

To Evaluate the Dimensional Stability of Alginate Using Normal Saline At Varied Time Intervals an In Vitro Study

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Abstract

Alginate impression materials (irreversible hydrocollide) is used in the field of dentistry for making diagnostic models. In the department of orthodontics diagnostic model is most important aid in orthodontic treatment planning. But the alginate impression tend to change in dimension (shrink) over a period of time. In the following study the alginate was mixed with normal saline as a solvent for mixing. total 60 impression was made (30 with water and 30 with normal saline) and compared at three different time interval (12mins, 60 mins, 120 mins). the following dimension was taken for measurement in the orthodontic models (a) mesio-distal width, (b) inter-premolar width, (c) inter-molar width and (d) antero-posterior width.

Keywords: Alginate, Delayed Pouring and Dimensional Stability.

Introduction

Alginate impression materials have stood the test of time in their simplicity of usage, optimal reproduction detail cost-effectiveness of the material itself in routine dental practice. Their purpose is to aid the dental care professional in making diagnostic models to provide information regarding any dental abnormality of the teeth and/or the supporting structures and working models for fabrication and verifying the fit of appliances in the field of prosthodontics and orthodontics and also serve as a guide to visualizing a change in occlusion prior to orthognathic surgery [1]. The irreversible hydrocolloid produces reasonable standards of reproduction detail and is not toxic or irritating to the user or patient. With the advantage of being hydrophilic, they help the operator in producing good impressions even in the presence of saliva or blood [2]. Alginate materials are marketed in different flavours for patient comfort as impression making is uncomfortable for certain patients

with exaggerated gag reflex. The materials also come in varied colours to aid the operator in exact manipulation and taking the impression followed by removal of the impression from the patient's mouth without having to probe into the material using fingers or any instruments. With any alginate, the setting time can be altered by changing the temperature of the water; the lesser the temperature, more the setting time and vice-versa.

Although it has these advantages, the user must also be well versed in its limitations as well. These include low tear strength[3], low reproduction detail, and poor dimensional stability in comparison with elastomeric impression materials. Also, these materials can be used only for single-pour [4] and not used multiple times as opposed to Agar-Agar.

Alginate is provided by various manufacturers in a powder form and this is routinely manipulated with water for impression making. Also, Dust-free alginates are preferred as powder aerosol may cause allergies in a few persons. The other form of alginate is the paste form which is provided in 2 different viscosities which are Tray type and Syringe type. It has been studied that the paste form produces a higher standard of surface quality reproduction than the powder form of alginate and prove to be more valuable in terms of material requirement [5].

Aim of the Study

To evaluate the dimensional stability of alginate impression material at varied intervals of time using normal saline as solvent for manipulating alginate and Orthokal(Class III dental stone) as a gypsum product for cast pouring.

Objective of The Study

To measure and compare the dimensional stability of alginate impression material using models poured with Orthokal and assess if Normal Saline can be used as an alternative to water for mixing alginate.

Materials And Methods

Alginate Impressions can be generally taken either using stock trays (metal or plastic) or custom trays depending on the arch form of the individual. As an aid to retain the impression material within the tray whilst removal after the material has set in the mouth, tray adhesives may be painted on the trays and allowed to dry for about 5 minutes.

The operator must be well versed in the contents of the water used in their locality as certain areas show variable amounts of minerals that may change the dimensional properties, working and setting time of alginate. The operator may use distilled water or any sort of demineralized water in such circumstances [6].

