

Efficacy of various chlorhexidine disinfecting agents on the reduction of bacteria and dimensional stability of alginate impression material

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Abstract:

Contaminated dental impression with saliva and blood provide a risk of cross infection for the dentist and dental laboratory staff. Microorganism from oral cavity in facts can survive on the impression surface and can be transferred to the stone casts. **The aim of the study:** To determine the effect of immersion of Chlorhexidine disinfection procedure on the contamination and dimensional stability of alginate impression material. **Materials and methods:** 40 volunteer students were selected from Dental Department in the Collage of Medical and Dental Technologies in Baghdad with age ranged from 18-22 years (20 females and 20 males). The students have been classified into 4 groups each group of 10 students. After taking impression of upper dental arch by alginate, the impressions of the first group were immersed in tap water for 10 minutes (the control group). The second group impressions were Glaxosmithkline group of companies United (immersed in Corsodyl mouthwash (Chlorhexidine digluconate 0.2%) for 10 minutes. The third group)Kingdom mouthwash (Chlorhexidine)zak DNV Syria(impressions have immersed in digluconate 0.12%) for 10 minutes. The fourth group impressions were immersed in Almansor company Iraq Baghdad (Chlorhexidine digluconate (Almansor mouthwash 0.2%) for 10 minutes. ll these impressions were swabbed and inoculated into blood agar plates, plates were incubated and examined for the bacterial colonies growths. The second part of the study was to investigate the effects of disinfection solutions (different types of Chlorhexidine) on the dimensional stability of alginate impression material. forty specimens were immersed in 4 different solutions groups : group 1 immersed for 10 minutes in tap water (control group), group 2 immersed for 10 minutes in Corsodyl mouthwash (Chlorhexidine digluconate 0.2%) , group 3 immersed for 10 minutes in zak mouthwash (Chlorhexidine digluconate 0.12%) , group 4 immersed for 10 minutes in Almansor mouthwash (Chlorhexidine digluconate 0.2%). **Results:** the contamination frequency were compared for statistical significance, the alginate (irreversible hydrocolloid) showed contamination in tap water and there was a significant reduction of bacterial growth with Chlorhexidine mouth wash. Corsodyl brand type has superior antibacterial effect over the other two types. There was no significant differences in the dimensional changes test between different types of Chlorhexidine and tap water. Disinfectants techniques by immersion alginate dental impression for 10 minutes caused no significant dimensional change. **Conclusion:** the use of Chlorhexidine disinfection after taking alginate dental impression is a good measure in reduction of contamination and cross infection and have a minute effect on dimensional stability and is recommended as step in protecting dentist and dental laboratories teams. **Key words:** Chlorhexidine, alginate impression, cross infection, dimensional stability

Introduction:

Impression materials that have been exposed to contaminated saliva and blood provide a significant source for cross contamination. Microorganism from oral cavity in facts can survive on the impression surface and can be transferred to the stone casts [Powell et al 1990; Mitchell et al 1978]. Moreover simple washing with water or rinsing in running water does not completely remove contaminating organisms from

the impression.[Rice et al 1991; McNeil et al 1992; Beyerle et al 1994]To achieve infection control in the dental office and dental laboratory it has been suggested that impressions made in dental office should be disinfected before they send to dental laboratory.[Samaranyake et al 1991 ;Mitchell et al 1997; McNeil et al 1992]

When considering methods and product for disinfecting impressions, two factors are important : the antibacterial efficacy of disinfecting procedures and the effect of these procedures on the dimensional stability of the impression material. Disinfection by immersion has been recognized as more effective and reliable than disinfection by spray.[Council 1992; Kohn et al 2003]Immersion the disinfection solution comes in contact with all surfaces of the impression material and tray. However maybe subjected to dimensional changes which may have direct effects on the prosthesis results achieved in dental practice.[Council 1991; Al-Omaeri et al 1998 ; Lepe and Johnson 1997; council 1988]Chlorhexidine antiseptic is a chemical antiseptic, effective on both gram positive and gram- negative microbes and some viruses, the mechanism of action is membrane disruption. Chlorhexidine is often used as an active ingredient in mouthwash intended to be effective against dental plaque and oral bacteria. It has been shown to have immediate bactericidal action and prolong bacteriostatic action due to adsorption onto the pellicle coated enamel surface.[Powell et al 1990; Gerhardt and Saydiskis 1991; Rice et al 1991; Kern et al 1993 ; Langenwalter et al 1990]

