

Disinfection Of Alginate And Silicon Impressions By Using UV And Blue Light. (In Vivo Study)

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الخلفية:

هناك قلق متزايد حول قضية العدوى في عيادات طب الأسنان والمختبرات. هناك العديد من أساليب التطهير لمواد الطبعة ، ولكن هذه الاستراتيجيات التقليدية تحتوي عدة عيوب. في هذه الدراسة نقدم ضوء الأشعة فوق البنفسجية والزرقاء كطريقة فعالة وأمينه في تطهير مادة الطبعة.

هدف الدراسة : إن الغرض من هذه الدراسة هو تقييم إمكانية تطهير ضوء الأشعة فوق البنفسجية والزرقاء على مادة السيلكون والالجنيت المكونة للطبعة.

: أربعون طالب كلية تم اختيارهم بشكل عشوائي من كلية طب الأسنان جامعة الكوفة في الفترة من الأول من شهر أيلول إلى الأول من شهر كانون الأول وتم اخذ أربعون طبعة من السليكون والالجنيت وتم تصنيفها وفقا لوقت التعرض (10 و 20 دقيقة). كل طبعة تم زراعتها على وسط أكار الدم ووسط الماكونكي قبل تعريضها لضوء الأشعة فوق البنفسجية والضوء الأزرق وبعد معاملتها بضوء الأشعة فوق البنفسجية والضوء الأزرق لمدة 10 و 20 دقيقة. وقد تم تحليل النتائج باستخدام مربع كاي ضمن القيمة المعنوية 0.05 .
: أظهرت نتائج الزرع أن كل طبعات السليكون أعطت نتائج موجبه بعد معاملتها بضوء الأشعة فوق البنفسجية والضوء الأزرق ماعدا المجموعة التي عرضت للأشعة فوق البنفسجية لمدة 20 دقيقة والتي أظهرت اختزال معنوي في النمو البكتيري. أما بالنسبة لطبعات الالجنيت فأعطت نتيجة موجبه للزرع البكتيري بعد تعرضها لضوء الأشعة فوق البنفسجية والضوء الأزرق لمدة 10 و 20 دقيقة.
: من هذه الدراسة نستنتج أن يمكن تعقيم طبعات السيلكون بضوء الأشعة فوق البنفسجية عندما تعامل لمدة 20 دقيقة.

Background:

There is growing concern about the issue of cross-infection in dental clinics and laboratories. There are many methods of disinfection for impression material; but these conventional strategies present several disadvantages .In this study we introduce the UV and blue light as effective savable method for the disinfection of the impression.

Aim: The purpose of this study was to evaluate the disinfection potential of UV and blue light on alginate and silicon impression material.

Material and methods: Forty college students were randomly selected from Collage of Dentistry in University of Kufa during the period between 1 December 2011 to 1 October 2011. And 40 alginate and silicon impressions were taken and grouped according to time of exposure (10 and 20 minutes). Each impression was cultured on blood agar and Mackonky agar before treatment with UV light or blue light, the treatment was done after 10 and 20 minutes; then cultured for bacterial inspection. The data were analyzed statistically using Chi-square test and P-value 0.05.

Result: The culture showed that all the silicone impressions gave a positive result after treatment with blue light and UV light except a group that treated with UV light for 20 minutes, which showed significant reduction in the bacterial growth. All the alginate impressions give positive culture after treatment with UV and blue light after 10 and 20 minutes.

Conclusion: From this study, we conclude that the silicon impression can be sterilized with UV light when treated for 20 minutes.

Key words: Disinfection, silicon impression material, UV light.

College of Dentistry, University of Kufa.

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. 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 alone².

Disinfection is generally a less lethal process than sterilization. It eliminates virtually all recognized pathogenic microorganisms but not necessarily all microbial forms (bacterial endospores), on inanimate objects. Consequently, products that have the ability to disinfect are referred to as disinfectants³. There is growing concern about the issue of cross-infection in dental clinics and laboratories, especially after several studies found that transmission of infection to dental laboratory technicians is mainly by contaminated impressions or by improper handling of clinical items after arrival at the dental laboratory⁴.

