

# DIMENSIONAL CHANGES OF IRREVERSIBLE HYDROCOLLOID IMPRESSIONS AFTER IMMERSION IN HYPOCHLORITE SOLUTION DISINFECTANT

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## **Abstract**

The aim of the study was to investigate the possible influence of disinfectant (sodium hypochlorite solution) upon the horizontal and vertical dimensions of gypsum casts produced by pouring of irreversible hydrocolloid impressions disinfected by immersion in the disinfectant .

For the realization of this study, 30 irreversible hydrocolloid impressions were divided in 3 groups: G1 - immersed in water, G2 - immersed in sodium hypochlorite disinfectant for 15 minutes and G3 - immersed in sodium hypochlorite disinfectant for 30 minutes. Every impression was poured with gypsum IV class and measurements were made between precisely defined points of the central maxillar incisors and the left and right maxillar molars. The obtained values were statistically analyzed using, Kruskal - Wallis ANOVA test, Mann - Whitney test, t - test for independent samples, analysis of variances, Post hoc analysis and Tukey HSD test.

Based on the performed measurements, as well as the statistical analysis and evaluation, 15 and 30 minutes' immersion in disinfectant is an acceptable irreversible hydrocolloid impression disinfection method, without producing significant dimensional changes of poured gypsum cast.

**Key words:** disinfection, impression, gypsum cast

## Кратка содржина

Целта на оваа студија беше да се испитаат можните влијанија на дезинфициенсот (натриум хипохлорид раствор) врз хоризонталните и вертикалните димензии на гипсениот модел, изработен со излевање на отпечаток земен со иреверзибилни хидроколоидни отпечаточни маси, дезинфициран со методот на потопување во дезинфициенс.

За реализација на оваа студија 30 отпечатоци земени со иреверзибилен хидроколоид беа поделени во 3 групи: Г1 – потопени во вода, Г2 – потопени во дезинфекционо средство натриум хипохлорид 15 минути и Г3 – потопени во дезинфекционо средство натриум хипохлорид 30 минути. Секој отпечаток беше излеан со тврд гипс класа IV и беше мерено помеѓу прецизно дефинирани точки, горниот централен инцизив, левиот и десниот горен прв молар. Добиените резултати беа статистички обработени со користење на повеќе методи, меѓу кои: средна вредност на мерените растојанија, Kruskal - Wallis ANOVA test, Mann - Whitney test, t – тест на независни примероци, анализа на варијанса, Post hoc анализа на Tukey HSD тестот за статистичка споредба.

Базирани на направените мерења и статистичката анализа констатиравме дека дезинфекцијата на потопување на отпечатоците во дезинфекционо средство 15 и 30 минути е прифатлив метод за дезинфекција на отпечатоците земени со иреверзибилни хидроколоиди, без притоа да предизвикува значајни димензионални промени кај излеаниот гипсен модел.

**Клучни зборови:** дезинфекција, отпечаток, гипсен модел.

## Introduction

Blood and saliva can be encountered by a large number of microorganisms that could cause various diseases among the dental staff or the same diseases can be transferred to the healthy individuals. The risk of infection through dental impression is significant for certain infectious diseases such as AIDS, hepatitis, herpes, tuberculosis [1]. In order to suppress the infection, sterilisation or disinfection of dental impressions must be performed routinely. Poulos at al. [2] suggest that the sterilization of the impression materials is not possible due to high temperatures and time therefore the disinfection is a method of choice.

Due to the fact that dental impressions are potential source of cross infection in dental laboratories, the British Dental Association [3] recommended their obligatory disinfection after removal from the patient's mouth in order to prevent spread of infection.

ADA recommended to use high or medium level of disinfection rinse which would kill all microorganisms [4]. There are four types of dental disinfectants such as: chlorine compounds, formaldehyde, glutaraldehyde and iodophor. Three methods for disinfection of dental impressions are disinfection of an impression by spraying, immersion in disinfectant and adding disinfectant in the impression material. Main goal of disinfection agents is to act quickly without making deformation of the dental impressions. According to Moura et al. [5] in order to have effective disinfection 5.25% sodium hypochlorite should be used.

