The effect of disinfectants on the surface quality of irreversible hydrocolloid impression material and gypsum cast

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المستخلص

الهدف: من اجل تقييم التغييرفي نوعية السطح لمادة الطبعة الغروية المائية هايدروكام غير المعكوسة بعد تطهيرها بصوديوم هايبوكلورايت ٥٢٥، ٠ %، كلورهيكسيدين كلوكونايت ٠،٢% ، بوفيدون ايودين ٤%.

المنهجية: تم تصنيع ٤٠ عينة من مادة الطبعة الجينيت وفقا للقياس اي اس او ١٥٦٣ وتم تقسيمها الى اربع مجاميع وفقا لطريقة الغطس في المحلول: المجموعة الاولى تغطس في صوديوم هايبوكلورايت ٥٢٥، ٠ %، المجموعة الثانية تغطس في كلورهيكسيدين كلوكونايت ٠،٢%، المجوعة الثالثة تغطس في بوفيدون ايودين ٤%، المجموعة الرابعة لاتغطس في اي محلول (التحكم). بعد ذلك تم صب العينات في مادة ستون نوع ٢. تفاصيل السطح تم قياسها باستعمال قالب ستينليسس ستيل.

النتائج: باستعمال اختبار كروسكيل واليس ، اظهرت النتائج عدم وجود فرق محسوس في تأثير محاليل المطهرات على نوعية تفاصيل السطح لكن استعمال محلول صوديوم هايبوكلورايت ادى الى تاكل او ضرر في نوعية سطح القالب وهذا الفرق احصائيا غير محسوس.

التوصيات:اجراء دراسة مختبرية لبيان تأثير محاليل المطهرات على انواع مختلفة من الجراثيم الموجودة في الفم واجراء فحص صلادة مادة الطبعة بعد استعمال محاليل المطهرات.

Abstract:

Objective: To evaluate the changes in the surface quality of irreversible hydrocolloid impression material hydrogum following disinfection with 0.525% sodium hypochlorite, 0.2% Chlorehexidine Gluconate, and 4% Povidone Iodine.

Methodology: Forty specimens of alginate impression materials hydrogum were fabricated according to the ISO 1563 and were divided into four groups according to the method of solution dipping: group 1: Dip in 0.525% sodium hypochlorite, group 2: Dip in 0.2% chlorhexidine gluconate, Group 3: Dip in 4% Povidone Iodine, Group 4: No treatment with any solution (control group). Then the specimens were poured in type II stone. Surface detail was determined using a stainless steel block in accordance with ISO 1563.

Results: The results were subjected to Kruskal – Wallis non parametric test showed no statistical significant difference in the effect of the disinfection solution on the surface detail quality (P – value 0.392, at p> 0.05). However, the surface quality of the specimens disinfected by sodium hypochlorite showed some degree of erosion or damage to the surface quality of the resultant cast, but the difference was not statistically significant.

Recommendations: make microbiological study to evaluate the effect of disinfectant solutions on different microorganisms present in the oral cavity and evaluate the hardness of impression material following the use of disinfectant solutions.

Key words: alginate impression material, stone cast, surface detail reproduction

Introduction:

Direct physical interaction between the dental clinic and dental laboratory is intrinsic in the practice of general dentistry. It is also one of the areas most difficult to deal with from a cross-infection control point of view. Transmission of infected materials from the clinic to the laboratory not only places unwary staff at risk but results in a high level of avoidable cross-contamination[1].

Impression materials that have been exposed to infected saliva and blood provide a significant source for cross contamination. Microorganisms from the oral cavity in fact can survive on the impression surface and can be transferred to the stone casts [2]. Moreover, simply washing with water or rinsing in running water does not completely remove contaminating microorganisms from the impression [3]. Rinsing with water has been shown to reduce approximately 40% counts of the bacteria present on an impression surface and a significant number of bacteria would remain[4].

It has been demonstrated that microorganisms on and/or in impression materials can be transferred to stone casts and remain viable. The concept is that microorganisms could move from an impression into the viscous medium of a setting laboratory stone. This would be especially valid for hydrocolloid types of impressions[5]. In addition; microorganisms which have contaminated the surface of an impression can be recovered readily from gypsum casts at 1 h and 24 h periods following the pouring-up of the impression. This indicates clearly that gypsum casts are possible routs of transmission of pathogenic microorganisms for at least the first 24 hrs.1 More recent recommendations advocate the use of a disinfecting solution, but there is still no universally recognized impression disinfection protocol[4]. The role of disinfectant is a dual process, in that it must be an effective antimicrobial agent, yet cause no adverse response to the dimensional accuracy and surface texture features of the impression material and the resultant gypsum cast.6 The purpose of this study was to evaluate changes in surface quality of irreversible hydrocolloid impression material following disinfection with 0.525% sodium hypochlorite, 0.2% chlorhexidine Gluconate and 4% Povidone Iodine.

