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The Effect of Chemical Disinfectants on the Setting Time and Dimensional Change of Alginate Impression Material.

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الخلاصة

الأهداف:تحديد تأثير خلط سوائل التعقيم مع مادة الطبعة الالجينيت على دقة و ثباتية الحجوم وتأثيرها على وقت التصلب.**المواد وطرائق العمل** :تم تحضير ٤٠ عينة ،عشر عينات منها كونت المجموعة القياسية تم الحصول عليها بعد صب طبعة الالجينيت المأخوذة للقالب القياسي المعدني . استخدمت ثلاثة سوائل معقمة لكي تخلط مع مادة طبعة الالجينيت .وتم حساب التغيرات الطولية عن طريق قياس محيط المثلث المتكون بين ثلاث نقاط مثبتة على قالب قياسي معدني يمثل الفك العلوي الادرد بواسطة برنامج الأوتوكاد .كما تم حساب وقت التصلب للمجاميع السابقة بعد خلطها مع السوائل المعقمة .استخدمت البرامج الإحصائية :تحليل التباين واختبار دنكن. **النتائج**: كانت نتائج التغيرات الطولية غير مؤثرة معنويا لكل المواد المستخدمة .وكان هناك تأثير معنوي في نتائج وقت التصلب **الاستنتاجات** : أظهرت هذه الدراسة انه يمكن خلط السوائل المعقمة بنسب معينة مع مادة الالجينيت بدون أن تؤثر على دقة الطبعة وبعض المعقمات ساهمت في تسريع وقت التصلب .

ABSTRACT

Aims: The aim of this study was to evaluate the effect of mixing different concentrations of chlorhexidine, iodine ,and sodium hypochlorite solutions on the setting time and dimensional change of alginate impression material. **Materials and methods**: Total number of samples (40) has been prepared in this study. Ten samples for control group made from pouring alginate impressions of metal model .The other groups made by mixing alginate with 0.05% iodine, 0.5% chlorhexidine and 0.5% sodium hypochlorite solutions. Dimensional change was measured with AutoCAD program .The Setting time was also measured for each group. Statistical analysis was performed using ANOVA and Duncan multiple range test. **Results**: no significant difference in the linear dimensional change among the tested groups ,sodium hypochlorite added to alginate as disinfectant showed the highest dimensional changes among the other groups. There was a significant difference among the tested groups in the setting time. It was found that treating the alginate with sodium hypochlorite and chlorhexidine disinfecting agents accelerated the setting time of the material. **Conclusion**: The testing disinfecting agents can be used safely regarding dimensional change.

Key words: Alginate impression, dimensional change, setting time, chlorhexidine, iodine, sodium hypochlorite

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INTRODUCTION

Dental practitioners, patients, and laboratory personnel are subjected to notable risks with respect to infectious diseases, which can be spread by saliva or blood from contaminated impression material, particularly irreversible hydrocolloid impression material.[(1)] An impression material must have dimensional stability to cause the overall success of the cast made from it. [(2)]

Many studies have evaluated the effect

of various disinfectants and methods of disinfecting impression materials, but the results of those studies varied widely. The role of a disinfectant should, ideally, be of a dual purpose, it must be an effective antimicrobial agent, yet cause no adverse response to the dimensional accuracy and surface features of the impression material and the resultant gypsum cast.[3]

Several methods of disinfection for alginate impression materials were proposed. Spray and immersion methods are the two most widely used techniques in clinical practice. However, these conventional strategies present several disadvantages like loss of surface detail and dimensional inaccuracy of the impression.[4] Due to the difficulties with the disinfection of alginate impression materials, self-disinfecting alginate impression materials were developed. Studies have shown that this technique demonstrated better dimensional stability than spray and immersion techniques, and saved disinfection time. [5, 6 ,7] for most of the self-disinfecting irreversible hydrocolloid impression materials, disinfectants are impregnated into the powder of impression material and few attempts have been made to add disinfectants into the mixing liquid.[8]

Therefore, the aim of the present investigation was to examine the effect of several disinfecting solutions on alginate impression material. The objectives to achieve this aim were: To assess the dimensional accuracy and to assess the setting time.

MATERIALS AND METHODS

In this study the impression material used was alginate Hydrogum- soft (Zhermack-Italy) .The disinfectant solution used were:

0.05% iodine solution (Konix –Germany)

0.5 % chlorhexidine gluconate (Tosel-Turkey)

0.5% sodium hypochlorite (Clorox-Saudi Arabia)

A metal model resembles the maxillary edentulous alveolar ridge with 3 reference marks were used for this study, one of the marks was found on the anterior region near the incisive papilla, the other two marks were positioned on the right and the left 2nd premolar region (Figure 1).

