

Research Article

# Determination of Surface Roughness and Accuracy of Alginate Impression Material Disinfected by Immersion

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Received date: 10-1-2022  
Accepted date: 12-2-2022  
Published date: 15-9-2022



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<https://doi.org/10.26477/jbcd.v34i3.3234>

**Abstract** Background: This study was conducted to evaluate the surface roughness and dimensional accuracy of commercially obtainable alginate impression material in terms of imbibition after immersion in two different media. Materials and method: Two disinfecting agents, ethanol 70% and povidone-iodine 4%, were used to assess the dimensional accuracy and surface roughness of alginate impression material. Weights of specimen discs of alginate impressions were measured before and immediately after immersion to gain a measure of imbibition. For surface roughness, disinfected specimens rectangle was examined before and after disinfection. Results: Minimal changes in weight were observed after disinfection, but a statistically non-significant difference was found before and after immersion. It did not affect the surface roughness of alginate impression material Conclusion: Disinfection of alginate impression material with ethanol and povidone iodine had no significant effect on dimensional accuracy and surface roughness.

**Keywords:** Alginate, Ethanol, Povidone iodine, Dimensional accuracy, Surface roughness.

## Introduction

Alginate impression is one of the highly contaminated materials between dental laboratory workers and patients. Infectious agents are transferred from saliva and blood to the casts via dental impression<sup>(1,2)</sup>. It has been found that 67% of dental material forward from a dental clinic to the lab is contaminated<sup>(3)</sup>. Dental materials must be disinfected after making an impression<sup>(4,5)</sup>. Various disinfection protocols related to the type and method of disinfection have been proposed for alginate and dental cast<sup>(3)</sup>. Immersion and spray application are two different chemical disinfection processes that are carried out on impression<sup>(6)</sup>. American Dental Association for control guidelines infection advised immersion disinfection of hydrocolloid irreversible impression because it was more reliable and effective. Various solutions, such as sodium hypochlorite, formaldehyde, synthetic phenol, iodine, and alcohol, are applied to the chemical disinfection of dental material<sup>(7)</sup>. The seen changes in the dimensional stability and surface chemistry of the impression depend on the type of disinfectant used. One of the adverse effects of disinfection solution is the dimensional change of the impression due to physical and chemical reactions between impression and disinfecting substance<sup>(8,9)</sup>. Alginate impression has an imbibition phenomenon that absorbs water within a certain time so it will expand. In addition, alginate can experience syneresis which is a continued reaction because of its ability to expand which may lead to more deformation of impression<sup>(10)</sup>. Various types of research studied the effect generated by imbibition on the surface detail reproduction and dimensions of impression. Some studies have agreed that the effect produced is negligible, others have shown that a significant dimensional change is caused by immersion<sup>(11)</sup>. The time for which the disinfection happens is also a contributing factor<sup>(12)</sup>. Immersion of impression in disinfectant solutions for a longer time causes changes in the impression, transferred to the cast<sup>(13)</sup>. Changes in the properties of gypsum cast, containing dimensional stability, hardness, surface detail reproduction and roughness will affect the accuracy of complete restoration after increasing the time of immersion of an impression<sup>(7)</sup>. This study

was designed to access the dimensional accuracy due to imbibition phenomena and surface roughness of alginate material immersed in two different chemical disinfectant solutions.

### Materials and Methods

In this study, alginate material (Zhermack, Hydrogum) was used. Forty specimens were prepared, 20 specimens for the surface roughness test, and 20 specimens for the dimensional accuracy test. Each test has two groups (consisting of 10 specimens, each n =10)

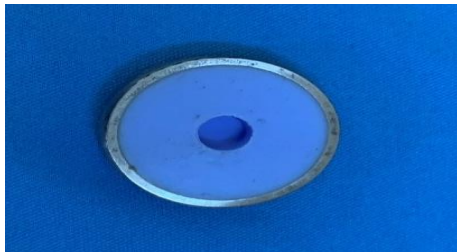
The study groups were as follows:

1- Impressions were immersed in ethanol 70% for 3 minutes

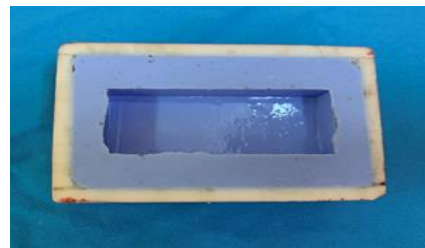
2- Impressions were immersed in povidone-iodine 4% for 3 minutes

A rectangular silicon mold measuring (5×2×1 cm) was used<sup>(14)</sup>. Figure (1)

A round disk-shaped silicon mold measuring (4mm H, 6 mm W) is used for the dimensional accuracy test<sup>(3)</sup>. Figure(2). Following the water-powder ratio (18gm / 36 ml) recommended by manufacturer instructions



**Figure 1:** Dimensional accuracy mold



**Figure 2:** Surface roughness mold

After applying the alginate to the impression mold, a glass slab was placed over the alginate material to ensure the accurate contact of alginate with the mold and a uniform flat surface<sup>(15)</sup>. All of the alginate specimens were allowed to sit for five minutes at 37 C<sup>o</sup>. After setting, the impression was separated, removed from the mold, and immersed in disinfecting solution<sup>(3)</sup>. Figure (3, 4) .