Materials & Methods:

Irreversible hydrocolloid impression material (Hydrogum / Zhermack, Italy, Batch no. 0158332117.105) which is generally used for prosthetic and orthodontic purposes was selected for this study. Dental stone Type III (ZETA selenor, Italy, Batch no. 00891) which is traditionally used in dental clinics and dental laboratories was chosen in this study. The disinfectant solutions used in this and their concentration are listed in Table 1.

Table 1. Disinfectant solutions used in the study

Solution	Manufacturer	Dilution
Sodium hypochlorite (NaOCl)	Fas (6.4% w/v) Babel Company, Baghdad, Iraq, diluted to 0.525%	0.525%
Chlorehexidine gluconate (CX)	(Al-Mansur mouth wash, Baghdad, Iraq) Batch no. 001	0.2%,
Povidon Iodine (PI)	(Al-Ansari for antiseptics, Aleppo, Syria) Batch no. 67703	4%

The irreversible hydrocolloid material was manipulated in accordance with the manufacturer's instructions recommended powder to liquid mixing ratio of 9gm to 17.5ml water respectively. To prepare the forty alginate specimen, the powder was measured into a mixing bowl using a digital balance (Sartorius, AG) accurate to 1µm and

thee distilled water (Al-Mansur Factory Iraq) was dispensed on top using a disposable syringe. The powder and liquid constituents were hand mixed together using a spatula for 10s [7].

Surface detail evaluation:

A stainless steel block was fabricated with three lines of 20, 50 and 75µ width in accordance with ISO 15638 to test the surface detail reproduction quality of casts obtained from each combination of impression material and disinfection solution [4].Before recording each impression, the test block was wiped with ethanol and allowed to dry at room temperature [2]. A circular plastic mold was used to retain the impression material. The impression material was mixed and applied carefully to the circular plastic mold and the test block with three lines faced toward impression material to minimize trapped air. The top of test block now load with 1Kg weight. The impression material was allowed to set for 5 min before being removed from the test block. The impression material was subjected to one of the following disinfection procedure (10 samples for each group):

1) Dip for 5s in 0.525% sodium hypochlorite, rinse in tap water, second dip for 5s in sodium hypochlorite, the cover the impression material with gauze dampened by sodium hypochlorite for 10 min.
2) Dip for 5s in 0.2% Chlorhexidine gluconate, rinse in tap water, second dip for 5s in sodium hypochlorite, the cover the impression material with gauze dampened by Chlorhexidine gluconate for 10 min.
3) Dip for 5s in 4% Povidone Iodine, rinse in tap water, second dip for 5s in Povidone Iodine, the cover the impression material with gauze dampened by Povidone Iodine for 10 min.
4) No treatment with any solution (control group).

Following disinfection procedure, all impressions were rinsed under tap water for 60s and then sealed in a plastic bag with the impression surface turned downwards to prevent water evaporation[9]. then all the impressions were cast using dental stone, with a powder to liquid mixing ratio of 4.5gm to 1ml of distilled water respectively. The distilled water which was dispense with a plastic syringe was placed into a mixing bowl and the stone powder was slowly added and hand mixed with the aid of spatula for 10s until the powder was completely wetted by the liquid. The mixing was done with aid of vibrator. The casts were allowed to set for 45min before separation from the impression. None of the cats were mechanically trimmed. The molds were stored at room temperature for 48 hrs prior to analysis [7].

Each specimen was then scanned at 1200 dpi resolution on a flat bed scanner (Genix, China), using a template as a guide on the scanner surface. The scanned images were saved as jpg format. Surface detail reproduction was evaluated by one operator examined the images of specimens on computer monitor after X10 magnification and graded using a scoring system from 1 to 4.10

The ratings were defined as follows:

1) Sharp detail, continuous line.
2) Continuous line, but with loss of sharpness.
3) Deterioration of line details.
4) Rough appearance, with loss of continuity of line.

The results were subjected to the Kruskul – Wallis nonparametric test using spss 10 soft ware statistical package.

Results:

The results were subjected to Kruskal – Wallis non parametric test using spss 10 soft ware statistical package. It indicates no significant difference in the effect of the disinfection procedure on the surface detail quality (P – value 0.392, at p> 0.05). The results of surface detail quality of the 40 specimens' scores are shown in Table 2. Dipping of the specimens in 0.525% sodium hypochlorite was shown to have a detrimental effect on alginate impression specimens and produced stone

casts of reduced quality. Dipping of the specimens in 0.2% Chlorhexidine gluconate and 4% Povidone Iodine did not have any serious effects on the surface quality of the impression material.