Surveys indicate that ranges of 37.5% to 90% of impressions are routinely disinfected, but until now, many impressions have been sent to laboratories without having gone through any disinfection process. The reasons for this include the following: 1) disinfection involves an overt effort or action; 2) spraying or immersing impression material with disinfectants may cause a loss of surface detail and dimensional accuracy of the impression 3) most of the disinfectants used for spray and immersion techniques are irritants and, therefore, inhalation of the disinfectant vapors may present health risks to the dental team; and 4) toxic disinfectants may also result in the corrosion of metal trays or abnormal dislodgement of the impression from the tray^{5,6}.

However, there are a number of problems associated with chemical disinfectant use. They take time and are expensive to perform in a dental practice. Moreover, all chemical disinfectants are potentially harmful to the health of the user and the environment, and they may have an unpleasant odor. Furthermore they are not

readily compatible with irreversible hydrocolloids, which is one of the most frequently used impression materials.

Recently, Alkhafagy et al used the natural materials such as lemon juice and apple vinegar as disinfectant solutions. They concluded that the immersion of silicon impression in lemon juice for 20 min and apple vinegar for 5 min were effectively disinfect the impressions against *streptococcus and staphylococcus* bacteria⁷. The ADA recommended disinfecting alginates by immersion in diluted hypochlorite, iodophor or glutaraldehyde with phenolic buffer. Investigators reported significant adverse effects of specific materials with disinfectants that are non-reactive with other alginates suggesting that caution should be exercised. Given the hydrophilic nature of the material, a minimal disinfection time should be used. Limited data are available on disinfection of reversible hydrocolloid, however research data suggest that there is no effect on dimensional accuracy of impressions immersed in an iodophor diluted 1:213, 5.25% sodium hypochlorite with a dilution 1:10, 2% acid glutaraldehyde with dilution of 1:4, and glutaraldehyde with phenolic buffer diluted 1:16. Immersion in 2% alkaline glutaraldehyde has significant adverse effects on the impressions and resultant dies⁸.

A variety of disinfection methods are targeted to specific viruses, including high hydrostatic pressure, hydrogen peroxide, and ultraviolet (UV) light; bleach and other chlorine compounds; glutaraldehyde, ethanol, and metal ions; quaternary ammonium compounds; and sodium hydroxide or sodium carbonate, among a few others⁹.

HIV inactivation by UV light was investigated and found to be dependent on the strength of the UV light and on the composition of the medium in which HIV was contained. Cellfree HIV suspended in medium was inactivated after 10 minutes and cell-associated HIV after 30 minutes.

But exposure of up to 60 minutes did not completely inactivate cell-associated HIV in the presence of blood¹⁰.

The effects of ultraviolet (UV) light on fungi and impression materials were tested by Ishida et al in 1991. They found that UV light (250 microW/cm²) killed most *Candida* organisms (10⁽³⁾ cells/ml) within 5 minutes. UV light (8000 microW/cm²) killed most *C. albicans* (10⁽⁷⁾ cells/ml) within 2 minutes of exposure. Also they tested the effect of UV light on dimensional change and surface roughness of impression materials (irreversible hydrocolloid, agar, and silicone rubber). The results showed that neither dimensional change nor surface roughness of the impression materials was affected. The results of this study indicate that UV light disinfects impression materials that are contaminated with *Candida* organism¹¹. However investigators are in agreement that in-vitro studies have limitations and evaluations according to an ADA specification will not exactly simulate the clinical evaluation¹². As most of the studies on impression material cross contamination used in-vitro methodologies.

AIM OF THIS STUDY:

is decided to be to investigate the disinfection effects of UV and blue light on alginate and silicon impression materials in-vivo, for realistic evaluation.