**Figure 3:** Specimen of dimensional accuracy



**Figure 4:** Specimens of surface roughness test

## Testing procedure

### Dimensional accuracy test

After specimens were constructed, the initial weight for each was measured using an electronic balance (KERN ,ALS 220.4, Germany) and was indicated as  $w_1$ . The specimens were weighed again after immersion. Change in percentage weight for each specimen in two different media was calculated. Figure (5).



**Figure 5:** digital electronic balance

### Surface roughness test

The specimens' surface was evaluated using a Profilometer (600 S , China), a measurement length of 5 mm /s. The device was adjusted according to the instructions before the measurement and the evaluated measures of each specimen surface; Ra's gained surface roughness values were averaged. Figure(6).



**Figure 6:** surface roughness tester

## Results

### Dimensional Accuracy test

Table (1) presents the descriptive statistics and figure (7) for the alcohol and povidone iodine groups. The mean values of alcohol specimens were decreased after immersion while increased in a povidone-iodine group after immersion.

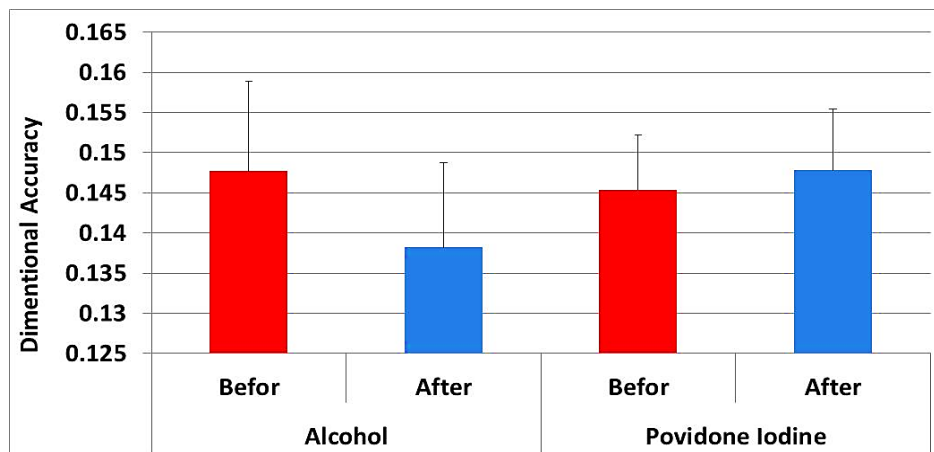
**Table 1:** summary statistics of dimensional accuracy test

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Dimensional Accuracy Alcohol	Before	10	.1477	.01121	.00354
	After	10	.1382	.01049	.00332
Dimensional Accuracy Povidone Iodine	Before	10	.1454	.00681	.00215
	After	10	.1478	.00762	.00241

The F-test results were accounted for non- sig differences before and after immersion in the povidone iodine solution group while significant in the alcohol group before and after immersion. The t-test revealed non – significant before and after immersion for both groups, as in table (2).

**Table 2:** F- and T-test of experimental groups

		Levene's Test for Equality of Variances		t-test for Equality of Means							
		F	Sig.	T	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference		
										Lower	Upper
Dimensional Accuracy Alcohol	Equal variances assumed	0.02	0.89	1.959	18	0.066	0.009	0.004	-0.0006	0.0197	
	Equal variances not assumed			1.959	17.921	0.066	0.009	0.004	-0.0006	0.0197	
Dimensional Accuracy Povidone Iodine	Equal variances assumed	0.15	0.70	-0.739	18	0.469	-0.002	0.003	-0.0092	0.0044	
	Equal variances not assumed			-0.739	17.777	0.469	-0.002	0.003	-0.0092	0.0044	



**Figure 7:** Bar chart of mean values for experimental groups

Surface roughness test

Table (3) presents descriptive statistics. The surface roughness values of alcohol and povidone iodine groups were decreased after immersion—figure (8).

Table 3:: summary statistics of surface roughness test

	Groups	N	Mean	Std. Deviation	Std. Error Mean
Surface Roughness Alcohol	Before	10	1.4785	.33265	.10519
	After	10	1.4585	.27289	.08629
Surface Roughness Povidone Iodine	Before	10	1.5620	.32673	.10332
	After	10	1.4585	.27289	.08629

The results of the F-test and t- test were accounted for non-sig differences before and after immersion in povidone-iodine and alcohol solution groups as in table (4).

