The dimensional stability of self-disinfecting alginate impressions compared to various immersion regimes

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In 1988, a survey of United Kingdom dental schools[1] was performed to investigate the procedures being followed for the disinfection of impressions. Considerable variation was found between schools, particularly with regard to the management of routine patients. This wide variation in procedures was undoubtedly due to the existence of a number of published guidelines which substantially agree on the management of high risk patients, but often differ on the routine disinfecting regime which should be followed for impressions leaving the clinic.

The 1987 British Dental Association guidelines[2] suggest that the only safe approach to routine treatment is to assume that every patient may be a carrier of an infective virus. The 1988 guidelines suggest that rinsing impressions thoroughly under running water before sending them to the lab is sufficient, but also recommend that laboratory technicians who handle impressions wear gloves. Guidelines issued by the International Dental Federation[4] suggest that all material be cleaned and disinfected before being sent to the laboratory. The American Dental Association[5,6] advises that impressions, bite registrations and appliances all be routinely rinsed and disinfected.

Today, there is common agreement that every patient should be treated as though he or she *could* transmit an infectious disease; it is sensible, therefore, to attempt routine disinfection of all impressions before they leave the clinic.

A number of studies have investigated the efficacy of disinfecting solutions against Hepatitis B and the AIDS virus.[7-9] Although these studies should not be seen as conclusive, they have suggested that glutaraldehyde, appropriately buffered, is very effective against such viruses at various concentrations and soaking times. A generally accepted appropriate time to render the surface of a material virus free would appear to be a 10-minute immersion[7] although for the disinfection of 'Hepatitis B contaminated'

Abstract

Alginate impressions of a master acrylic study model pair were made in order to assess the effect of various disinfection techniques on dimensional stability. Impressions were made using self-disinfecting alginate, traditional alginate which had been dipped or soaked in a disinfecting solution, and included was a control group which was not disinfected. Inter- and intra-arch linear measurements of the resultant study casts were made using a Reflex Metrograph. The small differences found for the variables measured were not statistically significant.

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Key Words

Alginate • Disinfection • Dimensional stability • Study casts • Reflex Metrograph

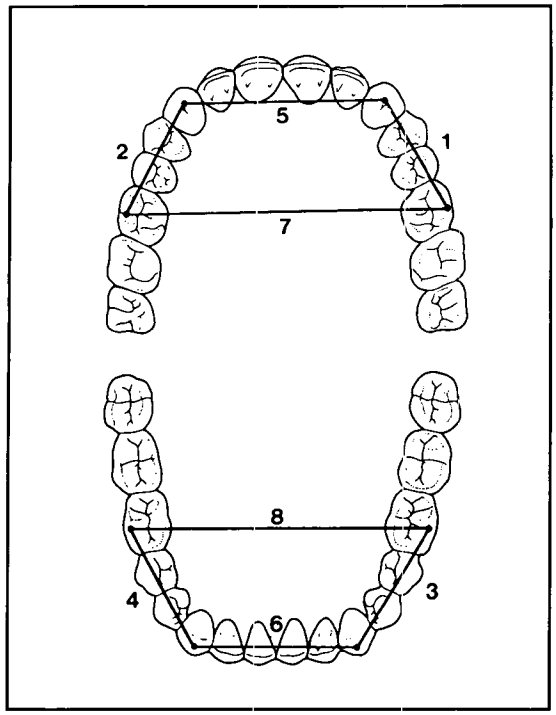


Figure 1
Illustrating the intra-arch measurements 1-8 used in the study. Right and left overjet and overbite inter-arch measurements 9-12 used defined mesio-incisal points on the centrals with the functional occlusal plane as reference.

Table 1
The planned protocol for the study.

Table 1

Master Model Pair	Control standard alginate*2 (No disinfection) Rinsed in H_2O and cast	— 8 copies
	Self-disinfecting alginate*1 Rinsed in H_2O and cast	— 8 copies
	Standard alginate*2 Impression dipped in 2.2% Glutaraldehyde*5 and stood 10 minutes Rinsed in H_2O and cast	— 8 copies
	Standard alginate Impression soaked in 2.2% Glutaraldehyde*5 for 30 minutes Rinsed in H_2O and cast	— 8 copies
	Standard alginate Impression dipped in 2% Virkon*3 solution and stood for 10 minutes Rinsed in H_2O and cast	— 8 copies
	Standard alginate Impression soaked in 2% Virkon*3 solution for 30 minutes Rinsed in H_2O and cast	— 8 copies

rubber and plastic objects, a 30-minute immersion has been recommended in the past by the Center for Disease Control.[10]

In order to routinely disinfect alginate impressions, two main questions must be considered:

1. Is the disinfecting regime effective — not just at the surface but within the alginate impression?
2. Does the disinfection regime affect the dimensional accuracy of the resultant study cast?

