Evaluation of the effect of storage time and disinfectant solutions on the dimensional accuracy of impression materials with digital radiography

Ocena wpływu czasu przechowywania oraz roztworów odkażających na wierność odtwarzania kształtu przez materiały wyciskowe z użyciem radiografii cyfrowej

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Abstract

Background. The dimensional accuracy of impression materials has been evaluated for a long time, but thus far, digital radiography has not been used for this purpose. The dimensional accuracy of impression materials is very important for the final adaptation of dental prostheses.

Objectives. The objective of this study was to evaluate the effects of different disinfectant solutions and storage times on the dimensional stability of different impression materials by means of digital radiography.

Material and methods. Polyether (PE), hydrocolloid (IH), condensation silicone (CS), and addition silicone (AS) materials were used for preparing impressions, taken from an acrylic master model with 2 vertical and 2 horizontal reference points. Water (W), sodium hypochlorite (SH) and a disinfectant solution without aldehyde (Z) were applied on the impressions. Half of the impressions were poured over immediately and half of them – 1 day after. Digital radiography was used to determine the dimensional accuracy of the impression materials. The data was analyzed with a variance analysis and Tukey's multiple comparison test.

Results. While PE showed the smallest dimensional changes, IH showed the greatest in all lines. Applying SH and pouring 1 day after caused the greatest dimensional changes in all impression materials.

Conclusions. Different disinfectant solutions and storage times had a different effect on the impressions, but the dimensional changes were clinically acceptable.

Key words: dimensional accuracy, storage time, impression material, digital radiography, disinfection solution

Słowa kluczowe: wierność odtwarzania kształtu, czas przechowywania, materiał wyciskowy, radiografia cyfrowa, roztwór odkażający

Introduction

Dental impression materials are used to register the form and relation of the teeth and the surrounding oral tissues. The accuracy of the impression is related to the dimensional stability of the impression material, and this is affected by many factors, such as the impression technique, impression tray, selection of a proper impression material, and properties of the material.^{1–3} An accurate impression is the most important stage for the construction of a dental prosthesis.⁴ Polysulfide polymers, condensation silicones and the addition type of silicones, synthetic elastomers containing polyether, and hydrocolloids are widely used in dentistry to obtain the copy of oral tissues.⁵ Impression materials are exposed to some factors, which may result in dimensional changes.⁶ The dimensional stability and accuracy of impression materials are significant for the adaptation of the final prosthetic restoration. The dimensional accuracy of impressions is mostly influenced by the procedure of disinfection and the time period after which the model is poured over with dental stone. In terms of the latter, the best results are obtained by pouring the dental stone immediately after removing the impression from the mouth. For practical reasons, the impressions may nevertheless sometimes not be poured over immediately. Some producers claim that recently produced impression materials can be kept in appropriate conditions for longer periods of time without loss of clinical accuracy. Glutaraldehyde and sodium hypochlorite are frequently used for disinfecting dental impressions.⁷ Sodium hypochlorite, which is an effective disinfectant recommended by the American Dental Association (ADA), is used in a 1:10 dilution for a 10-minute immersion to disinfect irreversible hydrocolloid impressions.⁸ The use of glutaraldehyde is not preferred due to its harmful and irritant effect. Therefore, dentists may prefer aldehyde-free disinfectant solutions.

Various dimensional measuring techniques are used in clinical and academic dentistry for dental stone models and scanned models. Manual measurements are performed with a Vernier caliper or needle-point calipers, and they are the standard method to evaluate the accuracy of dental models. Manual measurements have some advantages, such as the ease of application, low cost and immediate applicability. Alternatively, 3-dimensional computer dental models, scanned with an optical or laser beam, are considered appropriate in clinical applications. In this study, the dimensional changes of different impression materials were evaluated with digital radiography, which differs from the methods described in the current literature. Digital radiography is considered to be more economical than the 3-dimensional computer application and more reliable than the manual methods.^{8,9}

The aim of this study was to evaluate the effect of different disinfectant solutions and storage times on the dimensional stability of different impression materials.