Sofou et al. [6] in their study suggested that the contamination of the dental impression may also occur during its transfer from dental office to dental laboratory. Therefore, after disinfection of the dental impression, they recommended its transfer to the dental laboratory in sterilized bags.

Dimensional stability of the dental impression and precise reproduction of dental hard and soft tissues are essential characteristics of dental casts and disinfectants must not affect the accuracy and reproduction of the fine details on the impressions [7].

Due to hydrophilic properties, irreversible hydrocolloid dental materials are susceptible to dimensional changes depending on temperature, humidity and time. Water absorption of the impression immersed in sodium hypochlorite is due to the differences in osmotic pressure among the impression and the disinfectant solution [8]. Ivanich [9] described that irreversible hydrocolloid impression materials immersed in disinfectant are undergoing dimensional changes. Studies for alginate measured dimensional changes up to only 24 hours and found changes from 0.6% to 3.4% at 24 hours. The dimensional changes measured over a period of 1 and 2 hours were found to be in range of 1.5% to 2%. The absorption of the liquid appears to be highest in the first two hours and consequently decreases over time [10]. According to Beharovich et al. [11], elastomeric impression materials do not undergo significant changes during immersion in a hydrocolloid solution for disinfection.

The aim of this study was to determinate horizontal and vertical changes in gypsum cast made by pouring irreversible hydrocolloid impression after their immersion in sodium hypochlorite solution. Irreversible hydrocolloids were selected as material for this research as they are one of the most used materials in dentistry.

## **Materials and Methods**

In order to achieve the stated goals and to realize the examinations, it was necessary to fabricate physical master model, on which the research in this study was based on. The physical model was made from acrylic material as the basis for preparation of functional models. Horizontal measurements were made between precisely defined points of the maxillar central incisors and the left and right maxillar molars (Figure 1). Vertical measurements were made between 2 predefined ponts along the tooth axial dimensions (Figure 2).

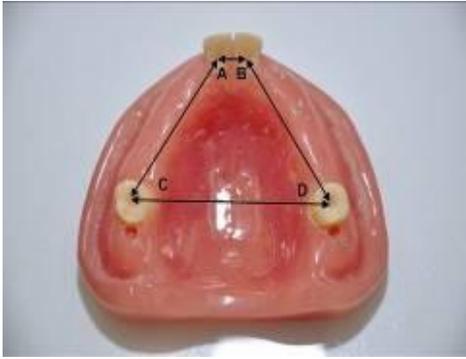


Figure 1. Defined points for measuring horizontal distance

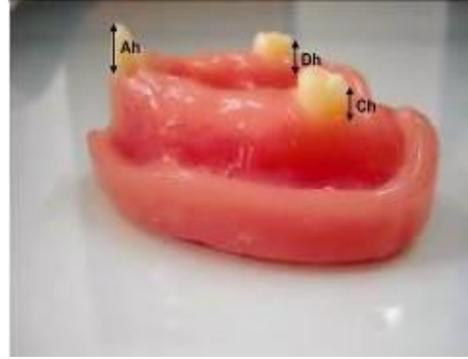


Figure 2. Defined points for measuring vertical distance

In order to standardize the experimental samples, we used the same size tray for anatomical impression and equal dose of irreversible hydrocolloid impression material. The sample consisted 30 type IV (Durone® Dentsply Ind. e Com.Ltda, Rio de Janeiro-Brazil) gypsum models, obtained from irreversible hydrocolloid impressions (Hydrogum®, 55896 lot, Zhermack s.p. A, Rovigo-Italy) of an acrylic master model Three groups were tested: G1 – 10 impressions immersed in water and poured with gypsum class IV within 30 minutes from taking the impression, G2 - 10 impressions were immersed for 15 minutes in the disinfectant sodium hypochlorite and after 30 minutes poured with gypsum class IV and G3 - 10 impressions immersed in a sodium hypochlorite disinfectant for 30 minutes and poured with gypsum IV class after 60 minutes.