This paper is concerned with the latter question.

In the routine disinfection of impressions many clinics employ either a 'dip' (and 10-minute stand under damp gauze) or a more prolonged soak in disinfectant. Other clinics use the more recently available self-disinfecting alginate.* This study compares these different procedures.

Previously, the authors[11] reviewed the topic and applied a three-dimensional measurement technique to investigate the effect on set alginate impressions of increasing the time of glutaraldehyde disinfecting soak regimes. The dimensional differences found between different regimes, although clinically small, could be significant in the context of a serial study where accurate and precise measurements were being recorded. Since the previous study was undertaken, new self-disinfecting alginates* and a virucidal odor-free disinfecting solution*** have become available. This study has been undertaken to investigate whether self-disinfecting alginate maintains greater dimensional accuracy than conventional alginate** subsequently subjected to various immersion disinfecting regimes.

Materials and methods

Using a method similar to that in a previously reported study,[11] alginate impressions were taken of a master acrylic model of a Class II division 1 type malocclusion; once fully set, the impressions (where appropriate) were exposed to a disinfection regime. The alginate impression was then rinsed in running water, shaken clear of loose water and immediately poured in plaster.**** In this copying process all impressions and study casts were made according to a standardized format in line with the recommendations of the manufacturer. In each instance, the temperature of the water was kept consistently at 20 degrees centigrade.

Blueprint Asept Regular (Dentsply Ltd., Weybridge, England)

**New Kromopan (Wright Dental Group Ltd., Dundee, Scotland)*

***Virkon (Antec International Ltd., Sudbury, England)*

****Crystacal R (South Western Plasters, Devizes, England)*

The disinfection regimes compared are shown in Table 1, which also outlines the plan of the study. To investigate the relative dimensional differences (if any) between the resultant study casts, 12 linear measurements were made on each pair of study casts, as shown in Figure 1. Eight of the measurements were intra-arch and four inter-arch: detailed definitions of the points used have been described previously.[11-13] The measurements were made using a Reflex Metrograph linked to a Series 35 Hewlett Packard computer; this system has been used within the department for a number of years and found to be both an accurate and precise method for the three-dimensional measurement of study casts.[14-17] The accuracy and reproducibility of both the software and hardware used in the present study, have previously been tested exhaustively by Jones and Richmond.[12-17] All measurements were made by one experienced and calibrated observer on a blind basis a minimum of one week after the casts had been poured (the disinfection regime that had been employed in any cast pair was unknown to the observer). To reduce systematic error no points were premarked on any study casts.

In all, 48 pairs of study casts were prepared (eight copies for each disinfection regime), from impressions taken in the self-disinfecting alginate,* the control alginate ** (not disinfected), alginate dipped in disinfectant (and allowed to stand under damp gauze for 10 minutes), and alginate soaked in disinfectant for 30 minutes. In the latter regimes, two disinfectants were used: a 2.2 percent glutaraldehyde***** and a two percent Virkon.*** Comparisons of mean measurements between different methods were performed by one-way analysis of variance. The degree of heterogenicity of variation between the six disinfection regimes was examined using the Bartlett test.[18]

Results

Figures 2-7 illustrate, in the form of means, the effect of each alginate treatment on the 12 variables measured on the resultant study casts. Included with each mean value is the 95 percent confidence interval to permit visual appraisal of the difference in mean values between regimes, relative to that expected because of variation among the eight copies. In measurements nine and 10 the single low outlier values related to a confirmed isolated recording error, were set to the next lowest value before statistical analysis was performed.

*****Asep Extra-Life (Galen Ltd., N. Ireland)*

Table 2

		Bartlett Value	Significance p
Intra-arch Measurements	1	4.81	n.s.
	2	10.75	n.s.
	3	4.65	n.s.
	4	13.35	*
	5	8.45	n.s.
	6	1.60	n.s.
	7	5.80	n.s.
	8	3.72	n.s.
Inter-arch Measurements	9	6.12	n.s.
	10	4.57	n.s.
	11	6.30	n.s.
	12	7.94	n.s.

Table 2
Summary of significance tests performed for each variable measured on differing disinfection regimes (*p<0.05).