The hypothesis of the study was that different storage times and disinfectant solutions would affect the dimensional stability of impression materials in different ways, depending on the type of impression material.

Material and methods

In this study, a denture base from heat-polymerized acrylic, prepared on a stone model of the edentulous maxilla, was used as a master model. Holes were drilled in the places corresponding to the right and left canines and tuber maxillary ridges on the acrylic base with a steel round drill of a diameter of 0.2 mm, and 4 different reference points were determined. Then, metal balls of a diameter of 1 mm were placed in the reference points of the master model and fixed with dental wax. Two vertical (line 1 and line 2) and 2 horizontal (line 3 and line 4) reference lines were identified on both sides between the 4 different reference points. The reference lines were determined as follows:

- line 1 – the distance between the steel balls in the region of the left canine and left tuber maxilla;
- line 2 – the distance between the steel balls in the region of the right canine and right tuber maxilla;
- line 3 – the distance between the steel balls in the region of the right and left canines;
- line 4 – the distance between the steel balls in the region of the right and left tuber maxillae.

Therefore, it was aimed to evaluate the dimensional changes that might occur in the impression materials both horizontally and vertically by measuring the vertical and horizontal reference lines. The master model was fixed inside the lower part of a dental prosthesis flask with dental white stone. Thus, it was ensured that the model remained stable during impression procedures.

The master model was placed in a digital radiography unit (PHOT-xII; Takara Belmont USA, Inc., Somerset, USA) and its image was taken with occlusal radiography. The reference measurements, determined by the reference points, were carefully performed digitally by 2 researchers (Fig. 1). These measurements were used as references and compared to those of the subsequent stone models. The dimensional changes that occurred due to the impression materials were evaluated by subtracting the 1st reference measurement value from those of the stone models.

Fig. 1. The radiographic image and reference lines on the master model

Table 1. Impression materials used in the present study

Impression material	Product	Manufacturer	Lot number	Code
Polyether	Impregum™ Penta™ Soft	3M ESPE, Neuss, Germany	624182	PE
Irreversible hydrocolloid	Hydrogum 5	Zhermack SpA, Badia Polesine, Italy	212976	IH
Addition silicone	Elite P&P	Zhermack SpA, Badia Polesine Italy	234875	AS
Condensation silicone	Zetaflow	Zhermack SpA, Badia Polesine Italy	242997	CS

Four different impression materials were used to produce the stone models (Table 1). A total of 240 impressions were taken from the master model.

Apart from polyethers (PE), all impressions of the master model were taken using a standard metal tray (Jescoform®; Aesculap AG, Tuttlingen, Germany). The irreversible hydrocolloid (IH) impression material was prepared by mixing powder and water in the amount suggested by the producer in an automatic mixing machine (Hurrimix™; Zhermack SpA, Badia Polesine, Italy). Room temperature water was consistently used for the mixtures so that the hardening time of the impression material could not be affected. The condensation (C-type) silicones (CS) were prepared by mixing a catalyzer and the base at the rates suggested by the producer with clean bare hands. Gloves were not used, because the powder in latex gloves may affect the hardening reaction of the impression material. The double mixing technique was used for the silicone-based impression materials (CS and addition silicone – AS). It was also applied for the light bodies of the silicone-based impression materials. A special tray was used for the PE impression material. A tray adhesive (EXAMIX™; GC America, Inc., Alsip, USA) was applied in a thin layer to the inside and edges of the special tray. The PE impression material was mixed in an automatic mixing machine (Pentamix™, 3M ESPE, Seefeld, Germany), placed in the special impression tray, and an impression was taken from the master model.

The impressions were separated into 6 equal groups, and 3 different disinfectant solutions were applied with 2 different storage times. The disinfectants were: water (W), 1% sodium hypochlorite (SH) and an aldehyde-free disinfectant solution – Zeta 7 spray (Z) (Zhermack SpA).

