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# Effect of natural disinfecting solutions on the wettability of silicone rubber impression materials.

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## Abstract :

**Back ground:** 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.

**Aim:** The aim of this study is to evaluate the effect of natural disinfection on the wettability of some silicone impression materials by contact angle registration of the gypsum slurry on flat surfaces of the impressions.

**Materials and methods:** Zetaplus putty and Oromamax light with two types of natural disinfecting solutions lemon juice and apple vinegar for three disinfecting times were used in this study. Two treatment regimes were investigated: The first group of impression materials specimens was exposed to saliva for 5 minutes (control group). Second group of specimens was exposed to saliva then to disinfectant agents (experimental groups), a computerized photographic procedure was used to measure the wettability of the specimens. Statistical analysis was performed by using t-est at $p<0.05$.

**Results:** Data indicated that Oromamax light recorded lower mean contact angles than the Zetaplus putty silicone used in this study regarding all tested groups. The disinfection of Oromamax light in lemon juice produced insignificant increase in the mean contact angle measurements at all disinfection times. Disinfection of Zetaplus putty in lemon juice produced a significant increase of the mean values at 10 and 15 min. disinfection times, while produced insignificant differences regarding 5 min. disinfection time when compared with the control group. The disinfection of Oromamax light in apple vinegar produced significant decrease in the mean contact angle measurements at all disinfection times. Disinfection of Zetaplus putty in apple vinegar produced a insignificant differences of the mean values at all disinfection times.

**Conclusion**: Immersion disinfection of silicone impressions materials in natural apple vinegar is recommended in preference to maintain wettability of silicone rubber impression materials for short disinfection time as well as improve the wettability when used the apple vinegar with Oromamax light. While the natural lemon juice solution may adversely affect the wettability, especially when used for 10, 15 min immersion to disinfect the putty silicon impression material.

Key words: Natural disinfection, wettability, silicon impression, contact angle.

**الخلاصة:**

هنالك أهتمام كبير بموضوع أنتقال العدوى في عيادات و مختبرات طب الأسنان. توجد طرق عديدة لتطهير الطبعات السنية بأستخدام مواد كيميائية و لكن يمكن لهذه المواد ان تؤثر سلبا على قابلية الترطيب لمواد الطبع. أعدت هذه الدراسة لتقييم تأثير مواد التطهير الطبيعية على قابلية الترطيب لبعض المواد السليكونية بأستعمال زاوية الأتصال لمحلول الجبس على السطوح المستقيمة لمواد الطبع.

أثبتت الدراسة أن تغطيس مواد الطبع السليكونية في محلول خل التفاح الطبيعي لا يؤثر على قابلية الترطيب بينما أثر عصير اليمون الطبيعي سلبا على قابلية الترطيب لسطوح مواد الطبع السليكونية خصوصا عند تغطيسها لمدة 10 ,15 دقيقة.

## 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 professionals[1].

Silicone impression materials have gained popularity among dentists; they exhibit very good accuracy, together with an absence of taste and easy de-molding. One problem with the use of these materials is bubble formation during pouring of the impressions[2,3,4,5].

Some dental laboratories spray the cured impression with surfactant solutions just prior to pouring the model to increase the wettability of the impressions[5].

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.

Chlorhexidine is a broad-spectrum disinfectant that is widely acknowledged as an extremely effective antiplaque and antigingivitis agent. It has been studied mostly in mouth-rinse formulations and is safe and effective. Although mouth rinses containing 1.2 g/L chlohexidine are ADA accepted and available on a prescription basis for treating gingivitis, studies indicate that 1.2 g/L chlorhexidine is cytotoxic to human fibroblasts in vitro and is able to induce primary DAN damage in leukocytes and oral mucosal cells[6].

The lemon is the common name for Citrus Limon, lemons are rich in citrus flavonoids which are photochemical (biologically active plant compounds) that can assist the healing of wounds, strengthen the walls of blood capillaries and prevent diseases such arteriosclerosis, alongside vitamin C, that have a powerful antioxidant function, and is good for strengthening the immune system and preventing infection and disease.

Lemon juice is a natural disinfectant and antiseptic, prior to the development of modern antiseptics, it was used in hospital for this purpose. The juice can be applied directly to the skin, it is an astringent and a bactericide and it is a useful ingredient in home.

Apple vinegar can also used as a disinfectant in dental field, Spano et al.(2009) reported that the apple vinegar is the effective solution for removal of smear layer when used as root canal chelators[7].