In Figures 2-7:

Blueprint = the self-disinfecting alginate
Kromopan = the control alginate (no treatment)
Kromopan Asep/Dip = glutaraldehyde 'dip' only of impression
Asep/Soak = 30 minute impression soak in glutaraldehyde
Virkon/Dip = Virkon 'dip' only of impression
Virkon/Soak = 30 minute soak of impression in Virkon

As may be seen from Figures 2-5 the differences between the mean values for the intra-arch measurements made on the casts were found to be quite small regardless of the disinfection regime applied to the previous alginate impression; the differences were larger for the inter-arch measurement. Statistically significant differences in location were obtained for one of the twelve measurements, number 5 (UICD, Figure 4).

For the intra-arch measurements (1-8) the standard deviation was found to range from 0.07 to 0.33 millimeters which would appropriately be summarized by an overall pooled value of 0.18 millimeters. For the inter-arch measurements (9-12) standard deviation ranged from 0.30 to 0.99 millimeters summarized by a pooled value of 0.47 millimeters. These values give an overall impression of the total amount of variation found for the variables measured.

The results of the Bartlett test comparing variability between the six regimes are shown in Table 2: only the fourth measurement showed

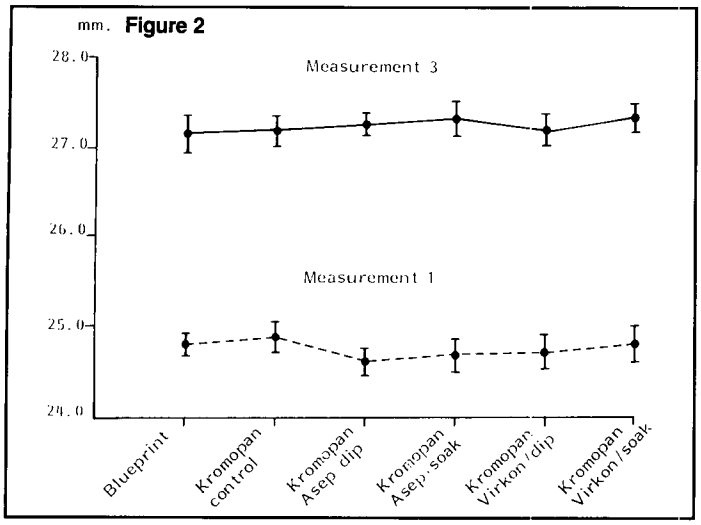


Figure 2

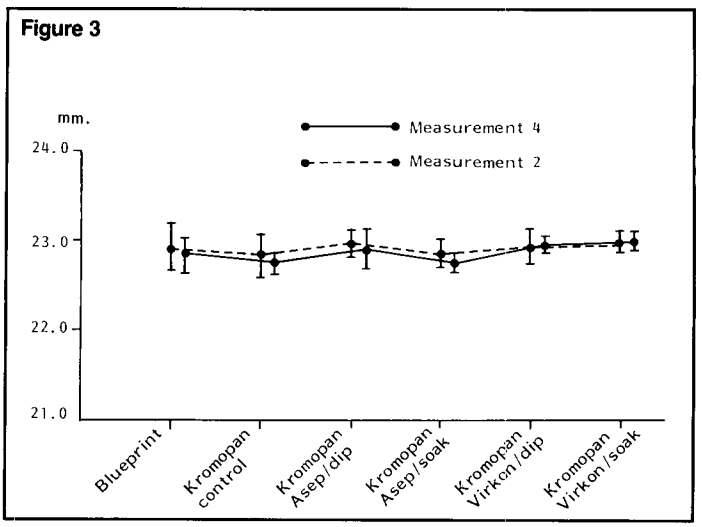


Figure 3

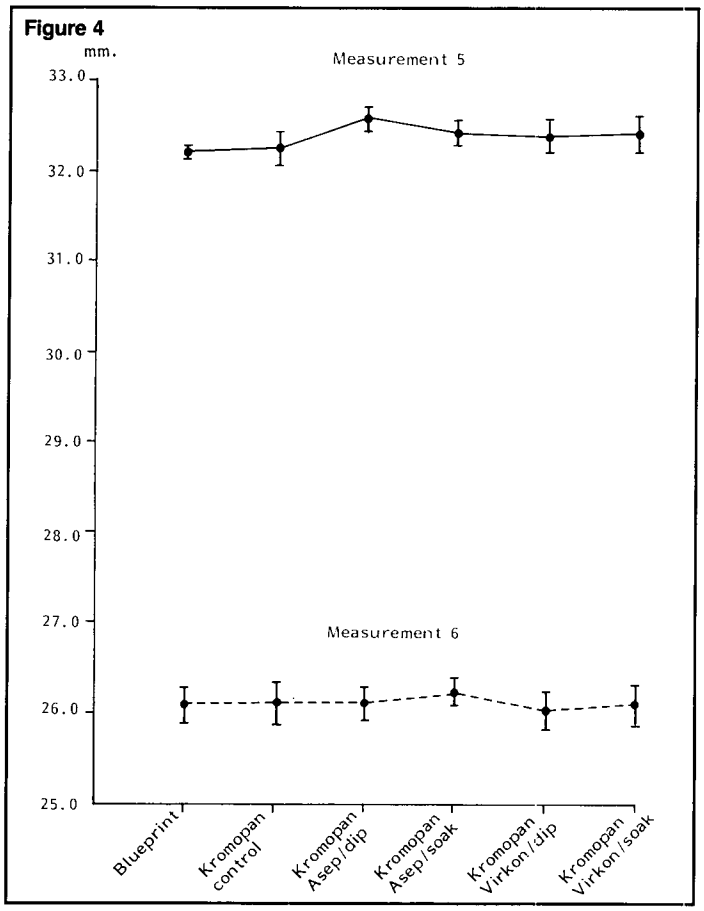


Figure 4

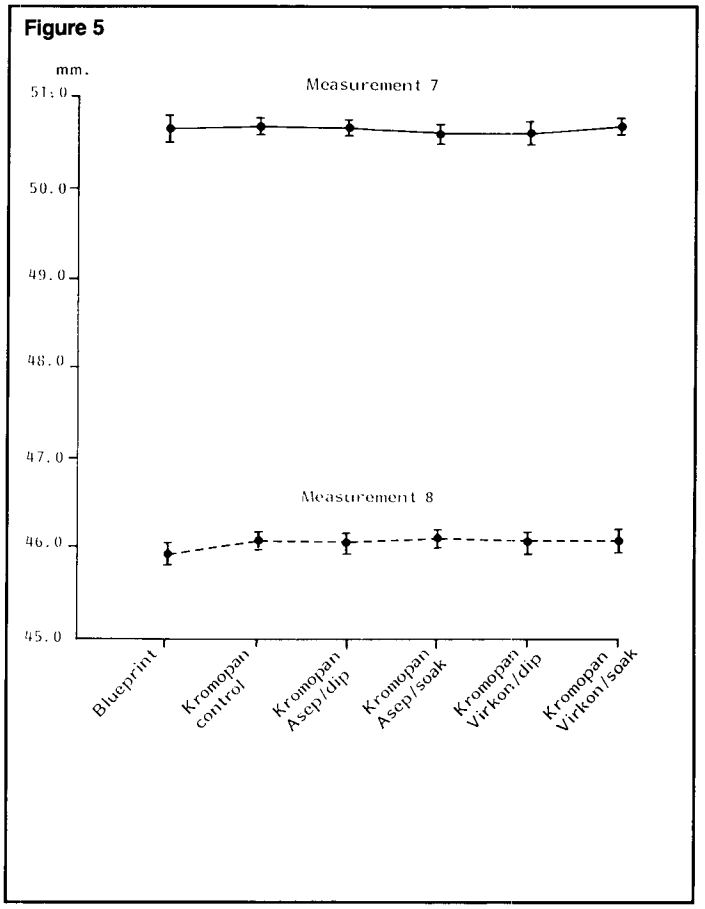


Figure 5

Figure 2
Left arch length measurements.

Figure 3
Right arch length measurements.

Figure 4
Inter-canine arch width measurements.

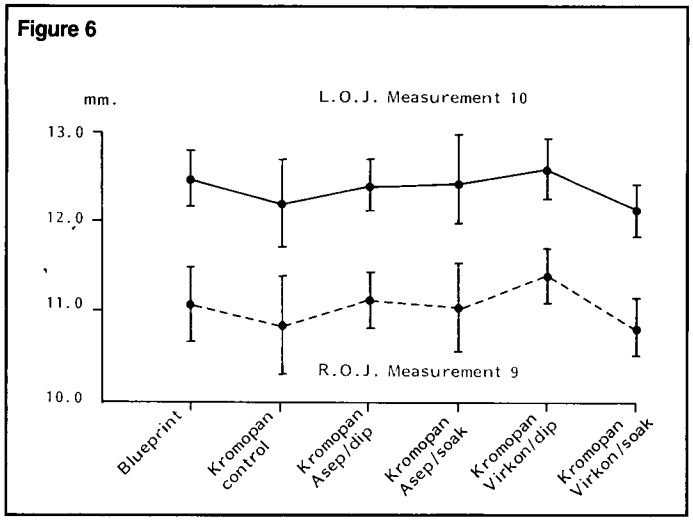
Figure 5
Inter-molar arch width measurements.

a value of statistical significance (at the five percent level). This might occur by chance variation alone and would not necessarily indicate any tendency to greater variation on some treatments than others.

