

Effect of Water Type Used in Mixing the Alginate on the Final Stone Cast of Removable Partial Dentures

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Research article

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Abstract

Introduction: Recording an accurate impression is one of the most important steps in prosthetic dentistry for a successful denture, alginate remains one of the most common impression materials in dentistry, Therefore, it is important to fully understand its characteristics and the factors that influence it in order to avoid possible complications.

Purpose: Study the effect of water type used in mixing the alginate on the final stone cast of removable partial dentures using different types of water.

Materials and Methods: The research sample consisted of 30 gypsum casts taken with alginate for *partially edentulous* metal cast class III modification 2, divided into three equal groups according to the different type of water used in mixing the alginate (distilled water, mineral water, tap water). The linear measurements were made in the longitudinal, vertical, and transverse dimensions according to points prepared in advance on the metallic cast using a digital caliper, then it was repeated on gypsum casts. The results were collected and analyzed statistically by the t-student, Anova, and Bonferroni method at a 95% confidence level.

Results: It was found that there were changes in the linear dimensions in all groups, regardless of the type of water used, but to varying degrees between them without statistically significant differences, except for the front vertical linear dimension which was the largest in the tap water group.

Conclusions: Within the limits of this study, we can say about the preference of distilled and mineral water in mixing alginate for final impressions compared to tap water.

Recommendations: We recommend the use of distilled or mineral water when mixing alginate for final impressions.

1. Introduction

Recording an accurate impression is one of the most important steps in prosthetic dentistry for a successful denture, Therefore, it is important to fully understand its characteristics and the factors that influence it to avoid possible complications^{1,2,3,4}. Alginate was developed as an alternative to agar during World War II, and is still the first choice for primary impressions of edentulous patients also can be used to record diagnostic impressions of orthodontic treatment, or to obtain the final gypsum cast in cases of partially edentulous patients where obtaining accurate final impression is an important first step For a series of subsequent steps to achieve a good oral prosthetics^{5,6,7,8}.

Alginate comes in the form of a powder. The powder is mixed with water to form a liquid alginate solution, and a network of interconnected polymers is formed by the interaction of potassium or sodium alginate with calcium sulfate to give the undissolved calcium alginate^{3,6}

There have been numerous studies on alginate to determine the factors that affect its accuracy or handling as (Culhaoglu et al, 2014)⁹ who found noticeable differences on the accuracy of the impression between the automatic and manual mixing method of alginate, while (Kulkarni and Thombare, 2015)¹⁰, which found that the best time to store the alginate impression without a significant change in the dimensions of the gypsum cast is 20 minutes at a temperature of 30 degrees, but nevertheless it was recommended to pour it directly to get the most accurate results while (Raszewski et al, 2018)¹¹ found The type of water used for mixing significantly affects the speed of setting rate and the change in the dimensions of the alginate, but his study did not include gypsum examples, while(Al- Qahtani et al, 2019)¹² brushed an amount of alginate over the occlusal surface of the teeth, Wetting the alginate with a wet finger in the tray before inserting it, and found a noticeable increase in the accuracy of the gypsum cast after pouring the impression.

From the foregoing and according to our knowledge up to the date of this research, we note the lack of sufficient studies on the effect of water type used in mixing the alginate on the final stone cast of removable partial dentures, so it was important to do this study.

2. Materials And Methods

The research sample consisted of 30 final gypsum casts divided into 3 groups according to the following division:

Group (1): 10 final gypsum casts were poured from alginate mixed with distilled water.

Group (2): 10 final gypsum casts were poured from alginate mixed with mineral water.

Group (3): 10 final gypsum casts were poured from alginate mixed with tap water from one of the clinics of the Faculty of Dentistry - University of Hama.

The work metal cast was obtained after casting prefabricated gypsum frazaco with insoluble metal, which had previously been modified to form a partial edentulous Class III, modification (2) according to the Kennedy classification

(Fig. 1).

Rest seats were prepared on the abutments according to the academic procedures, other reference points have also been prepared on the top of alveolar bone in the area of the first molar and midline (Fig. 2).

