

Effect of Two Different Disinfectants on Dimensional Stability of Newer Alginate Impression Materials Over Five Days

Prem Kumar Ambrose*, Andrzej S.Juszczuk†, Robert K.F.Clark‡ and David R.Radford§

Abstract - The effect of two different disinfectants on the dimensional stability of two alginate impression materials over five days was investigated. 60 impressions were made under standardised conditions, 30 with each alginate, of which ten were disinfected in each disinfectant and ten were controls. Impressions were stored over a period of five days in a container with 100% humidity. Measurements were made between four points. Two-way analysis of variance indicated no differences in the change from baseline to day 5 between any of the combinations of alginate and disinfectant. Only two of the changes between baseline and day 5 reached statistical significance at the $p < 0.01$ level. Therefore it can be concluded that within the limitations of this study when newer alginate impression materials are disinfected they remain stable over 5 days.

KEY WORDS: Impression, Stability, Disinfectant

INTRODUCTION

Alginate impression materials are routinely used in dentistry for production of both study and working casts. A disadvantage has been that, as a hydrocolloid, it may gain or lose water due to imbibition and syneresis and so conventional wisdom has been that casts should be poured as soon as possible after removal of the alginate impression from the patient's mouth^{1,2}. However, despite this apparent weakness there is only a limited body of literature on the effect of storage on dimensional stability and most studies only report on relatively short periods and conclude that alginates did not remain stable when stored for as little as three hours³ even when studied under ideal storage conditions⁴. Furthermore, most of the materials studied previously have been superseded by newer materials.

Introduction of more stringent cross-infection control procedures has created interest on the effects of disinfection on dimensional stability of impression materials^{5,6,7}. Immersion in disinfection solutions is the preferred method. Spray on surface disinfectants are not recommended due to the risk of inhalation. A recent survey concluded that dimensional changes produced as a result of disinfection are not likely to affect clinical outcomes⁸.

Recently, alginate impression materials have been introduced, which manufacturers claim are dimensionally stable for five days provided they are stored in 100% humidity. Subsequent investigation⁹ has shown that the manufacturers' claims were justifiable.

However, the effect of disinfection by immersion of these newer 5-day stable alginate impression materials has not yet been reported and therefore the aim of this investigation is to test the effect of two commercially available immersion disinfectants on the dimensional stability of two 5-day stable alginate impression materials over a 5 day period of storage.

METHOD AND MATERIALS

Two dust-free alginate impression materials Hydrogum 5 and Xantalgin Crono which were claimed by their manufacturers to remain dimensionally stable for up to five days, were selected for the study. Two immersion disinfectants Disifin Dent and Perform ID were chosen to investigate the effect of disinfectants on these impression materials.

The impression procedure was that previously described by Wandreker *et al*. A plastic typodont model was used as a master model representing a Kennedy Classification Class I Modification 2 partially dentate arch. Reference points on four teeth namely 13, 16, 23 and 27 were chosen so as to measure the dimensional accuracy in antero-posterior, mesio-distal and cross-arch directions when the impressions were made and stored. Reference markers were cut on the prepared rest seats to a diameter and depth of 1.5mm using a dental milling machine. These reference markers were named A, B, C and D on Frasco teeth 27, 23, 13 and 16 respectively. Impressions were recorded with the typodont model mounted on a plaster-less articulator. The impression recording procedure was standardized by fixing the typodont model to the lower member of the articulator so that the loaded impression tray was guided into a standard position by the upper member (Fig. 1).

The powder of the alginate impression material was weighed on an Electronic Balance. Deionized water from a centralized source was used for mixing the impression