In the present study, we have compared water and normal saline 0.9% w/v (both at room temperature) as liquid media to be mixed along with alginate for the purpose of impression making and have assessed the changes in mixing time, setting time and dimensional stability at varied intervals of time. Nissin Typodont has been used in our study, particularly the maxillary arch for the purpose of standardization. (Fig.1 and Fig.2)

Armamentarium



Fig.1

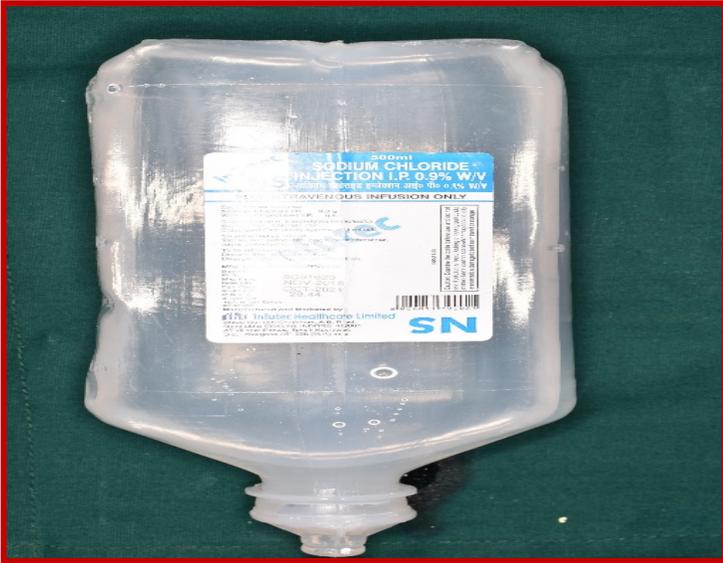


Fig.2

Alginate(Chromatex®) was measured into a rubber mixing bowl as per the manufacturer’s recommended measurements (water/powder ratio:15gm/40ml,mixing time 1.30min)and thoroughly spatulated until a homogenous consistency was obtained. This was placed into the stock tray and the impression was made over the maxillary arch component of the typodont. Once the alginate completely set, it was then removed from the typodont and inspected for any voids or tears.

A total of 60 impressions were made; 30 using water and 30 using normal saline 0.9% w/v. The impressions were then poured at three different intervals of time;

- (i) As per the manufacturer’s recommended time (12 minutes)
- (ii) 60 minutes after the recommended time
- (iii) 2 hour after the recommended time.

These steps were done for both groups of impressions taken (one group of impressions with water and one group of impressions with normal saline0.9% w/v) and the casts were recovered from the impression material and poured using Orthokal Dental stone and water as per the manufacturer’s specifications(water/powder ratio:28ml/100gm, mixing time 30sec,setting time 10-12min)

Results

Statistical analysis of the data was done using Statistical Package for Social Sciences, IBM Corporation, SPSS Inc., Chicago, IL, USA version 21 software package (SPSS).Descriptive statistics including mean and standard deviation was computed for various parameters at different time intervals. One way ANOVA was used to assess the overall level of significance. The level of significance in the present study is kept at $p < 0.05$

Mesio-distal dimension

Based on the result of one way ANOVA showed that the mesio-distal dimension with water group was different at different storage time($p=0.005$) but with normal saline the mesio-distal dimension was not different at different storage time($p=0.892$) .TABLE I

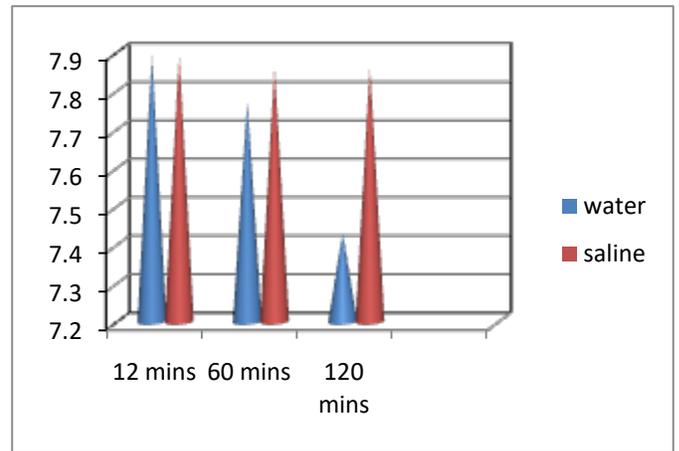


Table I: Mesio-distal measurements made on casts produced from the understudy alginates following different storage times

Type Of Solvent	Storage Time	Mean	Standard Deviation
Water	12min	7.890	.0316
	60mins	7.770	.0483
	120mins	7.430	.0483
Normal Saline	12MINS	7.890	.0316
	60MINS	7.860	.0516
	120MINS	7.860	.0516

Inter-premolar dimension

Based on the results of one way ANOVA, the inter-premolar width was different at different storage time for water group (p=0.000) but for the normal saline group inter-premolar width is not different at different storage time (p=0.590) TABLE II.

