The effect of different storage times and storage conditions of two types of alginate impression on accuracy of master cast

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ABSTRACT

The aims of this study were to determine the effect of using different storage time and storage media on the accuracy of two types of alginate impression material, Hydrogum soft and Hydrogum elastic.

One hundred sixty impressions were recorded from a standard acrylic model using perforated trays. These impressions were divided into three main groups. In the first group, (48) impressions were stored at (3) times interval namely (15) minutes, (30) minutes, (60) minutes and left on the bench uncovered. In the second one, (48) impressions were stored in disposable plastic bags at the same time interval mentioned above. In the third one, (48) impressions were divided into (3) subgroups, the first one were only washed with tap water before pouring, the other two subgroups were immersed in Sodium Hypochlorite (0.5%) and Chlorhexidine Gluconate (0.5%) disinfectant solutions for (30) minutes before pouring, (16) impression will be taken and poured immediately to be considered as a control for this study.

A three dimensional measuring machine (3D) was used for measuring the dimensional change of stone casts, the results showed that there was no significant differences of casts accuracy produced from the two types of an alginate impression material.

Storage of alginate impression material at (15) and (30) minutes on the bench or inside sealed plastic bags showed no significant differences in dimensional changes compared with control samples that poured immediately. Storage to (60) minutes showed a significant difference, washing alginate with tap water and immersion in chlorhexidine disinfectant solution (0.5%) for (30) minutes showed no significant difference. Immersion in sodium hypochlorite (0.5%) for (30) minutes showed significant changes.

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It was concluded that alginate impression could be stored for (30) minutes inside plastic bags without significant changes if the pouring of alginate impression will be delayed for any reason.
Key Words: Alginate, impression material, chlorhexidine.

الخلاصة

الغاية الأساسية من هذه الدراسة هي تبيان تأثير استخدام طرق خزن واوقات خزن مختلفة على دقة مادة الطبع (الالجينيت) قبل صبها بمادة البورك الصخري . نوعين من مادة الطبع (الالجينيت) تم استخدامها وهما : سوفت و ايلاستك.

مائة وستون طبعة اخذت لنموذج الاكريليك الثابت باستخدام حاملة مادة الطبع المصنوعة من مادة الالمنيوم المثقبة ، ثُبِّتَ النموذج الرئيسي على جهاز خاص صمم لهذه الدراسة ، قسمت هذه الطبعات الى ثلاث مجموعات رئيسية : في المجموعة الاولى ، ثمان واربعون طبعة خزنت في ثلاثة اوقات مختلفة وهي: (١٥) دقيقة، (٣٠) دقيقة ، (٦٠) دقيقة. وتركت على المنضدة مكشوفة بلا غطاء . في المجموعة الثانية ، ثمان واربعون طبعة خزنت في علب بلاستيكية محكمة الاغلاق في نفس الاوقات المذكورة آنفا . وفي المجموعة الثالثة، ثمان واربعون طبعة قسمت الى ثلاث مجاميع فرعية ، المجموعة الاولى غسلت بالماء الفاتر فقط قبل الصب ، اما المجموعتان الاخريتان فقد غطستا في نوعين من محاليل التعقيم وهما : صوديوم هايبوكلورايت و كلورهكسيدين كلوكانيت بتركيز (٠,٥%) ولمدة (٣٠) دقيقة.

استخدم جهاز القياس ثلاثي الابعاد لقياس تغييرات الابعاد الحاصلة في النماذج المصبوبة واظهرت النتائج انه ليس هناك فرق معنوي بين نوعي مادة الطبع (الالجينيت). خزن مادة الطبع (الالجينيت) الى (١٥) و (٣٠) دقيقة على المنضدة غير مغطاة او داخل العلب البلاستيكية اظهر عدم وجود فروقات معنوية مقارنة مع النماذج القياسية المصبوبة مباشرة . غسل مادة الطبع (الالجينيت) بالماء الفاتر والتغطيس بمحلول التعقيم كلورهكسيدين كلوكانيت بتركيز (٠,٥%) لمدة (٣٠) دقيقة اظهر عدم وجود فروقات معنوية في تغيير الابعاد مقارنة مع النماذج القياسية ، اما التغطيس بمحلول التعقيم صوديوم هايبوكلورايت بتركيز (٠,٥%) لمدة (٣٠) دقيقة ، فقد اظهر وجود فروقات معنوية .