The disinfection procedures were as follows: W – washing with water for 45 s; SH – applying 1% SH and keeping it for 10 min; and Z – applying the ready impression disinfectant solution and keeping it for 3 min. While half of the impressions were immediately poured over, the other half

were poured over 1 day after. The IH impressions were kept in a closed plastic box. Other impressions were kept at normal room temperature (23°C), humidity 55 ±5%. Type IV hard stone (Moldano®; Heraeus Kulzer GmbH, Hanau, Germany) was used to obtain the stone models from the impressions. The hard stone mixture was prepared by mixing powder (100 g) and water (30 mL) in the amount suggested by the producer. The required precautions were taken to prevent air bubbles in the stone during mixing and pouring it into the impression.

The resulting stone models were immediately removed from the impressions as soon as the stone was hardened.

As with the master model, metal balls of a diameter of 1 mm were placed in the reference points of the stone models and fixed with dental wax (Fig. 2), and then occlusal radiographs were taken. The measurements between the steel balls were performed on the radiographic images. All measurements were repeated 5 times and their averages were calculated. The digital measurements on the stone models were carefully performed by 2 researchers.

The mean, standard deviation (SD) and percentage values of the data of the line 1, line 2, line 3, and line 4 reference measurements were calculated. An analysis of variance (ANOVA) was conducted to evaluate the effect of the different impression material types, storage times and disinfectant solutions on 4 different reference measurements. Tukey's multiple comparison test was performed to compare the averages. A *p*-value ≤0.05 was considered statistically significant.

Results

The results of ANOVA regarding the effect of the impression material type, storage time and disinfectant on the dimensional changes in the impression materials are presented in Table 2. According to the Table, both the factors and the interactions between them were found to be statistically significant in all measurements performed in 2 vertical and 2 horizontal directions (*p* < 0.001).

The mean and SD values obtained with Tukey's multiple comparison test for line 1 are presented in Table 3. While the smallest dimensional change was observed in PE, the greatest dimensional change was observed in IH, and the differences between the impression materials were found statistically significant in the poured-immediately groups. The effect of different disinfectant solutions was also observed, but the differences were

Fig. 2. The radiographic image of the metal balls and reference lines on the stone model

Table 2. Results of the analysis of variance (ANOVA)

Variation	df	Line 1		Line 2		Line 3		Line 4		p-value
		MS	F	MS	F	MS	F	MS	F	
Storage time	1	0.010	209.509	0.107	1312.577	0.087	721.609	0.105	926.181	0.000
Impression material	3	0.020	405.128	0.035	427.465	0.046	379.392	0.063	552.373	0.000
Disinfection	2	0.010	208.981	0.017	213.605	0.017	140.900	0.022	190.995	0.000
Storage time × impression material	3	0.004	80.244	0.038	466.741	0.032	261.950	0.036	319.272	0.000
Storage time × disinfection	2	0.014	278.398	0.005	62.310	0.005	42.616	0.005	46.981	0.000
Impression material × disinfection	6	0.004	80.473	0.010	117.626	0.011	93.896	0.011	97.767	0.000
Storage time × impression material × disinfection	6	0.005	94.440	0.009	105.981	0.009	78.161	0.012	104.586	0.000

df – degrees of freedom; MS – mean square; F – F-test of ANOVA.

Table 3. Multiple comparison test results with mean ± standard deviation (SD) for line 1

Storage time	Impression material	W	Z	SH	Total
		mean ±SD	mean ±SD	mean ±SD	mean ±SD
Immediately	AS	0.0338 ±0.007 ^c	0.0343 ±0.002 ^c	0.0352 ±0.002 ^c	0.0344 ±0.004 ^c
	IH	0.0727 ±0.007 ^a	0.0741 ±0.004 ^a	0.0756 ±0.003 ^a	0.0741 ±0.005 ^a
	CS	0.0522 ±0.010 ^b	0.0569 ±0.007 ^b	0.0627 ±0.014 ^b	0.0573 ±0.011 ^b
	PE	0.0149 ±0.014 ^d	0.0157 ±0.006 ^d	0.0163 ±0.007 ^d	0.0156 ±0.009 ^d
1 day after	AS	0.0342 ±0.006 ^c	0.0349 ±0.003 ^c	0.0358 ±0.004 ^a	0.0350 ±0.004 ^b
	IH	0.0733 ±0.004 ^a	0.0752 ±0.004 ^a	−0.0170 ±0.008 ^c	0.0438 ±0.004 ^a
	CS	0.0564 ±0.006 ^b	0.0645 ±0.008 ^b	−0.0190 ±0.005 ^c	0.0340 ±0.004 ^b
	PE	0.0151 ±0.005 ^d	0.0169 ±0.006 ^d	0.0176 ±0.007 ^b	0.0165 ±0.006 ^c