Estrela et al[8] were found that vinegar had an antimicrobial effect against staphylococcus aureus when used in a ultrasonic cleaning system.

Recently, Alkhafagy et al[9] 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* bacteria

## Materials and methods

The impression materials used in this study were Zetaplus putty (Zhermack Clinical, Italy) and Oromamax light (Major Prodotti Dentari, Italy). The materials were manipulated according to manufacturer's instructions.

According to ADA specification No. (18) test molds were made from plastic rings 30 mm inside diameter and 16 mm high which was manufactured locally for this study (fig 1). The impression materials were applied within the test molds; flat surfaces were obtained by pressing the mold against well cleaned and dried a glass slab. The specimens pressed by using 1/2 kg weight to squeeze out the excess material till the specimens set.

Regarding each tested impression material, four specimens were produced for the control and every experimental group. The treatment regimes were as follows:

1- Oromamax light

Group 1.1 (control group) involved specimens exposed to diluted saliva (50% saliva in distilled water) for 5 minutes, then rinsed with distilled water and air dried.

Group 1.2 (experimental group) involved specimens exposed to diluted saliva for 5 minutes, then rinsed under distilled water and air dried. Then the specimens were immersed in the disinfecting solutions (commercially available apple vinegar and lemon juice solution) for either 5, 10 and 15 min. Finally, the specimens were rinsed under distilled water and air dried.

2- Zetaplus putty

Group 2.1 (control group) involved specimens exposed to diluted saliva (50% saliva in distilled water) for 5 minutes, then rinsed with distilled water and air dried.

Group 2.2 (experimental group) involved specimens that were exposed to diluted saliva for 5 minutes, then rinsed with distilled water and air dried. Then the specimens were immersed in the disinfecting solutions (commercially available apple vinegar and lemon juice solution) for either 5, 10 and 15 min. Finally, the specimens were rinsed under distilled water and air dried.

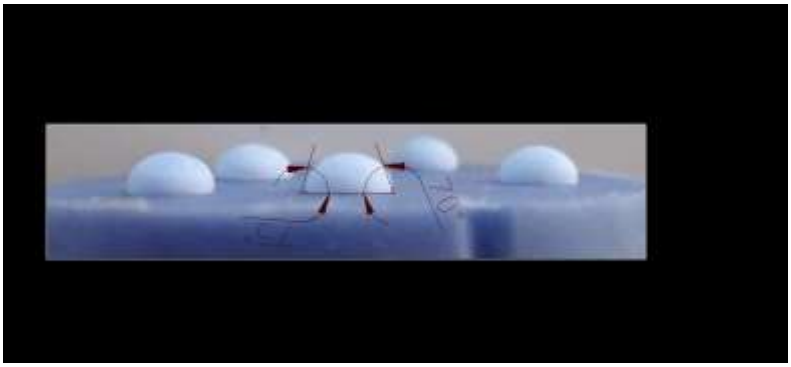
Gypsum slurry (Elite stone, Zhrmack, Italy) was prepared (100g of gypsum powder was mixed manually with 50ml of distilled water to produce a mixture of a workable consistency). Five droplets of 20 µL were dispensed on the surface of the impression specimens by using a micro pipette, figure (2). The distance between the tip of micro pipette and the surface of the impression sample was fixed on 5 mm.

The droplets were left for 10 seconds then direct reading of the contact angle was performed with a computerized photographic procedure by using digital camera (Sony, Cyper-shot, 14.1 mega pixels, Japan) and AUTO CAD program 2008. The camera was fixed on a stand and the distance between the lens of the camera and the sample was 10 cm.

Descriptive data include means and standard deviation was used in the statistical analysis. Comparison between groups was done by using T- test at $p<0.05$.

Figure (1):- plastic mold

Figure (2):- Impression specimens with slurry droplets of dental stone.



Figure(3):-Computerized photograph illustrates contact angle measurement with AUTO CAD program

## Results

Means and standard deviation of the measured contact angles for the control and experimental groups are shown in table (1). Data indicated that Oromamax light recorded lower mean contact angles than the Zetaplus putty used in this study regarding all tested groups.