Materials and methods

The study was conducted on selected forty volunteer students from Collage of Medical and Dental Technologies in Baghdad with age ranged from 18-22 years (15 females and 15 males). The students were classified into 4 groups. The antimicrobial effect study against two types of bacteria (Streptococcus mutans and lactobacilli) was carried out. The blood agar culture media was prepared according to the details that were supplied with the product manufacturer. After taking impression with alginate (chromic Italy) for upper dental arch then a swab was taken from the impression and send it for bacteriological culture blood agar (Himedia laboratories Ptv Ltd. India) test then we immerse each group in different solutions that is:

1. Group A: immersed for 10 minutes in tap water (control group)
2. Group B: immersed for 10 minutes in Corsodyl mouthwash (Chlorhexidine digluconate 0.2%) Glaxosmithkline group of companies United Kingdom.
3. Group C: immersed for 10 minutes in Almansor mouthwash (Chlorhexidine digluconate 0.2%) Almansor company Iraq.
4. GroupD : immersed for 10 minutes in Zak mouthwash (Chlorhexidine digluconate 0.12%) DNV Syria.

Then another swab taken from each cast for cultivation on blood agar and then studied for growth of Streptococcus mutans and lactobacilli . figure (1)Another part of this study was made for testing dimensional stability with a standardized stainless steel die , recommended by the American Dental Association (ADA) specification no .19 (23) and in accordance with international standard ISO 4823 (24), was used for impression making. The metal die was marked with 3 horizontal lines intersected by 2 vertical lines.

The impression material was placed on the metal die and compressed by a



Figure (1): blood agar dish with bacterial growth.

and rigid ,flat ,glass plate . sufficient force was applied to seat the plate firmly against the mold.

According to the ADA specification no.19 (23) and the International Standard ISO 4823(24) dimensional stability was assessed by measuring the d1-d2 distance (from the inner profile of line d1 to the inner profile of line d2) figure 2

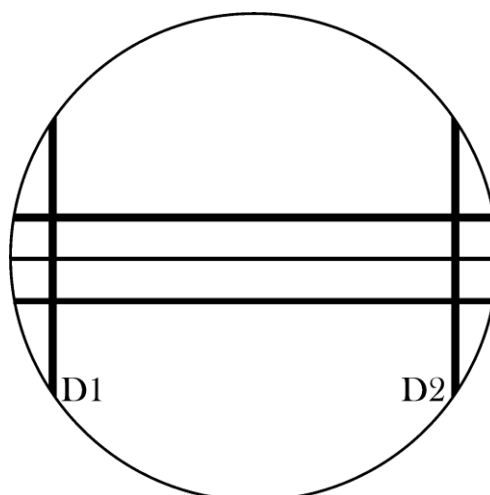


Fig. 2 Schematic illustration of the stainless steel test die showing the distance between the inner profile of Line d1 and the inner profile of Line d2 (d1-d2 distance). The width of vertical lines (d1 and d2) is 0.075 ± 0.008 mm, whereas the distance between the lines d1- d2 is 25 mm.

Measurements were taken by one investigator with a microscope (Olympus SZX9, Olympus, Tokyo, Japan) graduated at 8×magnification and provided with a digital micrometer (Mitutoyo, Hampshire, UK) to the nearest 0.001 mm.

The test specimens were measured at four different groups:

1. Group a: immersed for 10 minutes in tap water (control group)
2. Group b: immersed for 10 minutes in Corsodyl mouthwash (Chlorhexidine digluconate 0.2%) Glaxosmithkline group of companies United Kingdom.
3. Group c: immersed for 10 minutes in Almensor mouthwash (Chlorhexidine digluconate 0.2%) Almensor company Iraq.

4. 4.Group d: immersed for 10 minutes in Zak mouthwash (Chlorhexidine digluconate 0.12%) DNV Syria.

The percentage of change of the measurements for all groups was calculated using the following formula:

$$\frac{(d1-d2) - (d1-d2)}{(d1-d2)} \times 100$$

Results

Antimicrobial activity results for immersion in different disinfectant solution is summarized in table 1 and 2; figure 3 and 4 (P < 0.05), after immersion of the alginate dental impression in the different surface treatment, the high percent of lactobacilli bacteria in tap water group and lower percent in the chlorhexidine (UK) which had the high antibacterial activity about 100% than other groups. While Zak chlorhexidine group has 80% and Almansor chlorhexidine 40%. The analogous and similar outcome for antimicrobial activity test for Streptococcus mutans is presented in table 2. The result indicated a significant difference between the groups. The potency in antimicrobial activity from the highest group to the lowest group was chlorhexidine of corsidyl (UK), chlorhexidine Zak (Syria), chlorhexidine almansor (Iraq), then the tap water. Table 3 and 4 and figure 6 indicate the non significant (P > 0.05) effects on dimensional stability of alginate impression specimen after immersion in different disinfectant solution. There is non-significant difference between groups. Only the tap water group with chlorhexidine corsidyl (UK) has a significant difference.