W – water; Z – Zeta 7 spray (aldehyde-free disinfectant solution); SH – sodium hypochlorite. There are statistically significant differences between the values indicated with different letters ($p < 0.05$).

not statistically significant in the poured-immediately groups. Moreover, all impression materials poured over immediately showed dimensional expansion. Considering the effect of different storage times, there were no statistically significant differences between the poured-immediately and poured-1-day-after groups, except for the case when SH was applied. While the smallest dimensional change was observed in PE, the greatest dimensional change was observed in IH, and the differences between the impression materials were found statistically significant in the poured-1-day-after groups, except for AS and CS. Water and Z had the same effect on the dimensional accuracy of all impression materials, but SH showed a statistically significant effect in all poured-1-day-after groups. While the AS and CS groups after applying SH showed dimensional contraction, all other groups showed dimensional expansion. The percentages of the dimensional changes observed in the impression materials were also found to be statistically significantly different from each other. However, the dimensional changes observed in the impression materials were clinically acceptable (−0.047–0.187%) (Fig. 3).

The mean and SD values obtained with Tukey's multiple comparison test for line 2 are presented in Table 4. While the smallest dimensional change was observed in PE, the greatest dimensional change was observed in IH. There were no statistically significant differences between AS and CS in the poured-immediately groups. The effect

Fig. 3. Line 1 mean differences between dental impression materials

of different disinfectant solutions was also varied, but the differences were not statistically significant, except for CS, with SH applied in the poured-immediately group. Furthermore, all impression materials that were poured over immediately showed dimensional expansion, except for the CS group where SH was applied. Considering the effect of different storage times, statistically significant differences were observed between the poured-immediately and poured-1-day-after groups. While the smallest dimensional change was observed in CS, the greatest dimensional change was observed in AS, and the differences between the impression materials were found statistically significant in the poured-1-day-after groups. This might be caused by expansion and contraction occurring at the same time. Addition silicone and PE showed dimensional expansion, and CS showed dimensional contraction after applying different disinfection solutions. The IH group

Table 4. Multiple comparison test results with mean $\pm$ standard deviation (SD) for line 2

Storage time	Impression material	W	Z	SH	Total
		mean $\pm$ SD	mean $\pm$ SD	mean $\pm$ SD	mean $\pm$ SD
Immediately	AS	0.0468 $\pm$ 0.008 ^b	0.0471 $\pm$ 0.004 ^b	0.0478 $\pm$ 0.004 ^b	0.0472 $\pm$ 0.005 ^b
	IH	0.0844 $\pm$ 0.018 ^a	0.0849 $\pm$ 0.012 ^a	0.0853 $\pm$ 0.008 ^a	0.0849 $\pm$ 0.013 ^a
	CS	0.0745 $\pm$ 0.008 ^a	0.0811 $\pm$ 0.013 ^a	-0.0192 $\pm$ 0.007 ^d	0.0455 $\pm$ 0.009 ^b
	PE	0.0206 $\pm$ 0.012 ^c	0.0220 $\pm$ 0.008 ^c	0.0229 $\pm$ 0.012 ^c	0.0218 $\pm$ 0.011 ^c
1 day after	AS	0.0472 $\pm$ 0.004 ^b	0.0477 $\pm$ 0.003 ^a	0.0483 $\pm$ 0.004 ^a	0.0477 $\pm$ 0.004 ^a
	IH	0.0862 $\pm$ 0.010 ^a	-0.0209 $\pm$ 0.009 ^c	-0.0328 $\pm$ 0.005 ^c	0.0108 $\pm$ 0.006 ^c
	CS	-0.0355 $\pm$ 0.008 ^d	-0.0491 $\pm$ 0.007 ^d	-0.0672 $\pm$ 0.009 ^d	-0.0506 $\pm$ 0.015 ^d
	PE	0.0209 $\pm$ 0.011 ^c	0.0228 $\pm$ 0.005 ^b	0.0244 $\pm$ 0.007 ^b	0.0227 $\pm$ 0.008 ^b