* BDS MSc

† LCGI, PhD

‡ BDS PhD FDS

§ BDS PhD FDS MRD

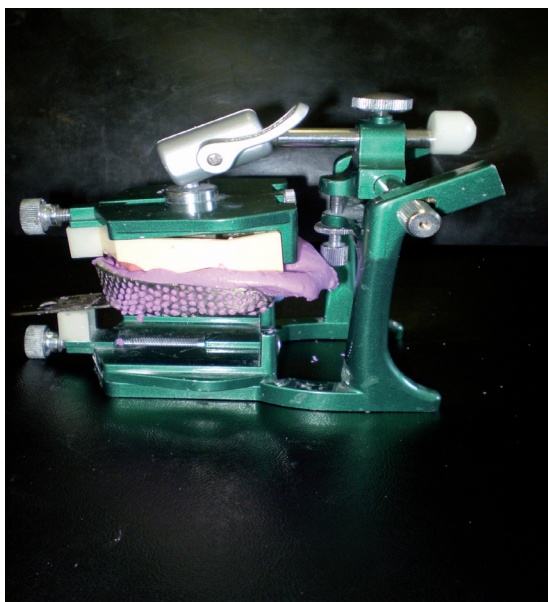


Figure 1. *The standardised impression procedure*

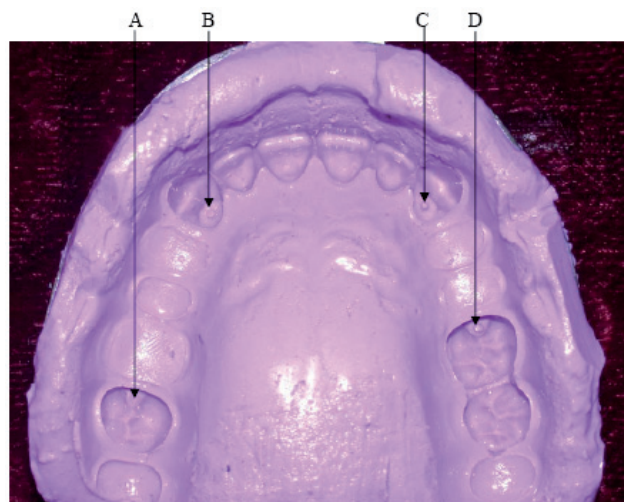


Figure 2. *Labelled reference markers on alginate impression*

materials at room temperature ($21^{\circ}\text{C} \pm 2^{\circ}$). For each impression the required water ratio was measured by means of a syringe to accurately measure the liquid. The alginate impression materials were mixed according to manufacturers recommended instructions using a clean rubber bowl mounted on an electrical alginate mixer and a clean plastic spatula and were timed using an electronic timer.

Metal stock impression trays were loaded with excess material. The reference teeth were filled with impression material prior to seating the impression tray, so as to avoid inclusion of any air voids. The metal tray was carefully positioned on the typodont model. Mechanical interlocking between the alginate and perforated stock metal tray was obtained. The impression was allowed to set and was then removed quickly. Impressions were examined individually for errors with special attention being given to the reproduction of the reference markers. Any impression that clearly showed failure to reproduce the reference points

was discarded and the impression repeated. Impressions were rinsed in running tap water for 10 seconds, excess water was shaken off and the impressions immersed in the disinfection bath.

The Disifin disinfectant was freshly prepared on the day when impressions were recorded, according to the manufacturer's protocol. Three Disifin tablets were dissolved in 1.5 liters of ordinary warm tap water, mixed well and kept in a closed container. Each impression (10 of each alginate) was immersed for 15 minutes. Perform ID (40g) sachet was dissolved in 2 litres of ordinary warm tap water and the impressions were immersed for 10 minutes according to the manufacturers' protocol. All the impressions were rinsed in running water once immersion was complete.

Sixty impressions were recorded, 30 for each alginate of which 10 control impressions were not disinfected, but were rinsed under running tap water and stored under the same conditions as the other impressions. After disinfection the impressions were then immediately transferred to a sealed plastic container, which contained a bowl of water in the centre to achieve 100% relative humidity in the container. The impressions were stored over a period of 5 days and were removed from the container only for the purpose of measurements under a travelling microscope. The plastic containers were left in laboratory conditions thereby trying to reproduce an environment similar to UK laboratories. Initial measurements were made one hour after the impression was made and daily thereafter for 5 days. Recorded measurements were entered into an Excel spreadsheet and all six distances - Distance AB, Distance AC, Distance AD, Distance BD and Distance CD were calculated.

Statistical Analysis

The data was analysed using STATA 10 software. The percentage changes in each of the six dimensions between baseline and 5 days showed Normal distributions and were described using the mean and standard deviation. Two-way analysis of variance was used to compare the percentage change in each dimension between alginates and disinfectants. In addition, the difference in each dimension between baseline and 5 days was assessed using paired t tests for each combination of alginate and disinfectant in order to determine whether any pattern existed. Due to the large number of tests in this latter exercise, a p value less than 0.01 was used to indicate statistical significance.