Table 1 Types of surface treatment anti-microbial activity test against lactobacilli

			Anti-microbial activity test against Sta lactobacilli		Total
			Positive	Negative	
Types of surface treatment	Tap water	N	5		5
		%	100.0%		100.0%
	Chlorohexidine 0.2% (U.K)	N		5	5
		%		100.0%	100.0%
	Chlorohexidine 0.2%	N	3	2	5
		%	60.0%	40.0%	100.0%
	Zak 0.12 % (Syria)	N	1	4	5
		%	20.0%	80.0%	100.0%
Total		N	9	11	20
		%	45.0%	55.0%	100.0%

	Value	df	P-value
Chi-Square	11.919	3	0.008 HS

*positive: resist antimicrobial solution,
 * Negative: sensitive antimicrobial activity

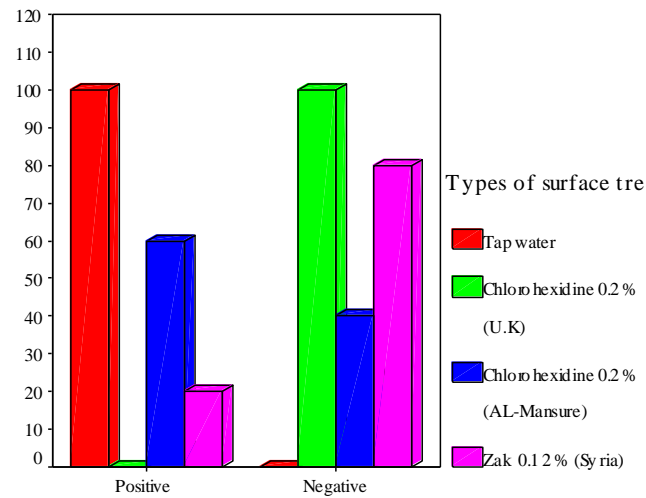


Figure 3 The antimicrobial activity test against lactobacilli

Table 2 anti-microbial activity of different types of antiseptics against *Streptococcus mutans*

			Anti-microbial activity test against <i>Streptococcus mutans</i>		Total
			Positive	Negative	
Types of surface treatment	Tap water	N	5		5
		%	100.0%		100.0%
	Chlorohexidine 0.2% (U.K)	N		5	5
		%		100.0%	100.0%
	Chlorohexidine 0.2% (AL-Mansure)	N	3	2	5
		%	60.0%	40.0%	100.0%
	Zak 0.12 % (Syria)	N	1	4	5
		%	20.0%	80.0%	100.0%
Total		N	9	11	20
		%	45.0%	55.0%	100.0%

	Value	df	P-v alue
Chi-Square	11.919	3	0.008 HS

* positive: resist antimicrobial solution,
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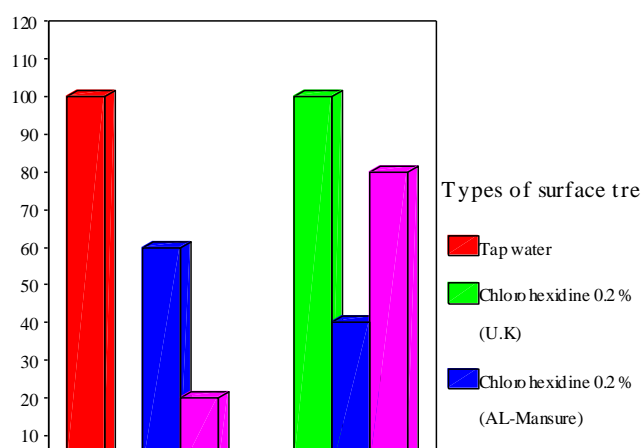