MATERIAL AND METHODS:

UV and blue light apparatus

A locally designed and manufactured UV apparatus from simple and available materials in the market (fig. 1). The UV apparatus supplied with pair of UV lamps (8 W/cm²) fixed parallel on the top of the chamber, connected to an electric circle which connected to the power supply. The drawer of the apparatus was lined with light reflected papers to reflect the light in all directions. For blue light test, a light cure apparatus (Tray-Lux, model M5, Taiwan) were used.

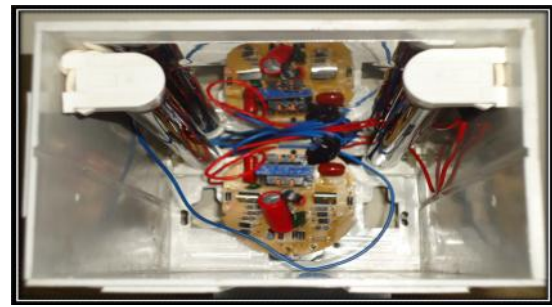


Figure (1) Locally designed and manufactured UV apparatus.

Sample selection:

This study was carried out in Collage of Dentistry in University of Kufa during the period between 1 December 2011 to 1 October 2011.

The samples were randomly selected on (40) students and classified into two groups males and females (20) students for each group according to the sex.

The students should be at the same age, caries free and completely dentulous.

Preparation of samples:

The tested samples were grouped into:

Group 1: 20 upper impressions were taken from 20 male and female students with an irreversible hydrocolloid impression material (Kromopan, Italy)

Group 2: 20 upper impressions were taken from 20 male and female students with heavy body impression material (Oramament, Italy)

Microbiological methodology was carried out according to Meiller et al and Atabek et al.¹³.

Collection of specimens:

All impressions were rinsed thoroughly under clean running water in order to remove all visible contamination, blood, saliva, etc.

For group (1), a disposable transport cotton swab was attached to the right side of the impression before treatment. Then the impression was kept in transparent plastic package and tritely zipped to prevent dehydration. After that the impression was putted inside the UV

apparatus for 10 minutes and then a disposable transport cotton swab was attached to the left side of the impression and then repeat the impression to the apparatus for further 10 minutes and take another swab. The other 10 alginate impressions were treated with blue light for 10, 20 minutes by following the same methods which used previously.

For group (2), all silicon impression were tested by using the same method which used with group (1).

Then all the swabs immediately grouped and transferred to the laboratory for bacteriological study.

Isolation of bacteria:

The disposable transport cotton swabs were soaked immediately and transferred quickly to the laboratory. Each swab was immediately inoculated on blood agar, it has been prepared according to McFadden JF¹⁴ by dissolving 40 gm blood agar base in 1000 ml D.W. and autoclaved at 121 C⁰ for 15 minutes. 5 % human blood was added after cooling the medium to 45-50

C⁰. This medium was used for primary cultivation and detection the type of hemolysis.

Culturing: inoculate the plate and incubated aerobically at 37 C⁰ for 24 hours. Then microscopical examination was carried out included the examination of shape, Gram stain reaction, arrangement of cells, then the colonial morphology and count has been studied. With respect to the 24 hours bacterial growth plates which showed no growth were further incubated up to 24 hours before deciding it as negative result.

Statistical Analysis:

The data were analyzed statistically using Chi-square test and P-value 0.05¹⁵.

RESULTS:

Table 1: Type of bacteria was isolated from silicon and alginate impressions .

Type of impression Type of bacteria	Silicon		alginate	
	No.	%	No.	%
<i>Streptococcus ssp.</i>	35	61.4	36	67.92
<i>Staphylococcus ssp.</i>	20	35.8	17	32.07
<i>Escherichia coli</i>	1	1.75	0	0
<i>Klebsiella ssp.</i>	1	1.75	0	0
Total	57	100	53	100

The type of bacteria that isolated from silicon and alginate impressions are shown in table (1), in which the *streptococcus ssp.* bacteria was shown in 35 (61.4%) of the silicon impression and in 36 (67.92%) of the alginate impressions ,while *staphylococcus ssp.*

bacteria was shown in 20 (35.8%) of the silicon impression and in 17 (32.07%) of the alginate impressions.