Table 4: F- and T-test of experimental groups

	Levene's Test for Equality of Variances	t-test for Equality of Means								
		F	Sig.	t	Df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval	
									Lower	Upper
Surface Roughness Alcohol	Equal variances assumed	0.758	0.395	0.15	18	0.885	0.020	0.1361	-0.266	0.3058
	Equal variances not assumed			0.15	17.337	0.885	0.020	0.1361	-0.2666	0.3066
Surface Roughness Povidone Iodine	Equal variances assumed	1.107	0.307	0.77	18	0.452	0.103	0.1346	-0.1793	0.3863
	Equal variances not assumed			0.77	17.446	0.452	0.104	0.1346	-0.1799	0.3869

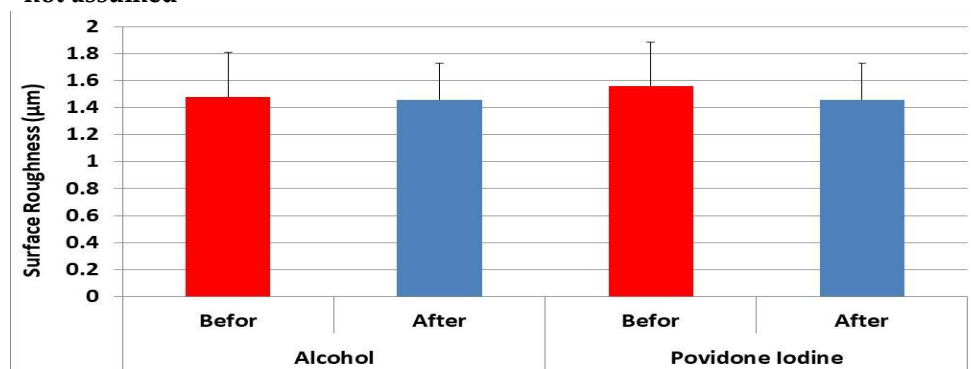


Figure 8: Bar chart of mean values for experimental groups

## Discussion

When making an impression, pathogens were transmitted in the oral cavity to the outer environment. The spread of infectious diseases can be prevented due to contamination<sup>(16)</sup>.

Disinfection of impressions is considered a topic of significance for several years<sup>(17)</sup>. The effect of disinfection treatment on the properties of dental impression and disinfecting solution in removing the pathogen is the main requirement<sup>(18)</sup>. The most workable and dependable method is chemical disinfection by immersion, which does not affect dental impressions and dimensional accuracy<sup>(19)</sup>. Irreversible hydrocolloids tend to be hydrated by ethanol. Therefore, it should be disinfected for a short time because of imbibition (absorption of water), resulting in inaccurate impressions and casts<sup>(20)</sup>. In this study comparison of alcohol, and disinfectant occurs with povidone-iodine. The observed alginate is a minimum dimensional change in weight immediately after immersion in two media but is statistically non-significant. This is in accordance with the results of the previous study<sup>(3)</sup> which concluded that disinfection of alginate material with Clorax will cause minimal dimensional changes related to imbibition and syneresis, but after thirty minutes, it observed the overall minimal change in weight. The activity of disinfecting agent is not essentially the same for all impressions, depending on the thickness and texture of the impression. To provide maximum accuracy, a uniform thickness of 4-6 mm was proposed for irreversible hydrocolloid Rudd and Morrow. In this study, the alginate disc was used to measure the dimensional accuracy before and after disinfection with a uniform thickness of 4 mm. The conclusion does not give a significant change in dimensional accuracy.

The disinfection procedure should not cause alteration in the surface roughness of impression material. Several studies were conducted to estimate the surface roughness of hydrocolloid impression materials. Kotha et al.(2017) concluded that chemical disinfection did not significantly affect surface roughness. In this study, no significant differences were found before and after immersion for two disinfectant solutions. This result agrees with AI Kheraif (2013), who evaluated polyvinyl siloxane material's surface roughness after various disinfection procedures.

## Conclusions

- 1- The dimensional accuracy of Hydrogum alginate material was not affected by immersion in either ethanol or povidone-iodine.
- 2- The immersion time or disinfecting agents did not have a significant effect in terms of surface roughness.

## Acknowledgments

Thanks and appreciation to Mr.Jaffer Raa'd for his help in prosthetic work.

## Conflict Of Interest: None

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**تحديد خشونه السطح ودقه طبعة ماده الاجنيت بعد تطهيرها بالغمر****اسراء محمد حمودي, نضال صاحب منصور****المستخلص**

الخلفية: تهدف هذه الدراسة الى تحديد خشونه السطح ودقه طبعة ماده الاجنيت بعد تطهيرها بالغمر

المواد وطرق العمل: تم استخدام نوعين من المطهرات ايثانول ٧٠٪ ويوفيدون ايودين ٤٪. تم استخدام عينه من ماده الاجنيت على شكل قرص لقياس الدقه بواسطه الوزن قبل الغمر وبعده اما خشونه السطح فشكل العينه مستطيل وقد استخدم جهاز خشونه السطح للقياس قبل وبعد الغمر.

النتائج: لقد لوحظ وجود تغييرات طفيفه لقياس الدقه بواسطه الوزن ولكن احصائيا لوحظ عدم وجود اي تغيير اما بالنسبه لخشونه السطح فلوحظ انه لم يتأثر بعد الغمر..

الاستنتاجات: تم الاستنتاج الى ان تعقيم ماده طبعة الاجنيت بواسطه الايثانول ٧٠٪ واليوفيدون ايودين ٤٪ لا يؤثر على دقه الطبعة وكذلك خشونه السطح.