Figure (1): Metal model with Reference points

The using of metal mold to measure the dimensional accuracy of the material was documented by many researchers. [9,10]. The rubber-mixing bowl and the steel spatula that were used for mixing were thoroughly cleansed with tap water, and dried, to prevent any adverse effects/contamination during the mixing and setting of the alginate material. The control that was used in this study was distilled water [11]. All impressions were mixed according to manufacturer's instructions ,water (18 ml) to (9 g) powder and the temperature of water was constantly kept at 20ºC [12] . Perforated acrylic resin trays with a uniform 1/4 inch of relief were made. The trays were keyed to fit the master model only to ensure consistent placement, removal and uniform thickness of the impression material[13]. Three stainless steel studs, welded to the tray with two holes on the horizontal parts, and two guiding pins on the fixed base were engaged into the holes to maintain the tray in a fixed and stable position. Disinfection solution was mixed with alginate. The impressions were poured in die stone (die-stone ,type IV) using a mechanical vacuum mixing machine (Multivac4, Degussa, Germany).A water/powder ratio of 22 ml water to 100g powder was used for each mix . The impressions were vibrated gently while being filled with stone using electrical vibrator (Qualy Dental, England), the casts were separated at 30 minutes from the beginning of the mixing of the stone. The separated casts were measured. All the procedures were carried out at 23°C and 50% relative humidity in a temperature controlled-room .[14]

Measuring dimensional changes

A digital camera with a high degree of resolution (360 Pixels) was used (DCR−SR45E Sony, Japan) and placed at constant distance (30cm)away from each specimen using stable horizontal stand .For the linear dimensional change the distance between three index marks were measured and selected to produce the circumference of triangle. The separated casts were measured to determine the dimensions illustrated in (Figure 2) using the AutoCAD computerized program. dimensional changes was determined from the mean percentage deviation of ten measurements taken from casts made from disinfected impressions compared with corresponding measurements from the master model and controls. Statistical analysis of data was determined by analysis of variance.

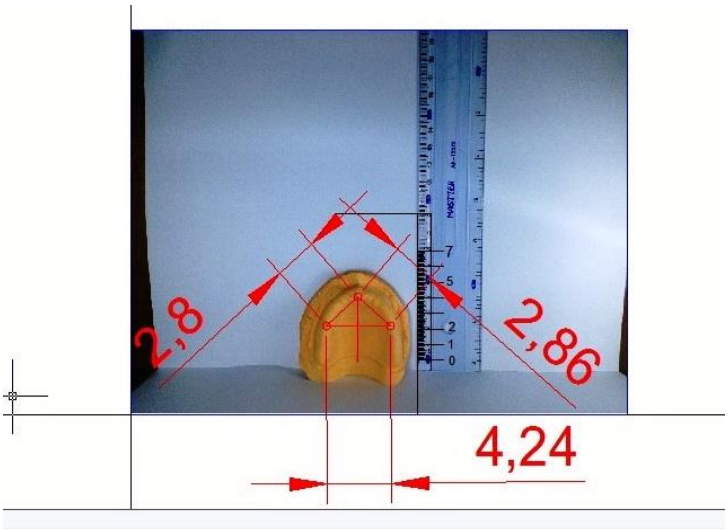


Figure (2): Measurement of dimensional accuracy

Measurement of Setting Time

Setting time was tested according to the method introduced by Lemon et al.(15) The impression material was mixed for 60 seconds and syringed on the surface of a flat glass slab. Sixty seconds after mixing, the flat end of a polished poly (methyl methacrylate) rod measuring 6 mm in diameter and 10 cm in length was placed in contact with the exposed surface of the material and then immediately withdrawn. This procedure was repeated at 3-second intervals in the early stages of setting and at 1-second intervals at the later stages until the impression material no longer adhered to the end of the rod. Setting time was established as beginning at the start of the mix and ending at the point at which the impression material no longer adhered to the end of the rod.

RESULTS

A. Evaluation of dimensional change

0.5 % chlorhexidine gluconate was found to produce the least dimensional changes in all the impression materials. 0.5% sodium hypochlorite produced the maximum changes. The dimensional changes, however, were minimal and statistically insignificant (Tables 1, 2) .