Table 2. Surface detail quality of the 40 specimens' scores

Solution	Number of specimens	Scores
NaOCl 0.525%	10	2
Chx 0.2%	10	1
Povidon Iodine 4%	10	1
No treatment (control)	10	1

Discussion:

The risk of cross – infection from a patient to a dental technician is a topic of interest. In order to protect all the members of the dental team, a high standard of hygiene and disinfection of dental equipment is required, including dental impression[2]. It has been suggested that dental impressions which become contaminated with patient's saliva and / or blood can cross – contaminates stone casts poured against them. A wide variety of disinfectants are commonly available, but specific recommendations about which one to use are primarily based on the disinfection characteristics of individual disinfectants [7].

Detail reproduction is an important characteristic of odontological plaster, since the correct adaptation of the prosthetic restoration is directly related to the exactitude of the cast [11].

This study was done to evaluate the surface detail reproduction of stone cast after dipping the alginate impression in various disinfectant solutions. NaOCl is one of the original and most widely used disinfectants and it is effective against a broad spectrum of micro – organisms including human deficiency viruses, hepatitis B viruses as well as numerous other bacterial species and their spores, viruses and fungi [7].

Chlorhexidine gluconate is inexpensive, commercially available disinfectant solution with wide range of antimicrobial activity [12]. Dipping alginate impression was employed in this study since dipping can be considered as a midway method between immersion and spraying method, however, the finding from previous studies have not been univocal because of different exposure time, concentration and various combinations of disinfectants, impression materials and gypsum casts.

The results of the present study showed that dipping the alginate impression in Chlorhexidine gluconate and Povidone Iodine disinfectant solutions did not affect the surface detail reproduction of the resultant casts and only the impression which was dipped in NaOCl showed score 2 which mean continuous line but with loss of sharpness, however, this difference was not statistically significant. In this study, NaOCl caused some degree of erosion or damage to the surface quality of the resultant casts. This could be explained that alginate impression material imbibed the disinfectants which, in turn, inflicted a discernable damage to the alginate impression surface[13]. This in agreement with Rentzia et al.,[7] who explained this result to either a reaction between the hypochlorite absorbed into the impression and the dental stone or a direct effect of the hypochlorite on the alginate in relation to the surface quality. This result of the present study is in accordance with Hiraguchi et al., [14]. who found that spraying alginate impressions with NaOCl did not lead to serious deformation of stone models. They recommended spray disinfection method as an effective and handy means for disinfection. This is also in agreement with Rweyendela et al., [15]. who concluded that disinfection of alginate impression material by immersion in chlorinated compounds was effective and ideal and in agreement with

Lucas et al., 11 who concluded that the incorporation of Chlorhexidine and glutaraldehyde in the concentrations and dilutions used in this study did not harm the detail reproduction capacityof gypsum.

The result of the present study agrees with Abdullah [10], who stated that repeating the process of immersion of stone in slurry with NaOCl reduces the compressive strength of dental stone. The results of the present study agrees with Taylor et al., [4] who concluded that, following immersion or dipping in 1% NaOCl, a partial deterioration of alginate impression material occur, which leads poor surface quality of the resultant casts.

In the present study, it has been shown that disinfection of alginate impression with 4% Povidone Iodine did not lead to a change in the surface detail reproduction of the resultant stone cast. This in conflict with Abdelaziz et al., [16] who incorporates 0.525% NaOCl and 0.1% Povidone Iodine as mixing water substitutes for dental stone. This could be explained by the differences in the methodology used in [16].

In the present study, the impression materials were undergone the process of dipping with disinfectant and not the stone cast. The present study agrees with Ivanovski et al., 1 who found that surface detail reproduction of stone cast was not affected by incorporating Povidone Iodine and Chlorhexidine gluconate to the stone mixture. They suggested the use of Povidone Iodine as a method of disinfection. From the present study, it could be concluded that:

1.Both Chlorhexidine Gluconate 0.2% and 4% Povidone Iodine can be used to disinfect irreversible hydrocolloid alginate impression material with no significant effect on the surface detail reproduction of the resultant cast.

2. The use of 0.525% sodium hypochlorite leads to some degree of damage to the surface quality of the resultant cast, although this difference was not significant.

Recommendations: make microbiological study to evaluate the effect of disinfectant solutions on different microorganisms present in the oral cavity and evaluate the hardness of impression material following the use of disinfectant solutions.

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