The following measurements were made on the metal cast first using an electronic digital caliper, (Digital Caliper, Zhejiang, China) (Fig. 3), to be reference values when compared with the gypsum casts:

1- Anterior-posterior linear dimension: the measurement was made between the rest seat on the first lower premolar and the rest seat on the lower third molar on each side of the gypsum cast.

2- Transverse linear dimension: between the rest seat on the right third molar and the rest seat on the left third molar.

3- The vertical linear dimension: between the left first premolar rest seat and the alveolar crest, between the alveolar crest at the area of the first molar and the lingual sulcus, and between the anterior alveolar crest and the buccal sulcus.

A special tray was made for each group of the study sample, and it was given a different color from the other as in (Fig. 4), and the gypsum casts were subsequently colored in the color specific to their group, according to the following division:

The first group (distilled water): is black in color.

The second group (mineral water): is yellow in color.

The third group (tap water): is red in color.

The alginate (talgin Chromatic Alginate, BMS dental, Italy) was mixed in each group with a different type of water by the same researcher by manual method, taking into account the correct ratio of (powder/water). And the impressions were poured directly with low expansion hard gypsum type III, (Sheralpin-L, shera werkstoff- Technologie Germany), After it was mixed with distilled water for all groups according to the manufacturer's instructions, taking into account the ratio of powder to water by weight based on the recommendation of (Phoenix et al, 2008)⁷ to obtain the final gypsum casts (Figs. 5,6), then the same Previous measurements were made on the final casts (Fig. 7) and recorded for results and discussion.

3. Statistical Analysis

The amount of difference from the metallic cast was calculated in the values of each of the dimensions measured in (mm). Statistical analyses were carried out using SPSS software (ver. 13.0; SPSS Inc., Chicago, IL). Arithmetic mean and Standard deviation were carried out according to the type of water used to mix the alginate (distilled water, mineral water, tap water). The study was done according to the T Student test for the single sample, the one-way ANOVA of variance, and the Bonferroni correction method at a P-value of 0.05.

4. Results

The results showed, as in Table (1), that there were changes in the linear dimensions in all groups, regardless of the type of water used, but unevenly between them without the presence of statistically significant differences, where the value of the significance level was greater than 0.05 in most of the measurements, except for the front vertical linear dimension where The significance level value was less than 0.05, meaning that there are statistically significant differences in all groups Whatever type of water

is used. To find out which groups contain the largest values of the differences, the Bonferroni method was used, which showed that the changes in the tap water group were the largest, where the p-value was less than 0.05, that is, at the 95% confidence level, there are statistically significant differences, as in table (2).

5. Discussion

The Alginate was mixed with three different types of water (distilled, mineral, and tap), these types differ in their composition of minerals and their proportions, knowing that tap water was of the type suitable for drinking and used routinely in some clinics. The partial edentulous Class III according to Kennedy was selected, with two modification zones, one of them was anterior to resemble the zone of Class IV of Kennedy Because these two classes are the most common types of loss among young patients¹³, In addition to the fact that the alginate impression is still indicated in tooth-supported removable partial dentures¹⁴. Also, The use of the metal cast is a common procedure in laboratory studies to investigate the accuracy and dimensions of gypsum casts^{15,16}, rest seats on the supporting teeth were prepared according to the academic practice¹⁴ to be reference points for measuring linear dimensions, in addition to other reference points on the top of the alveolar bone in the place of the first molars and the midline in the anterior region, then linear measurements were made on the metal cast first Several times and adopting the arithmetic mean for them to be reference values when compared with the rest of the gypsum cast, using a digital caliper similar to the previous studies¹⁷. A special tray was made for each group of the study sample, and the alginate was mixed in each group with a different type of water by the same researcher by the manual method as applied locally, taking into account the manufacturer's instructions to take the correct ratio of (powder/water) when mixing as recommended by a previous study¹¹, also, The gypsum was mixed in a separate rubber bowl, taking into account the ratio (powder/water) according to weight and using distilled water for all groups according to the manufacturer's instructions, to avoid the presence of any possible effect of the type of

water on the reaction of the gypsum or its physical properties⁷. The same previous physical properties⁷. The same previous measurements that were made on the metal cast were made on the final casts and recorded, then the statistical

study was conducted to get the results, which came as follows:

There are differences in the linear dimensions in all the final casts compared to the metal cast, but differently between them, regardless of the type of water used, but without significant differences, these differences are justified by the human factor first, that we used the manual method of mixing instead of the mechanical method, which gives more accurate impression and better mechanical properties, according to (Frey et al, 2005)¹⁸. Also due to the difference in the proportion of Ca + or Na + in each type of water, the presence of which will reduce the setting time and consequently the viscosity of the gel

phase and accuracy of details (Bradna and Cerna, 2006)¹⁹. As for the absence of statistically significant differences for the linear dimensions

and the measured values on the metal, except for the vertical linear dimension in the frontal region, this is consistent with the words of (Carr and Brown, 2016)⁵ who says: "Alginates were and still are an accurate impression material in a manner acceptable when dealt with appropriately".

It also agrees with the findings of (Jayaraman et al, 2018)²⁰ and (Al-Ansari, 2019)²¹, who said that there are no significant clear differences in the preference of one impression material over the other when complete or partial dentures will be made. As for the explanation for the differences in the vertical linear dimension in the frontal region in all groups, which was the largest in the tap water group, this is attributed to several factors, including the uncontrolled recovery period of the alginate from the deformation after

Table (1): shows the results of (the ANOVA) test to study the significance of the differences according to the type of water used in the study.

The studied variable	The calculated F value	p-value	The significance of the differences
Anterior-posterior dimension on the right side	0.054	0.948	There are no significant differences
Anterior-posterior dimension on the left	1.342	0.278	There are no significant differences
Transverse dimension: between the right and the left third molar.	2.545	0.097	There are no significant differences
The vertical dimension: is between the left first premolar and the alveolar crest.	0.968	0.393	There are no significant differences
The vertical dimension: between the alveolar crest at the first molar and the lingual sulcus on the right.	2.530	0.098	There are no significant differences
The vertical linear dimension: between the alveolar crest first molar and the lingual sulcus on the left.	0.475	0.627	There are no significant differences
The vertical linear dimension: between the anterior alveolar crest and the buccal sulcus.	4.798	0.016	There are significant differences

Table (2): shows The results of (the Bonferroni) test to study the significance of the binary differences between the anterior alveolar crest and the vestibular groove according to the type of water used in the study.

The studied variable	group (I)	Group (J)	The difference between the two averages (I-J)	standard error	Significance level value	The significance of the differences
The vertical linear dimension: between the anterior alveolar crest and the buccal sulcus	distilled water	Mineral water	-0.26	0.229	0.805	There are no significant differences
		tap water	0.44	0.229	0.191	There are no significant differences
	Mineral water	tap water	0.70	0.229	0.015	There are significant differences

Removal of the tray, especially that the anterior area in the working cast contains remaining teeth and more undercuts areas than the posterior in addition to retention type of the tray, where it was relied on only the holes that depend on the insertion of alginates in them, which are in the gel phase and after solidification, they form mechanical fixation areas, and according to (Raszewski et al, 2018)¹¹, the use of tap water will increase the speed of setting of the alginate, which reduces its entry into the holes, and as a result, the distortion increases in dimensions, Therefore (Marafie et al, 2008), in his study recommended the use of chemical adhesives with mechanical to obtain more accurate results for the final gypsum cast.

6. Conclusions

Within the limits of this study, we conclude that all types of water used in mixing alginate will cause differences in the dimensions of the gypsum casts unevenly, with no significant differences compared to metal cast, regardless of the type of water used. On the other hand, there are significant differences in the group of tap water compared with the group of distilled and mineral water in the vertical linear dimension in the anterior area²³.

Declarations

7.1 Consent and Ethical Consent to Participation:

The authors have taken into account ethical considerations regarding the studied materials and their applications to humans .

7.2 Consent to Post:

Ethical approval for publication from the faculty of dentistry.

7.3 Availability of data and materials:

All materials used are suitable for human use according to the recommendations of the World Health Organization.

7.4 Conflicts of interest:

There is no conflict of interest with any party.

7.5 Financing:

Hama University.