When we get the experimental cast models/samples, the linear distances between points in horizontal and vertical direction in the obtained models were measured. Linear distances in the horizontal direction were made between the points: A and B, A and C, C and D and D and B (Figure 3).

Linear distance in the vertical direction were made between the points: Ah, Bh, Ch and Dh (Figure 4).



Figure 3. Measurement of horizontal distance Figure 4. Measurement of vertical distance

The measurements were conducted by using a digital micrometer (caliper) with a metric capacity up to second decimal.

The obtained values and linear variations in the research were statistically analyzed through the parameters:

- Kruskal - Wallis ANOVA test
- Mann - Whitney test
- t - test for independent samples
- analysis of variances
- Post hoc analysis Tukey HSD test

## Results

This part of the research shows the results received by processing and statistical analysis of the data obtained by measuring and comparing the smallest horizontal linear dimensions AB and greatest horizontal intervals CD. It also shows the vertical linear dimensions Ah, Bh, Ch and Dh on the samples.

Comparing the smallest distance from the horizontal aspect (AB), the smallest deviations with minimum values of, respectively, 6.89 mm were measured in the first group.

Table 1. Results of the horizontal distances AB in the impressions of groups

AB 1/2/3	Kruskal-Wallis ANOVA		H=9.49	p=0.0087	Sig.
AB 1	Mann-Whitney	U=20.0	Z=-2.27	p=0.023	Sig.
AB 2	Mann-Whitney	U=12.0	Z=-2.87	p=0.004	Sig.
AB 3	Mann-Whitney	U=40.0	Z=-0.76	p=0.45	N.Sig.

Statistical analysis showed significant difference between the three sub-models in relation to the distance measured between the points A and B from the impressions ( $p < 0.01$ ). (Table 1). The obtained values confirm the fact that the disinfection method by immersion has an impact on the linear changes of the conventional alginate. The immersion time has a role in the process of imbibition of water, therefore, it has a role in the occurrence of dimensional changes after immersion in the disinfectant for the period of 15 to 30 minutes. Differences in horizontal intervals AB between the second and third sub-group were statistically insignificant ( $p > 0.05$ ), that is, the impressions immersed in a solution for 15 and 30 minutes, respectively, had no significant differences. In the biggest horizontal distance CD (Figure 2), the smallest average length was also determined in the first subgroup, where the impressions were not immersed in solution (control group) with an average value of 51.08mm.

The differences which occurred in the measured length CD, of the impression from all three of the subgroups, were statistically insignificant. ( $p > 0.05$ ) (Table 2).

Table 2. Results of the horizontal distances CD in the impressions of all groups

CD 1/2/3	Kruskal-Wallis ANOVA		H=3.84	p=0.15	N.Sig.
CD 1	Mann-Whitney	U=33.5	Z=1.25	p=0.25	N.Sig.
CD 2	t-test for independent samples	t=-1.13	df=18	p=0.27	N.Sig.
CD 3	Mann-Whitney	U=27.0	Z=-1.74	p=0.082	N.Sig.

The measured vertical distances, the differences between the three subgroups in regard to the average lengths of the vertical distances, are statistically insignificant ( $p > 0.05$ ). Thus, the impressions that are not immersed in the solution and those that are immersed for 15 to 30 minutes, have insignificant variations in the length of the vertical distance (Table 3,4,5,6).

Table 3. Results of the vertical distances Ah in the impressions of groups.

Ah 1/2/3	Kruskal-Wallis ANOVA		H=3.18	p=0.2	N.Sig.
Ah 1	Mann-Whitney	U=38.0	Z=-0.91	p=0.36	N.Sig.
Ah 2	t-test for independent samples		t=1.66	p=0.11	N.Sig.
Ah 3	Mann-Whitney	U=28.5	Z=1.63	p=0.1	N.Sig.

Table 4. Results of the vertical distances Bh in the impressions of groups.