نستنتج انه من الافضل غسل مادة الطبع (الالجينيت) بالماء الفاتر قبل عملية الصب من اجل ازالة اللعاب ، الدم واية شوائب اخرى ، اذا أُجلت عملية صب مادة الطبعة (الالجينيت) لاي سبب من الاسباب فمن الممكن خزن الطبعة لمدة اقصاها (٣٠) دقيقة داخل علب بلاستيكية ومن

الممكن ايضا تعقيمها بمادة الكلورهكسيدين بتركيز (٠,٥ %) لمدة (٣٠) دقيقة ومن دون أي تأثير معنوي على دقة الابعاد .

INTRODUCTION

Alginate impression materials are widely used for a variety of applications. In prosthodontics, they are used for recording the impression of edentulous and partially edentulous Arches. In orthodontics they are used for recording impression prior to appliance construction. They are rarely used for crown and bridge work because their tear resistance is a serious disadvantage when considering this application [1,2].

After the removal of the alginate impression from the patient mouth the distortion begins and the distortion will continue to increase progressively until the impression is no longer acceptable clinically [3].

The alginate impression material may loose water by evaporation from its surface or by exudation of fluid into the surface by a process known as syneresis. This process must be limited to ensure a better quality of the impression [4].

The risk of infection in prosthetic dental procedures is very real one, Normal sterilization and disinfectant procedures, in particular dry and moist heat and some chemical methods are inappropriate for many treatment processes [5].

The study was designed to determine:

1. The effect of storage of an alginate impression at a different time interval on the accuracy of master casts.
2. The use of different types of an alginate impression material will affect the accuracy of master cast if the impression is stored at a different time interval.
3. Whether the storage (in disinfectant solution, in sealed plastic bags or left on the bench uncovered) causes any dimensional changes in alginate impression and leads to inaccuracy of master casts also, using a different time interval.
4. To find the suitable time and media for storage of an alginate impression without a significant change, if the pouring of an alginate impression should be delayed for any reason.

MATERIALS AND METHODS

Materials

The manufacturer of the alginate impression materials, stone and disinfectant solutions are shown in table (1).

Table (1): Material used in this study

Material	Manufacturer	Batch No.
Alginate Impression (Hydrogum soft)	Badia Polesim (Rovigo ITALY)	45021
Alginate Impression (Hydrogum elastic)	Badia Polesim (Rovigo ITALY)	45021
Stone (Gypsum)	NOVI LIGURE (ITALY)	15067
Sodium Hypochlorite Solution (0.5%)	(IRAQ)	----------
Chlorhexidine Gluconate Solution (0.5%)	Macciesfield Cheshire (UNITED KINGDOM)	1932366

Methods

Construction of Master Model

Wax Pattern was prepared to simulate a maxillary dental arch in which four halls were made, two at the canine area and the two at maxillary first molar area (Class III Mod II-Kennedy Classification).

This wax pattern was milted and packed with a hot cure acrylic Resin in a similar way to complete denture construction. Four experimental abutments were prepared from a stainless steel, cut in milling machine; these experimental abutments were fixed with screw in the halls of the prepared acrylic model.

These abutments are of cubic shape in diameter and have the same dimension, which is (5x5x5) mm. In the middle part of the palate of the acrylic master model, a stainless steel rod of (1) cm in diameter and (7) mm in length was fixed to standardize the measurements, the border of master model was free from any undercut area to reduce the distortion of the impression during the removal (figure 1).

Test Apparatus

The test apparatus were designed in order to hold the acrylic master model in a secured constant position to the impression tray, providing a desirable thickness of an impression material.

The test apparatus consists of aluminum base of (18x11x 2) cm in dimension and weight of (2) kg.

Three vertical stainless steel rod was screwed at this base, the first one has the dimension of (2.2) cm in diameter and (10) cm in length and carries another small aluminum base of (9x9x2) cm dimension to which the master model was fixed with screws.

The second rod was (2) cm in diameter and (15) cm in length, which is fixed at the other side and attached to Aluminum plate of (19x2.5x1) cm dimension with hinge movement to permit placement and removal of impression tray.

The Aluminum tray was fixed in this horizontal plate in slide that prepared in the inner surface and will prevent any rotational and slipping of the tray during taking the impression. The third rod was designed of (1.5) cm in diameter and (14) cm in length and acts as a stabilizer by a certain screw in order to adjust a constant thickness of the impression material (figure 2).

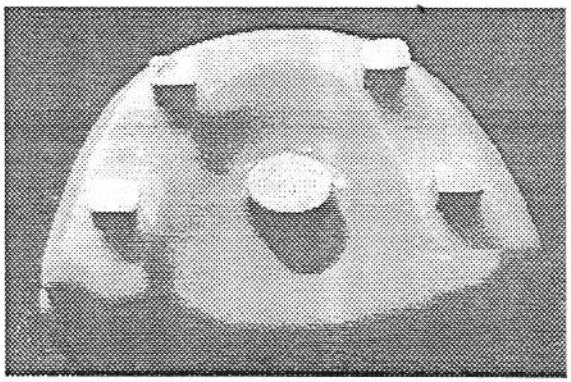

Figure (1): Master model.

