral diagnosis Patient's Chart which was kept in the College of Dentistry's stockroom.

One week after the participants' confirmation and evaluation, the researchers took the maxillary and mandibular impressions of every participant. To standardize the possible outcome, the impression material used was an alginate that has a normal setting time, silicon rubber-like characteristic, minimized body flow for maximum patient comfort, exact reproduction because impression sweating is eliminated and improved stone surface impression to stone reaction (REPLICA- Type 2 Normal set – Mint) which was manipulated according to the manufacturer's instructions.

Perforated impression trays were used, autoclaved at 121o C for 30 minutes and dry heated at 100o C for 60 minutes. The impression tray was sterilized to eliminate possible sources of bacteria, before the pouring of the impression material. All dental impressions (maxillary and mandibular) were rinsed under running tap water to remove saliva and visible blood as required by the Federation Dentaire International (FDI). The dental impressions were immediately poured with a dental stone (Armstrong cast stone 5-3) which was manipulated according to the manufacturer's instructions. Dental stone casts were allowed to set for a least 30 minutes.

Once the cast has been removed from the alginate impression, it was identified using the appropriate item number, date and the initials of the individual who removed the cast. Sixty eight dental casts were produced, 34 were for the experimental group and the other 34 were for the control group. All dental casts were rinsed for 10 seconds under running tap water. The first 17 maxillary casts were immersed in 100 ml. of 70% ethyl alcohol for 20 minutes and dried for 30 minutes. The first 17 mandibular casts were sprayed with 100 ml of 70% ethyl alcohol. The second 17 maxillary casts and 17 mandibular casts were washed under running tap water for 10 seconds and also dried for 30 minutes. All the dental casts were handled accordingly and were sent to the A.U.P. College of Health – Medical Laboratory Science Department to assess and determine which 70% ethyl alcohol disinfection method is better in reducing the bacterial colony count from dental casts.

For the statistical analysis of the data, ONE Way ANOVA was used to determine whether there are any statistically significant differences between immersion and spray disinfection methods using 70 % ethyl alcohol on dental casts. The two methods of disinfection using 70% ethyl alcohol were also compared with the method using tap water only.

RESULTS

The following tables illustrate the results of the two experimental groups of disinfection methods using ethyl alcohol (immersion and spray) and one control group disinfection method using tap water on dental casts.

Table 1. **Comparison of colony count for Immersion**

Test	Mean	N	SD	Mean Diff.	t	df	p-value	VI
Pre- test	128.59	17	104.33	128,24	5.061	16	<0.001	S
Post Test	0.35	17	0.86					

N- number of participants SD- Standard Deviation T- t test Df – degrees of freedom
VI – verbal interpretation

The table 1 above shows that immersion with the use of 70% ethyl alcohol was an effective method in reducing the bacterial colony count in dental casts since there was a Mean difference of 128.24 from the Pre Test result of 128.59 to the Post Test result of 0.35.

Table 2. **Comparison of colony count for Spray**

Test	Mean	N	SD	Mean Diff.	t	df	p-value	VI
Pre Test	125.41	17	124.77	125.35	4.14	16	0.001	S
Post Test	0.06	17	0.24					

The Table 2 above shows that with the use of the spraying method with 70% ethyl alcohol, the colony count on the dental casts was reduced by 125.35 when the Pre Test result of 125.41 was compared to the Post Test result of 0.06.

Table 3: **Comparison of Colony Count for Tap Water**

Test	Mean	N	SD	Mean Diff	t	df	p-value	VI
Pre –Test	148.47	34	101.41	45.68	2.933	33	0.006	S
Post- Test	102.39	34	85.32					

The Table 3 above show that tap water was also an effective disinfectant but it was not as effective and consistent as 70% ethyl alcohol in reducing the bacterial colony count in dental casts.