7.6 Author Contributions:

Nobody just authors

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Figures



Figure 1

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Figure 2

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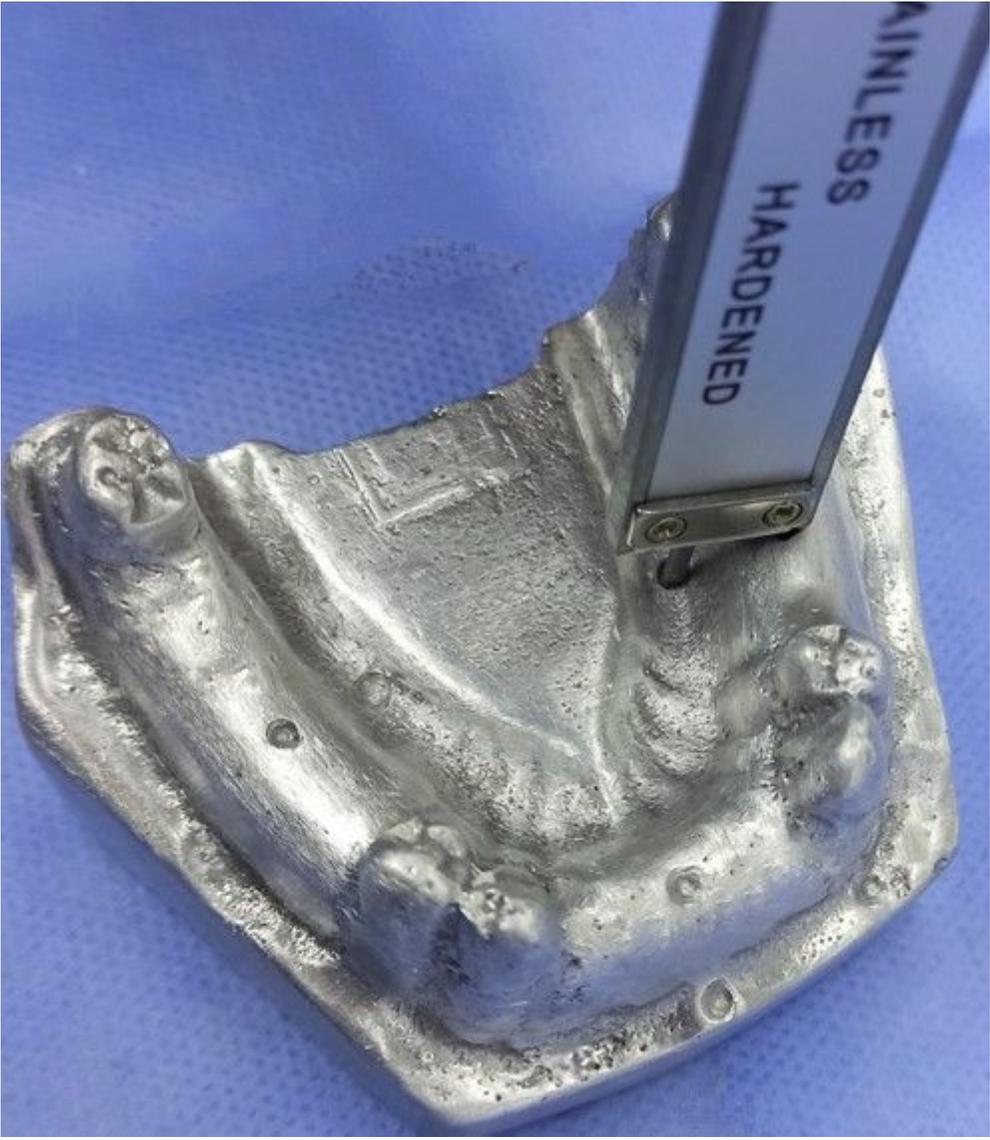


Figure 3

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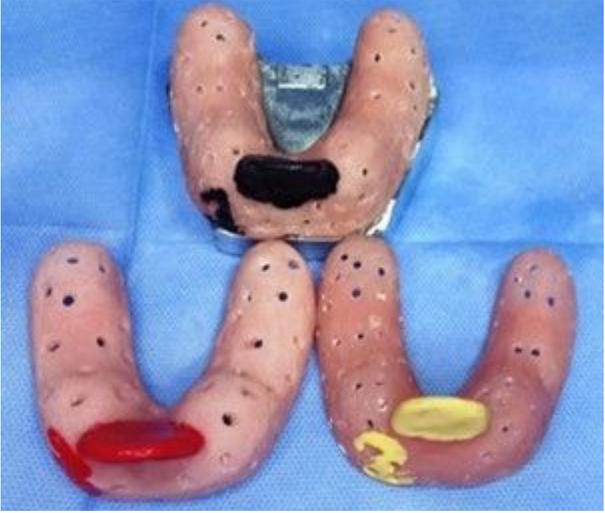