Escherichia coli bacteria was shown in 1 (1.75%) of the silicon impression and in 0 (0%) of the alginate impressions. *Klebsiella ssp.* bacteria was shown in 1 (1.75%) of the silicon impression and in 0 (0%) of the alginate impressions.

Table 2: Culture result of silicon impression before and after treatment with blue light

Culture result	Positive	Negative
Before treatment	10	0
After 10 minute	10	0
After 20 min	10	0
Total	30	0

$$X^2=12.15 \quad P \quad 0.0327$$

Table (2) shown the culture result of silicon impression before and after treatment with blue light ,where there was no statistical difference.

Table 3: Culture result of alginate impression before and after treatment with blue light.

Culture result	Positive	Negative
Before treatment	10	0
After 10 minute	10	0
After 20 min	10	0
Total	30	0

$$X^2=12.15 \quad P \quad 0.0327$$

Table (3) shown the culture result of alginate impression before and after treatment with blue light, where there was no statistical difference before and after treatment fore 10 or 20 minuets.

Table 4: Culture result of silicon impression before and after treatment with U.V light.

Culture result	Positive	Negative
Before treatment	10	0
After 10 minute	7	3
After 20 min	2	8
Total	30	0

$$X^2 =10.658 \quad P \quad 0.004$$

Table (4) shown the culture result of silicon impression before and after treatment with UV light ,where there was no statistical difference regarding 10 minutes exposure while there was high statistical significant reduction in the bacterial growth after the treatment with UV light for 20minuets with ($P \leq 0.004$)

Table 5: Culture result of alginate impression before and after treatment with U.V light .

Culture result	Positive	Negative
Before treatment	10	0
After 10 minute	10	0
After 20 min	10	0
Total	30	0

$X^2=12.15$ P 0.0327

Table (5) shown the culture result of alginate impression before and after treatment with UV light, where there was no statistical difference. There was no statistical significant reduction in the bacterial growth after the treatment with UV light for 10 or 20 minutes .

DISCUSSION :

The use of effective infection control procedures and universal precaution in the dental office and dental laboratory will prevent cross-contamination. Personal protection for oral health staff and patients within clinical environments are aimed at preventing microbial infection and cross-infection during dental practice. All members of the staff are susceptible to many diseases in the dental clinics and laboratories. The ADA has recommended that impression made be decontaminated¹⁶. Studies have shown that bacterial and viral contaminants can be effectively controlled by disinfection¹⁷.

There are many commonly used disinfectants in dentistry, keep in mind that disinfection process may sometime affect material properties of impression materials¹⁸, most of the disinfectant solutions are synthetic chemical, and may create hazardous waste-threatening human health and the natural environment. There are many "green

products" available that are as effective as traditional ones.

In this study, for the first time, the blue light was investigated for its antimicrobial activity, under the condition of this study there was no antimicrobial effect for the blue on the alginate or silicon impressions for 10 or 20 minuets. UV light has long been recognized as an effective method for killing microbes, and there has been a recent resurgence of interest in its application, particularly in the water industry and in disinfection of the surfaces of food. It has advantages over many existing disinfection methods in not requiring chemicals or heat, and being fast so it can be used for a surface sterilization, it is economic and environmentally friendly¹⁹.

The findings of this study showed that the use of UV light was effective method for elimination bacterial growth when used for 20 minuets, this finding agree with Robert JB 1987²⁰, they used the UV light as a mode of sterilization of

complete dentures, partial dentures and a rubber base impression contaminated with known species of microorganisms with killing of 100% of microorganisms within 2 minutes. The finding of this study coincide with the finding of Devine et.al 2001¹⁹. They obtained rapid killing effect of the UV-generated breakers in irradiation for 45 s which reduced viable bacterial count in saliva by 99%, but in this study the killing effect occur after 20 minuets this may be related to the complex lethal mechanisms which probably depend on interplay between the UV wave length, heat and the disinfected media.