Table (1): Means and standard deviation of the contact angle measurements for the control and experimental groups of each impression material.

| | Control | Lemon juice | | | Apple vinegar | | |
|---|---|---|---|---|---|---|---|
| | | 5min. | 10min | 15min | 5min. | 10min | 15min. |
| Oromamax light | 76.6<br>3.524911 | 79.4<br>2.880972 | 78.3<br>3.701351 | 80.4<br>1.294218 | 59.5<br>8.573214 | 67.6<br>3.267262 | 66.7<br>2.564176 |
| Zetaplus putty | 77.1<br>2.382226 | 80<br>1.968502 | 82.1<br>1.67332 | 81.7<br>0.570088 | 77.4<br>2.329163 | 75.8<br>3.012474 | 74.5<br>2.263846 |

**n= 5**

Table (2) showed a comparison between the control and experimental groups of the impression materials disinfected with lemon juice. The disinfection of Oromamax light in lemon juice produced insignificant increase in the mean contact angle measurements at all disinfection times. Disinfection of Zetaplus putty in lemon juice produced a significant increase of the mean values at 10 and 15 min. disinfecting times, while produced insignificant differences regarding 5 min. disinfection time when compared with the control group.

Table (2): T-test between the control and the lemon juice groups regarding Oromamax light and Zetaplus putty impression materials for the two testing periods.

| | Lemon juice | | | | | |
|---|---|---|---|---|---|---|
| | 5min. | | 10min | | 15min. | |
| | t-value | Sig. | t-value | Sig. | t-value | Sig. |
| Oromamax light | 1.279 | 0.270 NS | 0.937 | 0.402 NS | 1.862 | 0.136 NS |
| Zetaplus putty | 1.795 | 0.147 NS | 4.016 | 0.016 S | 4.757 | 0.009 S |

**NS**: insignificant difference **S**: significant difference

Table (3) showed the t-value and significant differences between the control and experimental groups of the impression materials disinfected with apple vinegar. The disinfection of Oromamax light in apple vinegar produced significant decrease in the mean contact angle measurements at all disinfection times. Disinfection of Zetaplus putty silicone in apple vinegar produced a insignificant differences of the mean values at all disinfection times.

Table (3): T-test between the control and the apple vinegar groups regarding Oromamax light and Zetaplus putty impression materials for the two testing periods.

| | Apple vinegar | | | | | |
|---|---|---|---|---|---|---|
| | 5min. | | 10min | | 15min. | |
| | t-value | Sig. | t-value | Sig. | t-value | Sig. |
| Oromamax light | -5.721 | 0.005 S | -4.663 | 0.010 S | -4.369 | 0.012 S |
| Zetaplus putty | 1.633 | 0.178 NS | -1.537 | 0.199 NS | -1.739 | 0.157 NS |

**NS**: insignificant difference **S**: significant difference

## Discussion

Under clinical conditions impression materials are exposed to saliva during setting in the oral cavity. When impressions are retrieved, they are covered by a thick salivary film and sometimes blood. In view of prophylaxis against infections, all impressions should be disinfected before pouring but disinfection procedure might affect their wettability[10, 11].

Wettability of impression materials can be improved by topical surfactant application. Surfactants are referred to as wetting agents; they lower the surface tension of the impressions[12].

The wettability of impression materials has previously been described by determining the contact angles of gypsum products or CaSo4 solutions on the impressions[13].

Results of this investigation indicated that the contact angle values varied according to type of impression materials and disinfecting agent. Disinfection of Oromamax light and Zetaplus putty silicones with lemon juice did not improved the wettability of the materials, furthermore, the contact angle measurements of Zetaplus putty impression material when immersed in lemon juice for 10 and 15 min were increased significantly. This could be attributed to the activity of lemon juice in elevation of surface tension of the putty silicon impression material.

The contact angles of Oromamax light in the apple vinegar were significantly lower than those of the control group at all disinfection times ($p<0.05$), this may be related to lower pH of the apple vinegar, while this action was not promote the wettability of Zetaplus putty silicon regarding all immersion times in apple vinegar solution.

## Conclusion

Immersion disinfection of silicone impressions materials in natural apple vinegar is recommended in preference to maintain wettability of silicone rubber impression materials for short disinfection time as well as improve the wettability when used the apple vinegar with Oromamax light. While the natural lemon juice solution may adversely affect the wettability, especially when used for 10, 15 min immersion to disinfect the putty silicon impression material.

Clinical Significant: Natural apple vinegar solution is recommended to use as disinfection material to disinfecting impressions in a short period of 5,10 minutes as being a very practical method will stop the cross-contamination and spreading of the infections in dental profession as well as improve the wettablility of silicon impression materials.

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