There are statistically significant differences between the values indicated with different letters ($p < 0.05$).

showed dimensional expansion when W was applied, and after applying Z and SH, showed dimensional contraction. The percentages of the dimensional changes observed in the impression materials were also found to be statistically significantly different from each other. However, the dimensional changes observed in the impression materials were clinically acceptable (-0.087 – 0.211%) (Fig. 4).

The mean and SD values obtained with Tukey's multiple comparison test for line 3 are presented in Table 5. While the smallest dimensional change was observed in PE and CS, the greatest dimensional change was observed in IH. There were no statistically significant differences between PE and CS in the poured-immediately groups. The effect of different disinfectant solutions was varied and the differences were statistically significant, except for IH in the poured-immediately groups. Moreover, all impression materials that were poured over immediately showed

dimensional expansion, except for the CS group where SH was applied. Considering the effect of different storage times, statistically significant differences were observed between the poured-immediately and poured-1-day-after groups. While the smallest dimensional change was observed in CS, the greatest dimensional change was observed in AS, and the differences between the impression materials were found statistically significant in the poured-1-day-after groups. This might be caused by expansion and contraction occurring at the same time. Addition silicone and PE showed dimensional expansion, and CS showed dimensional contraction after applying different disinfection solutions. The IH group showed dimensional expansion when W was applied, and after applying Z and SH, showed dimensional contraction. The percentages of the dimensional changes observed in the impression materials were also found to be statistically significantly different from each other. However, the dimensional changes observed in the impression materials were clinically acceptable (-0.135 – 0.223%) (Fig. 5).

The mean and SD values obtained with Tukey's multiple comparison test for line 4 are presented in Table 6. While the smallest dimensional change was observed in PE and CS, the greatest dimensional change was observed in IH. There were no statistically significant differences between PE and CS in the poured-immediately groups. The effect of different disinfectant solutions was also varied and the differences were statistically significant, except for IH

Fig. 4. Line 2 mean differences between dental impression materials**Table 5.** Multiple comparison test results with mean $\pm$ standard deviation (SD) for line 3

Storage time	Impression material	W	Z	SH	Total
		mean $\pm$ SD	mean $\pm$ SD	mean $\pm$ SD	mean $\pm$ SD
Immediately	AS	0.0401 $\pm$ 0.010 ^c	0.0406 $\pm$ 0.008 ^b	0.0417 $\pm$ 0.006 ^b	0.0408 $\pm$ 0.008 ^b
	IH	0.0801 $\pm$ 0.015 ^a	0.0808 $\pm$ 0.015 ^a	0.0818 $\pm$ 0.004 ^a	0.0809 $\pm$ 0.012 ^a
	CS	0.0642 $\pm$ 0.009 ^b	0.0708 $\pm$ 0.034 ^a	-0.0495 $\pm$ 0.012 ^d	0.0285 $\pm$ 0.006 ^c
	PE	0.0199 $\pm$ 0.009 ^d	0.0237 $\pm$ 0.010 ^b	0.0286 $\pm$ 0.009 ^c	0.0241 $\pm$ 0.009 ^c
1 day after	AS	0.0405 $\pm$ 0.012 ^b	0.0412 $\pm$ 0.003 ^a	0.0424 $\pm$ 0.008 ^a	0.0414 $\pm$ 0.008 ^a
	IH	0.0811 $\pm$ 0.004 ^a	-0.0174 $\pm$ 0.012 ^c	-0.0269 $\pm$ 0.006 ^c	0.0123 $\pm$ 0.005 ^c
	CS	-0.0405 $\pm$ 0.003 ^d	-0.0591 $\pm$ 0.007 ^d	-0.0738 $\pm$ 0.004 ^d	-0.0578 $\pm$ 0.015 ^d
	PE	0.0214 $\pm$ 0.004 ^c	0.0264 $\pm$ 0.003 ^b	0.0297 $\pm$ 0.004 ^b	0.0258 $\pm$ 0.005 ^b

There are statistically significant differences between the values indicated with different letters ($p < 0.05$).