Table 3. dimensional accuracy for the 4 groups

antimicrobial activity test against Streptococcus mutans4Figure

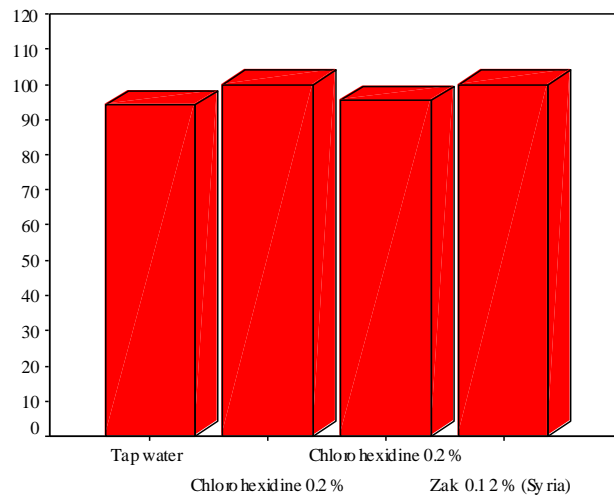
Dimensional accuracy test (%)

	N	Mean	Std. Deviation	Std. Error	Range		ANOVA test (P-value)	Sig.
					Minimum	Maximum		
Tap water	5	94.00	5.48	2.45	85	100	.066	NS
Chlorohexidine 0.2% (U.K)	5	100.00	.00	.00	100	100		
Chlorohexidine 0.2% (AL-Mansure)	5	95.40	5.81	2.60	85	98		
Zak 0.12 % (Syria)	5	99.80	.45	.20	99	100		
Total	20							

Dependent Variable: Dimensional accuracy test (%)

Table 4 the least significant differences (LSD)

Types of surface treatment		LSD test	
		P-value	Sig.
Tap water	Chlorohexidine 0.2% (U.K)	.031	S
	Chlorohexidine 0.2% (AL-Mansure)	.588	NS
	Zak 0.12 % (Syria)	.036	S
Chlorohexidine 0.2% (U.K)	Chlorohexidine 0.2% (AL-Mansure)	.088	NS
	Zak 0.12 % (Syria)	.938	NS
Chlorohexidine 0.2% (AL-Mansure)	Zak 0.12 % (Syria)	.101	NS



dimensional accuracy for the 4 groups

Discussion

The risk of cross-infection from a patient to the dentist and dental technician is a topic of interest for the researcher for ideal antiseptic used in as mouth wash. In order to protect all the members of the dental team, a high standard of hygiene and disinfection of dental equipment, including dental impressions is recommended. [Council on Dental Materials 1988] through a questionnaire addressed to dental technicians in the united kingdom , Jagger et al. founded that only 4% of the laboratories received disinfected impressions, whereas 56% of the laboratories did not know if impressions coming from the dental offices had been previously disinfected. Therefore, most of the laboratories (approximately 94%) usually disinfected the impressions they received there is no available data in our country about the disinfecting of alginate dental impression that will be send to dental laboratories a future study is therefore suggested. [Jagger et al 1995, Kugel et al 200]) variety of disinfection solutions and regimes were highlighted both within and between dental hospitals. Several of the disinfecting solutions currently being used have not been specifically tested for efficacy with impression materials. [Blair and Wassell 1996] The result of this study come in harmony with Casemiro et al suggest that the method of preparing irreversible hydrocolloids (alginate) with a 0.2% digluconate chlorhexidine solution is effective methods to reduce cross-contamination caused by dental impressions. The results get nearer the results of Turhan et al who find that chlorhexidine is effective in reduction bacteria growth after taking dental impression. [Casemiro et al 2007 ;Turhan2007] In this study we used the immersion of alginate dental impression in disinfecting agent rather than spraying the disinfecting agent over the dental impression as recommended by Oderinu et al and Jagger et al in which delegated procedure might needed when using disinfecting spray this research the. [Jagger et al 2007 ; Oderinu et al 2007] From the standpoint of dimensional change, the results appear in conformity with Yilmaz et al and as the stated the disinfectants tested for 10 minutes caused no significant dimensional change in the alginate impression materials, And Oderinu et al whom stated disinfection of alginate impressions by immersion techniques for ten minutes will produce casts with minimal dimensional changes. [Yilmaz 2007; Oderinu et al 2007] However, especially after the long-term immersion in the disinfecting solution encourages water absorption phenomena in the case of the so-called hydrophilic impression materials and chemical interactions between impressions and disinfectants may occur, but they do not appear

to influence the dimensional behaviour of the impression material. Different impression disinfection methods have only a marginal influence on dimensional stability and surface quality of dental casts. [Kotsiomiti 2008 ; Bock 2008]

Conclusion:

The use of Chlorhexidine disinfection after taking alginate dental impression is a good measure for reduction of contamination and cross infection and have a minute effect on dimensional stability. It is recommended that all impressions should at least undergo a disinfecting procedure by immersion in 0.2% Chlorhexidine for a minimum period of 10 minutes.