RESULTS

The mean and standard deviation of dimensional change in the six dimensions between baseline and day 5 for the control, the two alginates and the two disinfectants are contained in Table 1 and are expressed as percentage change in Table 2. None of the dimensional changes were greater than 4% and the majority were less than 1%. Two-way analysis of variance indicated no differences in the change from baseline to day 5 between any of the combinations of alginate and disinfectant. Only two of the changes between baseline and day 5 reached statistical significance at the $p < 0.01$ level.

Table 1. Mean and standard deviation of dimensional change between Day 0 and Day 5.

Alginate	Disinfectant	AB	AC	AD	BC	BD	CD
Hydrogum	Control	0.001 (0.22)	0.02 (0.57)	0.08 (0.33)	0.09 (0.84)	0.09 (0.27)	0.04 (0.84)
Hydrogum	Disifin	0.07 (0.22)	0.06 (0.12)	0.01 (0.12)	0.06 (0.14)	0.03 (0.17)	0.04 (0.09)
Hydrogum	Perform	0.03 (0.09)	-0.18 (0.56)	0.11 (0.12)	0.23 (0.66)	-0.15 (0.14)	0.03 (0.29)
Xanthin	Control	0.08 (0.26)	0.16 (0.22)	-0.1 (0.26)	0.25 (0.27)	0.08 (0.25)	0.001 (0.52)
Xanthin	Disifin	1.24 (0.23)	0.03 (0.19)	-0.03 (0.13)	-0.14 (0.67)	0.008 (0.10)	0.28 (0.71)
Xanthin	Perform	0.1 (0.1)	0.003 (0.47)	-0.06 (0.52)	0.36 (0.47)	0.21 (0.59)	0.76 (1.3)

Table 2. Mean and standard deviation percentage change between baseline and day 5 for the six dimensions

Alginate	Disinfectant	AB	AC	AD	BC	BD	CD
Hydrogum	Control	0.45 (0.82)	0.01 (0.40)	-0.06 (0.28)	-0.53 (2.41)	0.02 (0.25)	1.38 (3.41)
Hydrogum	Disifin	0.38** (0.34)	-0.01 (0.98)	0.23 (0.77)	1.20* (1.57)	0.52 (1.47)	-3.14 (5.30)
Hydrogum	Perform	0.28 (0.91)	0.32 (0.44)	-0.21 (0.54)	0.84* (0.92)	0.19 (0.62)	-0.04 (2.92)
Xanthin	Control	0.25 (0.79)	0.12 (0.24)	0.02 (0.24)	0.21 (0.47)	0.08 (0.43)	-0.13 (0.58)
Xanthin	Disifin	-0.11 (0.32)	-0.38 (1.22)	-0.21* (0.23)	-0.83 (2.39)	-0.31** (0.34)	0.13 (1.51)
Xanthin	Perform	-0.01 (0.81)	-0.16 (0.19)	-0.04 (1.15)	0.30 (2.83)	0.23 (0.69)	0.09 (4.57)

* $p < 0.05$, ** $p < 0.01$ (paired t test: baseline v day 5)

DISCUSSION

Wandreker *et al*⁹ showed that newer alginate impression materials designed to remain dimensionally stable for longer were, as claimed by the manufacturers, dimensionally stable for 5 days when stored in an atmosphere saturated by water vapour. Minor dimensional discrepancies were found, but these were judged not to be clinically significant.

Modern cross infection control protocols require impressions to be disinfected before transmission to the dental laboratory. The requirement to soak the impression in disinfectant solution for 10 or 15 minutes according to the manufacturers' instructions offers a potentially significant challenge to the dimensional stability of the impression.

In the present study two impressions made from two different alginate materials were exposed to two different disinfectant solutions and dimensional stability was measured over a 5-day period. Dimensional change expressed as a percentage in Table 1 allows comparison of the six different measurements made for each combination of alginate and disinfectant. Paired t-tests indicated only two statistically significant changes in dimension: measurement AB

for Hydrogum when disinfected in Disifin and dimension BD for Xanthin when disinfected in Disifin.