Table 4: **Comparison of Change in Colony Count among three Avenues**

	N	Mean	SD	df	F	Sig.	VI
Immersion	17	128.24	104.47	2, 65	5.227	0.008	S
Spray	17	125.35	124.82				
Tap Water	34	45.68					

Table 5: **Pairwise Comparison of the Change in Colony Count among Three Avenues**

(I)Group	(J)Group	Mean Diff(I-J)	Std. Error	p-value	VI
Immersion	Spray	-2.88	35.49	0.996	NS
	Tap Water	-82.56	30.74	0.025	S
Spray	Immersion	2.88	35.49	0.996	NS
	Tap Water	-79.68	30.74	0.031	S
Tap Water	Immersion	82.56	30.74	0.025	S
	Spray	79.68	30.74	0.031	S

As can be seen from Tables 4 and 5 that there is a mean score of 128.24 (SD= 104.47) for immersion, 125.35 (SD=124.82) for spray and 45.68 (SD=90.80) for the tap water disinfecting method when the three avenues are compared. This means that both the immersion and spray methods of disinfection of dental casts with 70% ethyl alcohol were effective in reducing the bacterial colony count in dental casts.

Table 6: **Percentage of Reduced Bacterial Colony Count**

Avenue	Pre-Test	Post-Test	% of Reduced Bacterial Colony count
Immersion	128.59	0.35	99.72
Spray	125.41	0.06	99.75
Tap Water	148.47	102.79	30.77

Table 6 shows the percentage of reduced bacterial colony count of the three disinfecting methods. The immersion method has 99.72%, spray method has 99.75% and 30.77% for the tap water method. This means that the two disinfection methods using 70% ethyl alcohol were almost 100% effective in reducing the bacterial colony count on dental casts.

DISCUSSION

The purpose of the study was to compare the effectiveness of the different ethyl alcohol disinfection methods on dental casts. Knowing which 70% ethyl alcohol disinfection method is more effective will aid in better prevention of bacterial growth and thus will also assist in the prevention of the spread of compromising diseases from the patients to the dental sealants, clinical consultants and Prosthodontics staff.

To answer the first question, “Is 70% ethyl alcohol an effective dental cast disinfectant?” the results in both Tables 1 & 2 show that there was a great amount of decrease in the colony counts on the dental casts when they were immersed and sprayed with 70% ethyl alcohol. For the immersion method it was a 128.24 decrease in colony count while for the spray method it was a 125.35 decrease in colony count.

To answer the second question, “Which 70% ethyl alcohol disinfection method is effective in reducing the bacterial colony count in dental casts?” the results from Table 6 showed that both the immersion and spray methods were both effective in reducing the bacterial colony count in dental casts. It was concluded by Weeks in 2012 that among the important chemical agents for microbial control are the alcohols wherein ethyl alcohol is the most widely used

alcohol which is 70% in concentration. It may be used as an antiseptic on the skin or as a disinfectant by immersing dental casts in it for a minimum of ten minutes.

To answer the third question ”Is there a significant difference between immersion method and spray method and running tap water method of disinfecting dental casts?” the ONE Way ANOVA statistical method was employed. It was found that there is no significant difference in the bacterial colony count between the immersion and spray method of disinfection as seen in Table 5. As seen on the same table, it was found that there is a significant difference between immersion method to tap water and spray method when compared to tap water. The above result could be explained by the statement from Sousa (2013) when it was revealed that washing dental casts with tap water only partly cleanses the flora in it. It decreases bacterial load by 48%. In 2017 Garret and Grisham mentioned that water is a “poor” solvent for non-polar substances thus making water unstable to dissolve or clean bacteria with nonpolar substances.

Conclusion

As a result of the findings from this study the following conclusions can be drawn: The use of 70% ethyl alcohol was proven to reduce the bacterial colony count on the dental casts. There are however no significant differences between immersion and spray methods so it means that it does not matter whether you use any of the two methods because each one is equally effective. Therefore the hypothesis that there is no significant difference in the colony count reduction between immersion and spray method of ethyl alcohol disinfection on dental casts is true.

It is recommended by the researchers that future studies be done to look into the other kinds of alcohols with varying concentrations to be used as disinfectants on dental casts. More in-depth studies are also suggested to be performed in which the sample size will be increased, another impression material can be used aside from choosing patients with more missing teeth.

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