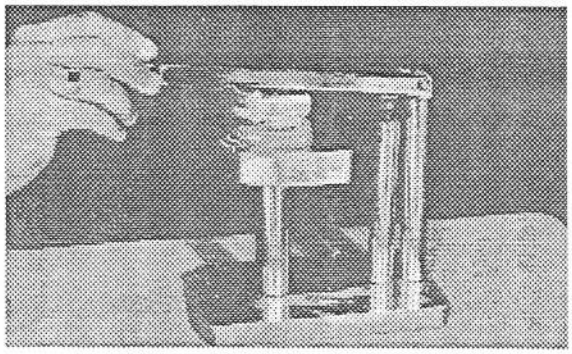

Figure (2): Test Apparatus

Impression Making and Preparation of Stone Casts

The alginate powder was mixed and loaded to the tray uniformly, then slided in its position and adapted over the master cast. After setting the impression removed, boxing technique was used, and poured with a stone according to the manufacturer instruction, (100) gm of powder were added to (23) ml of distilled water. Gentle vibration was used for minute. The stone casts allowed to set for (1) hour before they were separate and left for (24) hours to dry before testing [6].

One hundred sixty impressions were divided into (3) main group according to their storage procedure as follows.

The first group contains (48) impressions for each type of alginate, (8) impressions were stored on the bench at (3) time intervals (15), (30), (60) minutes before pouring.

The second group contains (48) impressions, stored in disposable plastic bags at (3) time intervals mentioned before.

The third group contains (48) impressions, which were divided into (3) subgroups. The first one, the impression is just washed will tap water before pouring while in the second and third subgroup the impression were immersed in two types of diluted disinfected solutions sodium hypochlorite (0.5%) and chlorhexidine gluconate (0.5%) for (30) minutes.

Eight impressions for each type alginate impression material were taken and poured immediately to be considered as a control for this study.

Statistical Analysis

Analysis of variance (ANOVA) was used, followed by Duncan Multiple Range test. The differences were considered significant when the probability (p) was equal or less than (5%) level ($p \leq 0.05$). Unpaired t-test also was used.

RESULTS

The Results of Using Two Brands of Alginate on Cast Accuracy

For the two brands of alginate impressions material unpaired t-test was used and showed that there is no significant differences on cast accuracy between the two types of alginate impression material $p \leq 0.05$ (table 2).

Table (2): Comparison between casts produced from soft and elastic types of alginate impression materials using unpaired t-test

		Time	Soft ± SD	Elastic ± SD	t-value	p
X	Open Air	Control	22.951 ± 0.14	22.984 ± 0.15	0.22	0.85
		15	22.968 ± 0.04	23.002 ± 0.05	0.78	0.45
		30	23.011 ± 0.16	23.005 ± 0.15	1.40	0.18
		60	23.156 ± 0.05	23.151 ± 0.05	0.21	0.83
	Close Bag	15	23.073 ± 0.15	23.177 ± 0.04	1.82	0.09
		30	22.987 ± 0.15	22.995 ± 0.31	0.35	0.73
		60	23.554 ± 0.03	23.630 ± 0.11	1.93	0.07
	Water	0	23.044 ± 0.12	23.099 ± 0.05	1.17	0.26
	Sodium hypochlorite	30	23.513 ± 0.08	23.547 ± 0.10	0.76	0.46
	Chlorhexidine	30	23.092 ± 0.13	23.135 ± 0.14	0.38	0.71
Y	Open Air	Control	20.029 ± 0.04	20.044 ± 0.02	0.46	0.69
		15	20.026 ± 0.02	20.023 ± 0.02	0.24	0.81
		30	20.049 ± 0.03	20.069 ± 0.03	1.25	0.23
		60	20.053 ± 0.03	20.066 ± 0.12	0.32	0.75
	Close Bag	15	20.067 ± 0.08	20.044 ± 0.03	0.75	0.47
		30	20.064 ± 0.04	20.046 ± 0.03	0.97	0.35
		60	20.029 ± 0.01	20.068 ± 0.03	1.55	0.14
	Water	0	20.068 ± 0.05	20.041 ± 0.08	0.82	0.43
	Sodium hypochlorite	30	20.071 ± 0.06	20.014 ± 0.05	1.97	0.07
	Chlorhexidine	30	20.040 ± 0.03	19.995 ± 0.13	1.0	0.38
Z	Open Air	Control	6.483 ± 0.02	6.453 ± 0.01	1.59	0.25
		15	6.501 ± 0.07	6.471 ± 0.20	1.00	0.33
		30	6.475 ± 0.05	6.418 ± 0.10	1.44	0.17
		60	6.434 ± 0.04	6.397 ± 0.08	1.18	0.26
	Close Bag	15	6.452 ± 0.12	6.443 ± 0.05	0.21	0.84
		30	6.463 ± 0.21	6.408 ± 0.07	0.69	0.50
		60	6.436 ± 0.13	6.487 ± 0.29	0.45	0.66
	Water	0	6.403 ± 0.16	6.421 ± 0.26	0.17	0.87
	Sodium hypochlorite	30	6.532 ± 0.27	6.501 ± 0.30	0.22	0.83
	Chlorhexidine	30	6.398 ± 0.08	6.4850 ± 0.11	1.77	0.10