Regarding the exposure time, the results were showed that 10 min the exposure to UV or blue light were in effective in disinfection of the alginate or silicon impression while 20 min exposure was enough to give negative culture results just for the silicon impression with UV light.

CONCLUSION:

From this study, we conclude that the silicon impression can be sterilized with UV light when treated for 20 minutes.

Recommendation: According to the result of this study, UV light may be use for sterilization of silicon impression.

REFERENCES:

1. Silva SM, Salvador MCG. Effect of Disinfection Technique on the Linear Dimensional Stability of Dental Impression Materials. *J Appl Oral Sci* 2004; 12: 244-249.
2. Russell JN, Michael GN 1988 *Oral Microbiology and Immunology*. Saunders company. USA, pp.120-127.

3. Naylor WP. Infection control in fixed prosthodontics. *DCNA* 1992; 36(3):809-31.
4. AL-Dwairi ZN. Infection control procedures in commercial dental laboratories in Jordon. *J Dent Educ* 2007; 71(9): 1223-1224.
5. Wakefield CW. Laboratory contamination of dental prosthesis. *J Dent Prosth.* 1980; 44:143-146.
6. Beall FE, Schuster GS, Rugeberg F. Disinfection and distortion of alginate impression by hypochlorite[abstract] *J Dent Res.* 1990; 69-242.
7. Alkhafagy MT, Yasiri IK, Hamed SJ. Disinfection of silicon impression materials by using different natural solutions (in vivo study). *Kofa Medical Journal* 2010; Vol.13, No.1S, , p45-51.
8. Herrera SP and Merchant VA. Disinfection of Alginate , Polysulfide, Vinyl Polysiloxane and Polyether Dental Impression *J Dent Res* 1985;64; 194-97.
9. Kumar NR, Karthik KS , Malle SV. Infection Control in Prosthodontics *JIADS* 2010; 1 (2) April – June: 22-24.
10. Druce, JD. Susceptibility of HIV to Inactivation by Disinfectants and Ultraviolet Light. *J. Hosp. Infect.* 1995; 30 (3): 167–180.
11. Ishida H, Nahara Y, Tamamoto M, Hamada T. The fungicidal effect of ultraviolet light on impression materials. *J Prosthet Dent.* 1991; Apr;65(4):532-5.
12. Walker MP, Rondeau M, Petrie C, Tasca A, Williams K. Surface Quality and Long-term Dimensional Stability of Current Elastomeric Impression Materials after Disinfection. *J Prosthodontics* 2007; 16: 343-351.
13. Atabek D, ALacam A, Tuzner E, Polat S, Sipahi AB. In-Vivo Evaluation of

- Impression Material Disinfection with Different Disinfectant Agents. Hacettepe Diş Hekimliği Fakültesi Dergisi 2009; 33(2) 52-59.
14. McFadden JF Biochemical tests for identification of medical bacteria. 3rd ed., William and Wilkins,2000.
 15. Daniel W. Biostatistics. A Foundation for analysis in the Health Sciences. 1999; 7th ed. Wiley and Sons, INC.
 16. Council on Dental Materials, Instruments and equipment. disinfection of impressions. J Am Dent Assoc. 1991; 122:110.
 17. Best M, Sattar SA, Springthorpe VS, Kennedy ME. Efficacies of selected disinfectants against *Mycobacterium tuberculosis*. J Clin Micro 1990; 28 2234-2239.
 18. Matyas J, Dao N, Caputo AA, Lucatorto FM. Effects of disinfectants on dimensional accuracy of impression materials. J Prosthet Dent 1990; 64:25-31.
 19. Devine DA, keech AP, Wood DJ, Killington RA, Boyes H, Doubleday B, Marsh PD. Ultraviolet Disinfection with a novel microwave-powered device. J of Applied Microbiology 2001;91(5):786-794.
 20. Robert JB. Evaluation of an ultraviolet disinfection unit. Prosthet Dent.1987 ;58:650-654.