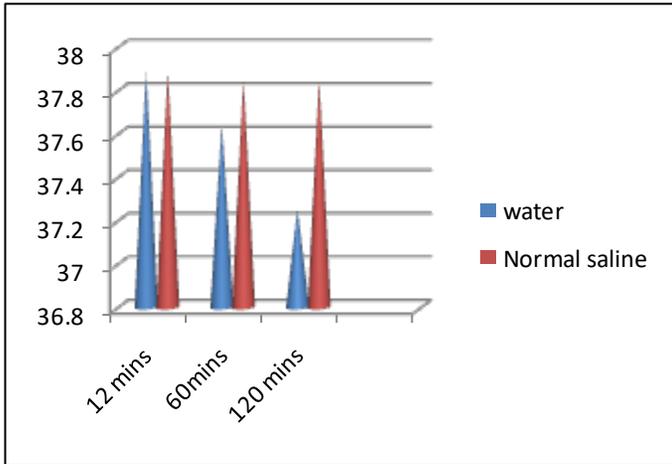


Table II: Inter-premolar width measurements made on casts poured from the understudy alginate impression at different storage time

Type Of Alginate	Storage Time	Mean	Standard Deviation
WATER	12MINS	37.890	.0316
	60MINS	37.640	.0516
	120MINS	37.250	.0527

Normal Saline	12MINS	37.890	.0316
	60MINS	37.850	.0527
	60 MINS	37.850	.0527

Inter-Molar Dimension

Based on the result of one way ANOVA, the inter-molar width was different at different storage time for water group (p=0.000) but for the normal saline group the inter-molar width is not different at different storage time (p=0.892) TABLE III

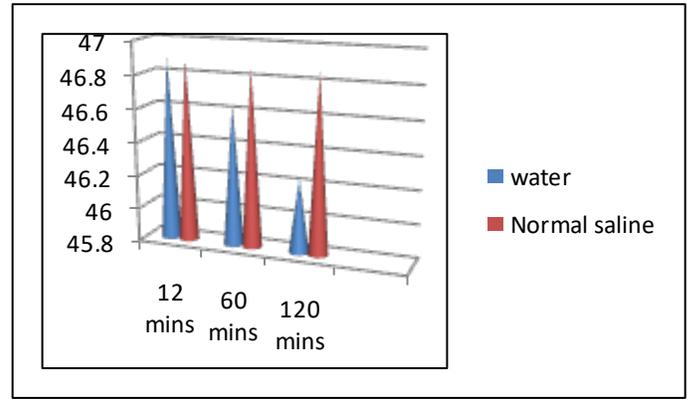


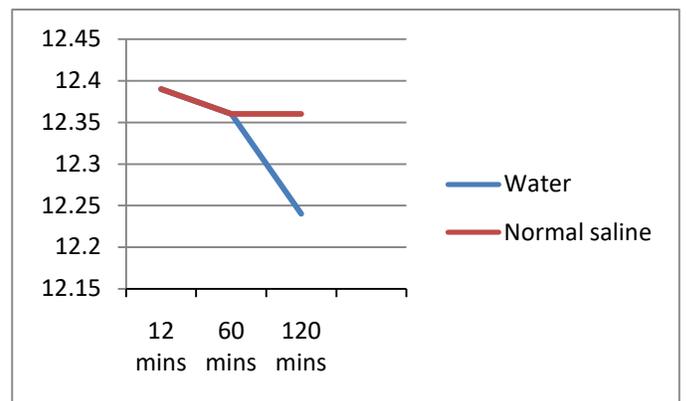
Table III: Inter molar width measurements made on casts poured from the understudy alginate impression at different storage time.