Fig. 5. Line 3 mean differences between dental impression materials

in the poured-immediately groups. Also, all impression materials that were poured over immediately showed dimensional expansion, except for the CS group where SH was applied. Considering the effect of different storage times, statistically significant differences were observed between the poured-immediately and poured-1-day-after groups. While the smallest dimensional change was observed in CS, the greatest dimensional change was observed in AS, and the differences between the impression materials were found statistically significant in the poured-1-day-after groups. Addition silicone and PE showed dimensional expansion, and CS showed dimensional contraction after applying different disinfection solutions. The IH group showed dimensional expansion when W was applied, and after applying Z and SH, showed dimensional contraction. The percentages of the dimensional changes observed in the impression materials were also found to be statistically different from each other. However, the dimensional changes observed in the impression materials were clinically acceptable (-0.090 – 0.156%) (Fig. 6).

Fig. 6. Line 4 mean differences between dental impression materials

Table 6. Multiple comparison test results with mean $\pm$ standard deviation (SD) for line 4

Storage time	Impression material	W	Z	SH	Total
		mean $\pm$ SD	mean $\pm$ SD	mean $\pm$ SD	mean $\pm$ SD
Immediately	AS	0.0541 $\pm$ 0.007 ^c	0.0543 $\pm$ 0.002 ^c	0.0547 $\pm$ 0.002 ^b	0.0544 $\pm$ 0.004 ^b
	IH	0.0869 $\pm$ 0.006 ^a	0.0875 $\pm$ 0.002 ^a	0.0888 $\pm$ 0.003 ^a	0.0877 $\pm$ 0.004 ^a
	CS	0.0659 $\pm$ 0.014 ^b	0.0697 $\pm$ 0.005 ^b	-0.0514 $\pm$ 0.015 ^d	0.0281 $\pm$ 0.006 ^c
	PE	0.0263 $\pm$ 0.009 ^d	0.0268 $\pm$ 0.017 ^d	0.0273 $\pm$ 0.006 ^c	0.0268 $\pm$ 0.011 ^c
1 day after	AS	0.0545 $\pm$ 0.002 ^b	0.0549 $\pm$ 0.004 ^a	0.0556 $\pm$ 0.003 ^a	0.0550 $\pm$ 0.003 ^a
	IH	0.0875 $\pm$ 0.004 ^a	-0.0228 $\pm$ 0.002 ^c	-0.0377 $\pm$ 0.007 ^c	0.0090 $\pm$ 0.006 ^c
	CS	-0.0493 $\pm$ 0.014 ^d	-0.0610 $\pm$ 0.015 ^d	-0.0744 $\pm$ 0.003 ^d	-0.0616 $\pm$ 0.015 ^d
	PE	0.0270 $\pm$ 0.003 ^c	0.0273 $\pm$ 0.003 ^b	0.0274 $\pm$ 0.004 ^b	0.0272 $\pm$ 0.003 ^b

There are statistically significant differences between the values indicated with different letters ($p < 0.05$).