Significant difference is obtained at $p \leq 0.05$
X= length , Y = width , Z = height

The Results of Storage of Alginate at Different Time Intervals on Stone Cast Accuracy

Analysis of variance (ANOVA) and Duncan multiple range test was performed, the result in table (3) shows that the dimensional changes at x-dimension occurs at (60) minutes storage period only for booth open and closed storage procedure. While there is no significant difference in the dimensional changes at (15) and (30) minutes compared with the control samples that poured immediately.

Table (3): The effect of storage times of alginate impression material on the dimensional accuracy of the resultant stone casts

	Time	Open Air		Closed Bag	
		Soft	Elastic	Soft	Elastic
X	Control	22.951 ± 0.10 a	22.984 ± 0.10 a	22.951 ± 0.10 a	22.984 ± 0.10 a
	15	22.968 ± 0.04 a	23.002 ± 0.02 a	23.073 ± 0.06 a	23.177 ± 0.01 a
	30	23.011 ± 0.05 a	23.005 ± 0.05 a	22.987 ± 0.06 a	22.995 ± 0.05 a
	60	23.156 ± 0.01 b	23.151 ± 0.02 b	23.554 ± 0.01 b	23.630 ± 0.04 b
Y	Control	20.029 ± 0.02 a	20.044 ± 0.02 ab	20.029 ± 0.03 a	20.044 ± 0.02 a
	15	20.026 ± 0.01 a	20.023 ± 0.007 a	20.067 ± 0.03 a	20.044 ± 0.01 a
	30	20.049 ± 0.01 a	20.069 ± 0.01 a	20.064 ± 0.01 a	20.046 ± 0.01 a
	60	20.053 ± 0.03 a	20.066 ± 0.04 a	20.029 ± 0.004 a	20.068 ± 0.02 a
Z	Control	6.483 ± 0.02 a	6.453 ± 0.02 a	6.483 ± 0.02 a	6.453 ± 0.02 a
	15	6.501 ± 0.02 a	6.471 ± 0.07 a	6.452 ± 0.04 a	6.443 ± 0.02 a
	30	6.475 ± 0.05 a	6.418 ± 0.04 a	6.463 ± 0.07 a	6.408 ± 0.16 a
	60	6.434 ± 0.04 a	6.397 ± 0.03 a	6.436 ± 0.05 a	6.487 ± 0.10 a

X= length, Y = width, Z = height

The Results of Immersion of Alginate Impression in Disinfectant Solutions on the Dimensional Accuracy of Stone Casts

Duncan Multiple Range test was performed and the results in table (4) showed that only immersion in sodium hypochlorite disinfectant solution (0.5%) for (30) minutes produce a significant difference in the dimensional change compared with other treatment and the control samples.

Table (4): Comparison between dimensional accuracy of stone cast result from immersion of alginate impression materials in two types of disinfectant solutions, washing with tap water and control, using Duncan Multiple Range test

	Type of Immersion	Soft	Elastic
X	Control	22.951 ± 0.10 a	22.984 ± 0.10 a
	Washed with water	23.044 ± 0.04 a	23.099 ± 0.02 a
	Immersion in sodium hypochlorite (3min)	23.513 ± 0.08 b	23.547 ± 0.04 b
	Immersion in chlorhexidine (30 min)	23.092 ± 0.05 a	23.135 ± 0.05 a
Y	Control	20.029 ± 0.03 a	20.044 ± 0.02 a
	Washed with water	20.068 ± 0.02 a	20.041 ± 0.02 a
	Immersion in Sodium hypochlorite (30min)	20.071 ± 0.02 a	20.014 ± 0.02 a
	Immersion in Chlorhexidine (30 min)	20.040 ± 0.01 a	19.995 ± 0.05 a
Z	Control	6.483 ± 0.02 a	6.453 ± 0.02 a
	Washed with water	6.403 ± 0.06 a	6.421 ± 0.12 a
	Immersion in Sodium hypochlorite (30min)	6.532 ± 0.13 a	6.501 ± 0.10 a
	Immersion in chlorhexidine (30 min)	6.398 ± 0.08 a	6.4850 ± 0.04 a