The dimensional differences (Table 1) are all relatively small. When compared with the dimensional inaccuracies that may be a feature even of cast cobalt chromium frameworks whose fit is acceptable clinically^{10,11}, they may be considered to be unimportant. The fact that the dimensional changes are a mixture of slight expansions and contractions suggest both imbibition and syneresis are progressing at the same time and although the materials were stable over a five-day period, storage conditions are clearly important. In this study storage was in laboratory conditions, but in practice conditions, if for example an impression was to be sent by post to a distant technical laboratory then care would need to be taken that the impression was kept in an atmosphere of saturated water vapour. For this reason, although the materials may be stable for five days, in practice it may be better to pour the casts at the first convenient opportunity.

CONCLUSIONS

Within the limitations of this study, newer 5 day stable alginate impression materials can be considered to be dimensionally stable over a five-day period following immersion in disinfectant according to the manufacturers' instructions.

MANUFACTURER'S DETAILS

- Zhermack, Rovigo, Italy
- Heraeus Kulzer, Germany
- Hagenring, Ammerbuch, Altingen, Germany
- Schülke & Mayr UK Ltd, Meadowhall, Sheffield
- Frasaco, Tettang, Germany
- Galloni, Milan, Italy
- Yamaura, Tokyo, Japan
- OertlingTP30, Orpington, UK
- Quadra-Chek 300, Metronics Inc Ltd, Bedford, UK
- StataCorp., TX USA

ACKNOWLEDGEMENT

The authors would like to thank Dr Ron Wilson for his advice with the statistics.

ADDRESS FOR CORRESPONDENCE

Professor Robert Clark, Department of Prosthodontics, Floor 25, Guys Tower, Guys Hospital. London SE1 9RT, United Kingdom. E-Mail: rkfc@talk21.com

REFERENCES

1. O'Brien W.J. Dental materials and their selection, 3rd edition. Chicago; London: Quintessence, 2002;90-112.
2. McCabe, J.F., Walls, A. Applied Dental Materials London, Blackwell. 2008.
3. Dahl, B.L., Dymbe, B., Valderhaug, Bonding properties and dimensional stability of hydrocolloid impression systems in fixed prosthodontics. *J.Prosthet.Dent.*, 1985;**53**:796-800.
4. Eriksson, A., Ockert-Eriksson, G., Lockowandt, P. Accuracy of irreversible hydrocolloids (alginates) for fixed prosthodontics. A comparison between irreversible hydrocolloid, reversible hydrocolloid, and addition silicone for use in the syringe-tray technique. *Eur. J. Oral Sci.*, 1998;**106**:651-660.
5. Sedda, M., Casarotto, A., Raustia, A. and Borracchini, A. Effect of storage time on the accuracy of casts made from different irreversible hydrocolloids. *J. Contemp. Dent. Pract.*, 2008; **9**:59-66.
6. Sevedge, S.R., Gunderson, R.B. and Singer, M.T. Linear distortion and compatibility of an antimicrobial irreversible hydrocolloid impression material and improved dental stones. *J. Prosthet. Dent.*, 1989; **62**:612-615.
7. Martin, N., Martin, M.V. and Jedynakiewicz, N.M. The dimensional stability of dental impression materials following immersion in disinfecting solutions. *Dent. Mater.*, 2007; **23**:760-768.
8. Kotsiomiti, E., Tziaila, A. and Hatjivasiliou, K. Accuracy and stability of impression materials subjected to chemical disinfection- a literature review. *J. Oral Rehabil.*, 2008; **35**:291-299.
9. Wandreker, S., Juszczuk, A.S., Clark, R. K.F., Radford, D.R. Dimensional stability of newer alginate impression materials over seven days. *Europ.J.Prosthdont.Rest.Dent.* .2010;**18**: 163-170.
10. Juszczuk, A.S, Likeman, P.R. A laboratory study of the fit of cast cingulum rests. *Quintessence Dental Technology*, 1995;**18**:133-141.
11. Murray, M.D., Dyson, J.E. A study of the clinical fit of cast cobalt chromium clasps. *J.Dent.*, 1988;**16**:135-9.