Type of Alginate	Storage Time	Mean	Standard Deviation
Water	12MINS	46.890	.0316
	60MINS	46.640	.0516
	120MINS	46.240	.0516

Normal Saline	12MINS	46.890	.0316
	60MINS	46.860	.0516
	120MINS	46.860	.0516

Anterio-Posterior Dimension

Based on the one way ANOVA, the antero-posterior width was different at different storage time for water group (p=0.000) but for the normal saline group the antero-posterior width is not different at different storage time (p=0.0892) TABLE IV



Type Of Solvent	Storage Time	Mean	Standard Deviation
Water	12MINS	12.390	.0316
	60MINS	12.360	.0516
	120 MINS	12.240	.0516

Normal Saline	12MINS	12.390	.0316
	60MINS	12.360	.0516
	120MINS	12.360	.0516

TABLE IV Antero-posterior measurements made on casts poured from under study alginate impression at different storage time

Overall comparison

Based on the results of the previous data the overall comparison of the two groups at different time interval shows that at 12 mins the two group was not significant (p=1.000,MD,IPW,IMW,APW) but for 60 mins and 120 mins both group showed the significant. At 60 mins (p=0.000,MD,IPW,IMW,APW) for 120 mins (p=0.000,MD,IPW,IMW)(p=0.001 APW) TABLE V (TABLE V)

Legend of Table V

MD-MESIO DISTAL WIDTH OF TEETH

IPW - INTER PREMOLAR WIDTH

IMW-INTER MOLAR WIDTH

APW-ANTERIO-POSTERIOR WIDTH

Discussion

One of the prime advantages of using irreversible hydrocolloid impression materials in routine dental practice is that they are highly economical and can be easily manipulated by the dental care professionals. Although they present with ease of use, they present certain limitations to their usage in terms of dimensional stability over a long interval of time. One must not overlook the fact that there is some amount of syneresis/imbibition between alginate and

the environment causing a change in their innate properties such as reproduction detail and diminished storage capacity. There is extensive literature to conclude that the highest quality of reproduction detail is achieved on cast pouring immediately after impression making [7-11].

Other studies have been done using extended pour irreversible hydrocolloids which state that the impressions are stable upto a 5 day period prior to cast pouring [12-15]. Most of the earlier studies done using these materials have little or no value in terms of comparison as they are unavailable in the present day market. This study is unique in that, although it is routine of manipulating alginate with water, we have used normal saline 0.9% w/v as a liquid component for mixing alginate in an attempt to overcome the loss of dimensional stability and reproduction detail which is lost by extended period of cast pouring. Measuring the changes on the stone model can be done using a variety of methods such as using digital software[13], vernier calliper [16] or even gauges [17], but one cannot substantiate on the best method from the aforementioned as each has its pros and cons. Optical microscopes offer a high quality of precision (upto 1µm) but they are not to be used in routine dental practice and any irregularity in the change in dimension of the impression material of a few µm is clinically insignificant as the internal structure of the gypsum materials cannot reproduce such high quality of detail[18]. There is little to no change in the properties of the irreversible hydrocolloid in comparing manual and machine spatulation [19]

There is a speculation that using colour changing alginates contain certain additives that may change the dimensional stability of the material [12] but there were no significant differences in the statistical values pertaining to the dimensions of the impression material.

Conclusion

This study does present with certain limitations such as disregarding the effects of disinfectant solution and application of the adhesive material on the impression tray. It is evident from the study that Normal Saline 0.9% w/v does have an advantageous effect on maintaining the dimensional stability of extended pouring time and can be used as an alternative to more expensive commercially based “extended pour alginate” impression materials.

Further probing into increasing the sample size may prove to be a beneficial factor as a prospective study.

Ethical Approval

It is an in-vitro non clinical study. Hence there is no involvement of any humans or animals in the study

Informed Consent

There is no live subject involved in the study so there is no requirement of informed consent.

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