X= length, Y = width, Z = height

The Results of Comparison between Stone Casts Result from Alginate Impression that Stored on the Bench and in Sealed Plastic Bags

In order to find the significant difference in stone casts poured from all the levels of impression samples that stored on the bench uncovered and in sealed plastic bags in spite of storage time and the types of alginate impression materials, unpaired t-test were performed. The results in table (5) show that there is a significant difference in the dimensional changes ($p \leq 0.0001$) between the two storage procedures in x- values only.

Table (5): Comparison between stone cast poured from alginate impression samples that stored on the bench uncovered and in sealed plastic bags using unpaired t-test

Dimension	Open Air	Closed Bag	t-value	p
X	23.277 ± 0.28	23.043 ± 0.13	5.33	0.0001*
Y	20.049 ± 0.04	20.048 ± 0.05	0.17	0.86
Z	6.459 ± 0.16	6.449 ± 0.10	0.03	0.97

* Significant difference

X= length, Y = width, Z = height

The Results of Comparison between Stone Casts Result from Each Type of Alginate Impression that Stored on the Bench and in Sealed Plastic Bags

The poured stone cast in relation to the two types of alginate impression material that stored on the bench uncovered and in sealed plastic bags, unpaired t-test was performed. The result in table (6) show that there is a significant difference in the dimensional changes on stone cast ($p \leq 0.0001$) between the two storage procedures at x-value for the two types of alginate impression material.

Table (6): Comparison between the two types of alginate impression samples that stored on the bench uncovered and in sealed plastic bags using unpaired t-test

Dimension	Type	Open Air	Closed Bag	t-value	p
X	Soft	23.240 ± 0.26	23.037 ± 0.14	3.39	0.001*
	Elastic	23.31 ± 0.29	23.059 ± 0.10	4.02	0.0001*
Y	Soft	20.053 ± 0.05	20.042 ± 0.03	0.87	0.39
	Elastic	20.065 ± 0.03	20.053 ± 0.07	0.48	0.63
Z	Soft	6.481 ± 0.15	6.478 ± 0.06	0.81	0.42
	Elastic	6.446 ± 0.17	6.429 ± 0.13	0.39	0.70

* Significant difference
X= length, Y = width, Z = height

DISCUSSION

The result showed no significant different between the two types of alginate impression materials and in agreement with Eams and Litvak [7]; MaCabe [8].

Storage of alginate impression uncovered for (15-30) minutes showed no significant difference in the dimensional change compared with controlled sample while storage for (60) minutes showed significant difference. This could due to the fact that further evaporation of water from alginate impression occurs, these results are in agreement with those of Coleman *et al.* [9] and Ericksson [10].

Samples stored in disposable bags showed significant difference at (60) minutes. The results were in agreement with Craig [11]. The explanation for this that storage of impression inside bags reduce the evaporation of water, but even in high degree of relative humidity a significant difference in the dimensional change is occurs if the impression stored for (60) minutes or more.

Washing with tap water before pouring produce no significant difference also immersion in chlorhexidine disinfectant solution (0.5%) for (30) minutes will not affect the accuracy and these results are in agreement with Rowe and Forrest [12].

However, immersion in sodium hypochlorite solution (0.5%) for (30) minutes showed dimensional change compared with chlorhexidine samples, this may be due to degradation of the impression surface, this results are in agreement with Tullner *et al.* [13], Gin and Rabe [14].

CONCLUSIONS

1. There is no significant difference between stone casts poured from the soft and elastic types of alginate impression material used in this study.
2. Storage of impression samples for (60) minutes on the bench uncovered and in sealed plastic bags produced a significant difference compared with controlled samples that poured immediately.
3. Storage of impression samples in closed sealed bags reduces the evaporation of water and the dimensional change, which could occur in stone casts.
4. Immersion of impression samples in chlorhexidine gluconate disinfectant solutions (0.5%) for (30) minutes produces no significant differences in the dimensional change while immersion in sodium hypochlorite (0.5%) for (30) minuets produces significant changes.
5. If the pouring of impression samples will be delayed for any reason, I recommend the storage of impression samples in sealed plastic bags for (30) minuets as maximum.

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