Table (1): Descriptive Statistics of dimensional change

Groups	No.	Mean	Std. Deviation
Control	10	100.270	± 1.4553
Iodine	10	100.890	± 1.4783
Chlorhexidine	10	100.830	± 1.3801
Sodium Hypochlorite	10	101.300	± 1.3960

Table (2): One–way ANOVA of dimensional change

SOV	Sum of Squares	Df	Mean Square	F–value	*p*–value
Between Groups	5.379	3	1.793	0.879	0.461
Within Groups	73.411	36	2.039		
Total	78.790	39			

No significant difference existed ($p > 0.05$)

B .Evaluation of setting time:

There was a significant difference among the tested groups in the setting time (Tables 3,4).It has been found that mixing the alginate with the disinfectant agents such as sodium hypochlorite and chlorhexidine solutions resulted in acceleration of the setting time of alginate compared to the control specimen. While mixing alginate with iodine disinfectant solution prolonged the setting time (Figure 3).

Table (3):Descriptive Statistics of Setting Time

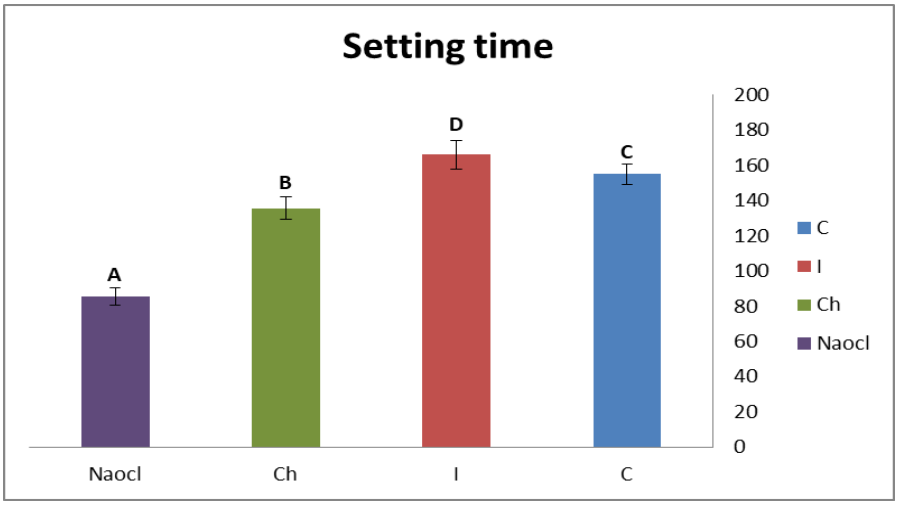
Groups	No.	Mean*	Std. Deviation
Control	10	155.00	± 5.774
Iodine	10	166.00	± 8.097
Chlorhexidine	10	135.50	± 6.433
Sodium Hypochlorite	10	85.50	± 4.972

*Mean Measurement unit in seconds

Table (4):One–way ANOVA of Setting time

SOV	Sum of Squares	Df	Mean Square	F–value	*p*–value
Between Groups	38105.000	3	12701.667	307.919	0.000*
Within Groups	1485.000	36	41.250		
Total	39590.000	39			

* Significant difference existed at p < 0.01



C- control, CHX – Chlorhexidine, I- Iodine, Naocl- Sodium Hypochlorite

Figure (3): Duncan of Setting time of alginate mixed with disinfectants.

DISCUSSION

The use of impregnated alginate with the antimicrobial compounds, if proven to be antiseptic as claimed, is advantageous for many reasons, such as time, accuracy, convenience and effectiveness of infection control. [16,17].

Regarding the three types of disinfectants, the results of this study showed that mixing alginate with disinfectant solutions had no effect on the accuracy of irreversible hydrocolloid impression material. It is most convenient because the surface of the impression need not be subjected to a chemical disinfection that may not always reach the internal portion to attack entrapped microbes. In conclusion, the three-dimensional accuracy

of the irreversible hydrocolloid was not influenced, even if disinfectants solutions served as the mixing liquid.[12,18]

The acceleration of the setting time resulted from mixing the alginate with the disinfectant agents could be explained, that sodium phosphate which control the setting characteristics of alginate materials (inhibitor of the reaction) sediments down wards while the other reactive components sediments upwards, so there will be sufficient calcium ions that required to complete the cross linking of alginate chains and thus accelerate the setting time of the material. [14]

CONCLUSION

No significant differences in dimensional changes were found between the control alginate and self-disinfecting alginate. However ,there are significant differences in setting time.

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