Bh 1/2/3	Kruskal-Wallis ANOVA		H=1.73	p=0.42	N.Sig.
Bh 1	Mann-Whitney	U=39.5	Z=0.79	p=0.43	N.Sig.
Bh 2	t-test for independent samples		t=-0.54	p=0.6	N.Sig.
Bh 3	Mann-Whitney	U=32.0	Z=-1.36	p=0.17	N.Sig.

Table 5 Results of the vertical distances Ch in the impressions of groups.

Ch 1/2/3	Analysis of variance		F=4.33	p=0.023	Sig.
Post hoc analysis Tukey HSD test					
	Ch 1	Ch 2	Ch 3		
Ch 1		p=0.03	p=0.067		
Ch 2	p=0.03		p=0.93		
Ch 3	p=0.067	p=0.93			

Table 6. Results of the vertical distances Dh in the impressions of groups.

Dh 1/2/3	Analysis of variance		F=0.095	p=0.91	N.Sig.
Post hoc analysis Tukey HSD test					
	Dh 1	Dh 2	Dh 3		
Dh 1		p=0.99	p=0.95		
Dh 2	p=0.99		p=0.91		
Dh 3	p=0.95	p=0.91			

## Discussion

Disinfection of the dental impression is a necessary method that was made by immersion of the dental impression in a solution of sodium hypochlorite. The irreversible hydrocolloid dental materials changed their dimension after being immersed in the disinfectant. The dimensional changes in the impression materials are limited to the allowed range of 0 to 0.15% [12]. This study shows that the impression immersed in disinfectant 15 minutes has no significant dimensional changes. In a research conducted by Tan et al. [13] who observed the effects of all the different methods of disinfection on the dimensional changes, it was proven that immersion of the gypsum cast in a disinfectant for more than 15 minutes, results with horizontal dimensional changes in the gypsum cast. According to them, a method of choice is using spray for the disinfection, whereupon there are no significant dimensional changes. Our results were similar with Hiraguchi et al. [14] and Panza et al. [15] who suggest that if dental impression is kept for more than 15 minutes immersed in the disinfectant, dimensional changes occur.

After 15 min and 30 min of keeping the dental impression immersed in disinfectant sodium hypochlorite the difference that occurs in dimensional changes of impression is minimal, which means that the impression has been undergoing major changes after the first 15 min once immersed in the disinfectant. According to Poulos et al. [16] the best time for disinfection of impressions is when they are immersed in disinfectant for 30 minutes, and during that time the impression undergoes dimensional changes within the acceptable range.

In the research carried out by Taylor et al. [17] on dimensional changes of disinfected hydrocolloid impressions by sodium hypochlorite, the dimensional variation in impressions was not meaningful because inaccuracy up to 78  $\mu\text{m}$  is acceptable. Ten minutes absorbing the disinfectants can be useful because it works against synergies associated reduction.

Iwasaki et al. [18] and Oderinu et al. [19] in their study showed that immersion of hydrocolloid impressions in 0.5% sodium hypochlorite up to 10 min does not adversely affect the surface properties of the resulting stone casts.

Cohen et al. [20] in the study of "Dimensional accuracy of three different alginate impression materials", indicated that the dimensional changes that occur in dental impressions also depend on the type of alginates used, because some alginates absorb water from a disinfectant quicker and some slower, some more and some less.

Vertical dimensional changes that occur in dental impression between impressions that are not immersed in disinfectant and impressions that are immersed for 15 minutes and 30 minutes, are minimal. Vertical dimensional changes that occur in the impression after disinfection by immersion in sodium hypochlorite are insignificant.

## Conclusion

Based on the performed researches and measurements, as well as the statistical analysis and evaluation, the short term of 15 – 30 minutes' immersion in disinfectant is an acceptable irreversible hydrocolloid impression disinfection method, without producing

significant dimensional changes of the gypsum cast. In every dental office should be a protocol for treatment of prosthetic impressions: general hygiene measures, careful washing with water, immersion of the impression in disinfectant 15 to 30 minutes, again washing with water, removing excess water from the impression and pouring of impression with gypsum as quickly as possible.

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