Discussion

In a previous study by the authors,[11] set alginate impressions were soaked for different lengths of time in glutaraldehyde; small differences in measurements were detected between the differing disinfection regimes, some of which were of statistical significance.

In the present study, small dimensional differences again were found but only one measurement showed a statistical significance at the five percent level (and this could have been expected to have occurred by chance alone). The range of variation of the intra-arch measurements was really very small showing a pooled value for the standard deviation of 0.18 millimeters. Of course, this variation would include not



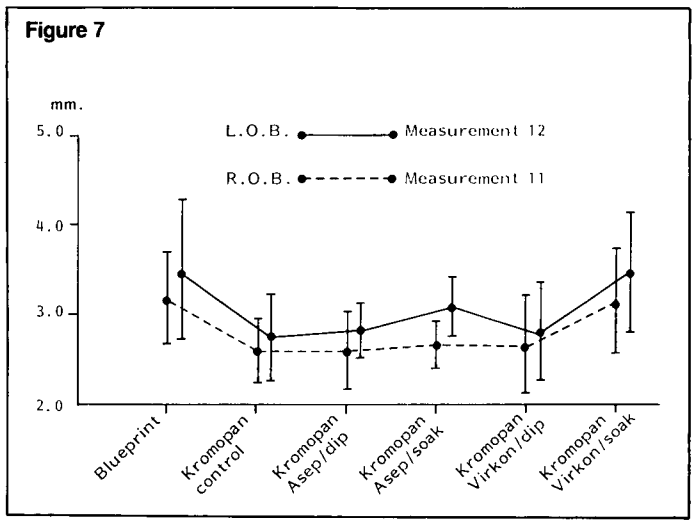


Figure 6
Overjet measurements.

Figure 7
Overbite measurements.

only the differing disinfection regimes employed but also the error of the method and the measurement process. The inter-arch measurement, although again showing no statistically significant difference between the disinfection regimes, did show a larger variation for the dimensional measurements being employed; this was almost certainly related to small errors in relating maxillary and mandibular study casts in the laboratory process.

The results from the present study broadly agree with previous work[11,19,20] showing that a transient 'dip' in disinfectant (and stand under a damp cloth), and a 30-minute immersion in disinfectant, have only a minimal effect on the dimensional accuracy of the resultant study casts. If, however, alginate impressions are soaked for longer than 30 minutes, effects may be more dramatic. Bergman and his co-workers[21] found a one-hour immersion in disinfectant solution produced unacceptable dimensional changes.

In the present study the two disinfectant solutions employed showed no clinically significant dimensional differences in the resultant casts. However, even some weeks after the study, those casts from alginate impressions soaked in 2.2 percent glutaraldehyde had a characteristic odor and color, which were not apparent where 'Virkon' had been used.

'Blueprint,' an alginate material promoted as self-disinfecting and virucidal, showed no clear advantage in regards to dimensional accuracy over a 'dip' or 'soak' of conventional alginate in disinfectant; however, it did save clinical time and does, theoretically, avoid the need for a further disinfecting process. Blueprint showed no significant differences in the dimensions measured from the control (Kromopan), but again, none of the immersion disinfectant regimes showed any conclusive differences.

The Reflex Metrograph and other three-dimensional measurement instruments derived from it are being used increasingly in orthodontic research. For many of the angular measurements derived from such instruments, the error tolerance is low. Increasingly, clinics are applying various disinfection methods to alginate impressions before allowing them to leave the clinic. From the results of this study it would appear there are few dimensional changes of any significance to be found between a control alginate, a self-disinfecting alginate (Blueprint) and a normal alginate exposed to various disinfecting regimes, up to a 30-minute soak. Clinically significant differences that might affect either the subsequent fit of an appliance or clinical measurement with a ruler were not found. However, where more precise measurement is required, as might occur in a serial research project, it would be prudent to ensure that the study casts involved have been poured from alginate impressions treated to a consistent disinfecting regime.

Conclusions

1. No evidence was found in this study of clinically significant dimensional differences between the various impression disinfecting regimes tested.
2. No significant differences were found between the control alginate, self-disinfecting alginate and immersion disinfected alginate impressions.
3. Soaking alginate impressions longer than 30 minutes in disinfectant may well have a more significant dimensional effect.
4. If study casts are likely to be used in subsequent serial studies, particularly where sophisticated three dimensional measuring instruments are to be used, implementing a consistent disinfecting policy for impressions would be sensible.

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