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كفاءة أنواع الكلور هيكسدين المُخْتَلِفة المنشأ على تخفيض البكتيريا والاستقرار البعدي في مادة طبعة الأسنان الالجنيت

تلوث طبقات الأسنان من اللعاب أو من دم المريض يمكن أن يكون خطراً لانتقال العدوى إلى طبيب الأسنان والعاملين في مختبرات الأسنان. ويمكن للميكروبات الموجودة داخل فم المريض أن تلتصق على طبعة الأسنان ويمكن أن تنتقل إلى قالب الأسنان بعد صبه.

الهدف من الدراسة: تحديد تأثير غمر مادة الطبعة والقالب الحامل للطبعة بمادة الكلور هيكسدين بمختلف الأنواع و التراكيز على وجود البكتيريا في مادة الطبعة (الالجنيت alginate) وكذلك دراسة تأثير الغمر بالكلو هيكسدين على ثباتية الأبعاد في مادة الطبعة.

المواد والطرق:

الجزء الأول من الدراسة: تم اختيار 40 متطوعاً من طلاب قسم الأسنان بالكلية التقنية الطبية \ بغداد من عمر (18-22) سنة منهم 20 ذكر و 20 أنثى. قسم الطلاب إلى 4 مجاميع كل مجموعة 10 طلاب. بعد أخذ الطبعة بمادة الالجنيت لكل الطلاب وللفك العلوي تحديداً. المجموعة الأولى غمرت بماء الحنفية ولمدة 10 دقائق (المجموعة القياسية). المجموعة الثانية غمرت بمادة الكلور هيكسدين (نوع كورسيديل صنع المملكة المتحدة) بتركيز 0.2% ولمدة 10 دقائق. المجموعة الثالثة غمرت بمادة الكلور هيكسدين (نوع زاك صنع سوريا) بتركيز 0.12% ولمدة 10 دقائق. المجموعة الرابعة غمرت بمادة الكلور هيكسدين (نوع المنصور صنع العراق) بتركيز 0.2% ولمدة 10 دقائق. أخذت مساحة من كل هذه العينات وزرعت في أوساط صحون الاكار لنمو المستعمرات الجرثومي.

الجزء الثاني من الدراسة : كَانْ أَنْ يَتَحَرَّى تَأْثِيرَاتُ مَحْلُولِ التَّطْهِيرِ أَنْوَاعٍ مُخْتَلَفَةٍ مِنْ Chlorhexidine على الإِسْتِقْرَارَ البَعْدِي لمادّة (alginate) حيثُ إِسْتَعْمَلْنَا 40 نَمُودَجَ مِنْ مادّة طبعة الأسنان وقسمت هذه الى 4 مجاميع. المجموعة الأولى غمرت بماء الحنفية ولمدة 10 دقائق (المجموعة القياسية). المجموعة الثانية غمرت بمادة الكلور هيكسدين (نوع كورسيديل صنع المملكة المتحدة) بتركيز 0.2% ولمدة 10 دقائق. المجموعة الثالثة غمرت بمادة الكلور هيكسدين (نوع زاك صنع سوريا) بتركيز 0.12% ولمدة 10 دقائق. المجموعة الرابعة غمرت بمادة الكلور هيكسدين (نوع المنصور صنع العراق) بتركيز 0.2% ولمدة 10 دقائق.

النتائج : وجد تلوثاً و نموا جرثومياً في ماء الحنفية وهناك انخفاض شديد في النمو الجرثومي في المجموعة الثانية التي غمرت بمادة الكلور هيكسدين (نوع كورسيديل صنع المملكة المتحدة) التي لها تأثيرٌ مضادٌ للجراثيم متفوقٌ على النوعين الآخرين. و لم يكن هناك إختلافات هامة في التغيرات البعدية بين الأنواع المختلفة ل Chlorhexidine و ماء الحنفية

الخاتمة: إنَّ إِسْتِعْمَالَ مطهر Chlorhexidine بعد أخذ طبعة الأسنان alginate إجراء جيد في تخفيض التلوث والعدوى المنتقلة. وليس له تأثير على الاستقرار البعدي. ويمكن أن تعتبر كتوصية للعاملين في صناعة الأسنان من أطباء أسنان وتقنيين في مجال صناعة الأسنان.