Figure 4

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Figure 5

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Figure 6

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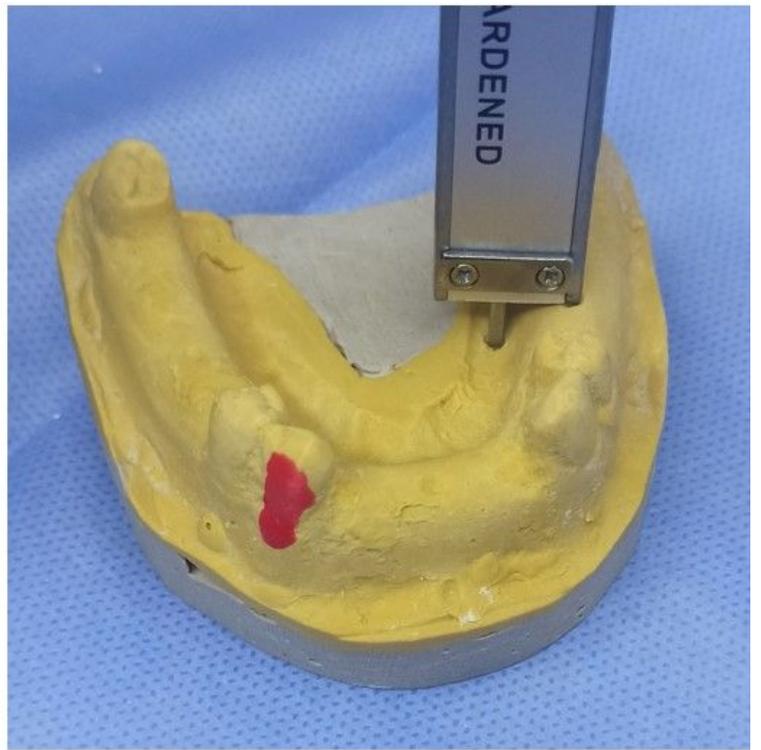
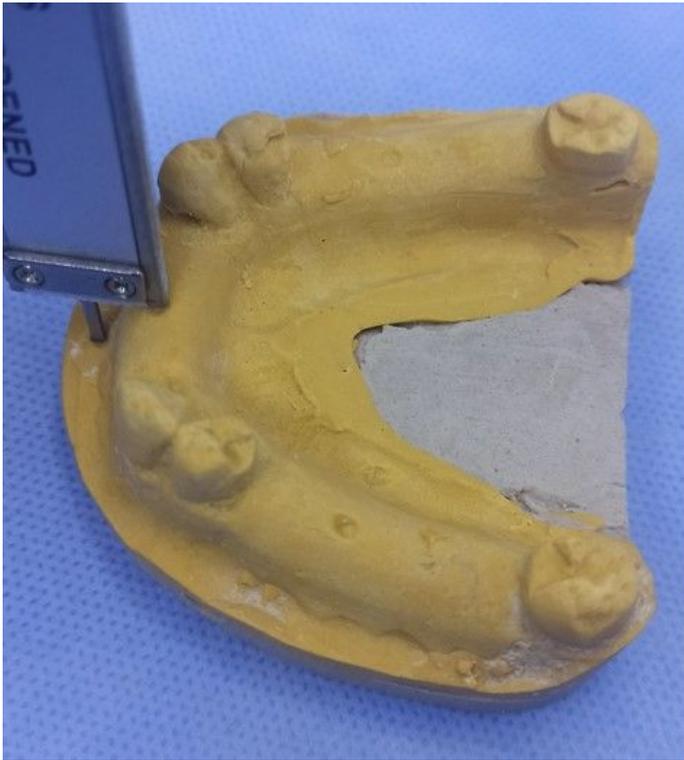


Figure 7

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