Discussion

The results obtained in this study support our hypothesis. In the study, the dimensional changes observed in the impression materials were found to be different from each other in relation to the type of impression material, storage time and type of disinfectant solution. However, the dimensional changes occurring in the impression materials were at a clinically acceptable level according to the ADA specification No. 19 ($<0.5\%$).⁹

While reviewing the literature, it can be observed that the dimensional changes in impression materials have been evaluated manually or with laser scanning and computed tomography.^{8,9} It has been reported that there are some drawbacks in such methods; specifically, the manual methods are not sensitive enough and the other methods imply increased cost.⁹ In this study, digital dental radiography, which had never been used until this time in the evaluation of dimensional changes, was utilized. It is considered that it is technically and financially more economical than computed tomography, and more sensitive than the manual methods. However, it does not enable monitoring 3-dimensional tooth movements, as in computed tomography. Zilberman et al., in their study in which they evaluated the dimensional stability of impression materials with the conventional measurement method and the 3-dimensional computed model method, reported that the conventional method proved to be better.¹⁰ In the present study, all reference measurements on the stone model were evaluated with single radiography, using occlusal radiography procedures. Moreover, 4 different reference measurements – in total 2 vertical (line 1 and line 2) and 2 horizontal (line 3 and line 4) – were performed on the master model to evaluate the dimensional changes occurring in the impression materials in multiple ways. After obtaining the radiographs of the stone models, the measurements were digitally performed on a special system of the radiography software program. The measurements were repeated 5 times in the digital environment, in an attempt to increase the sensitivity of the results.

If irreversible hydrocolloid impression materials are to be kept without being poured over immediately, they lose water in their structure and shrink, or if there is water in the environment, they tend to absorb it, and then they are exposed to dimensional changes by expanding.^{11,12} Therefore, impressions taken with irreversible hydrocolloid impression materials should not be kept in the mouth for more than 10 min and should be poured over within 1 h at the latest. Otherwise, shrinkage or expansion may be observed in the impression.¹³ Alkurt et al., in their study in which they evaluated the effect of storage time on the dimensional change of different impression materials with computed tomography, reported that irreversible hydrocolloids exhibited the greatest dimensional change and this change was at a clinically acceptable level.¹⁴ In our study, the IH group was determined to be the group exhibiting the greatest dimensional change. Furthermore, the researchers stated that the use of computed tomography was non-economic and required professional help.

In the present study, PE was determined to be the impression material exhibiting the smallest dimensional change, depending on the applied storage time and disinfectant solutions. The differences between other impression materials were found to be statistically significant. On the other hand, Alkurt et al. reported in their study that polyether impression material was dimensionally the most stable impression material, taking into account different storage times.¹⁴ Polyether impression materials are significantly sensitive impression materials that do not create by-products when they harden. However, due to their hydrophilic structure, they may be exposed to dimensional changes if they are kept in a humid and aqueous medium. In this study, the impressions taken were dried after applying the disinfectant solutions and kept in an environment of 23°C with 55 ±5% humidity. Kamble et al., in their study in which they examined the effect of different disinfectant procedures on the dimensional change of elastomeric impression materials, stated that polyether impression material was exposed to more dimensional change compared to addition silicone; however, this change was at a clinically acceptable level.¹⁵

Silicone impression materials are separated into 2 groups as addition and condensation silicones according to whether they create a by-product during the hardening reactions or not. While by-products are not formed in addition silicones, volatile by-products are formed in condensation silicones. In this regard, addition silicones are dimensionally more stable.⁵ As it was shown in the results of the present study, AS was exposed to less dimensional change compared to CS, and the dimensional stability of both materials was found to be significantly higher compared to IH. Since mixing in latex gloves during the preparation of CS exhibits an inhibitory effect on the polymerization reaction, it was mixed with clean bare hands.

Since the present study did not imitate intraoral conditions, new studies can be conducted under in-vivo

conditions using the same techniques. Thus, the reliability of digital radiography in the determination of dimensional changes can be tested. Moreover, the reliability of digital radiography can be evaluated by comparing it with the previously used methods.

Conclusions

The type of impression material causes some dimensional changes. While PE is dimensionally the most stable impression material, the changes observed in IH are greater. Different disinfectant solutions applied to impression materials cause dimensional changes. Notably, the application of SH caused the greatest dimensional change in all the impression materials. Significant differences were observed between the poured-immediately and poured-after-1-day groups. More dimensional changes were identified in the impressions stored for 1 day. The dimensional changes were clinically acceptable according to the ADA specification No. 19 for all lines (<0.5%).

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