Dimensional changes of alginate impression by using perforated and non-perforated ring trays

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ABSTRACT

Dimensional changes are a common occurrence in impressions, either during or after impression taking. It produces a difference in the dimensions of the object and the model, which leads to the restoration being ill fitted. Several causal factors have been proposed such as friction between the impression material and the teeth, the bulk of the impression material, the type of impression materials used, the impression technique, the pouring time and many others. The exact causal factor is still unknown and the dimensional change mechanism is still poorly understood. The objective of this research was to investigate the role of the perforation on the ring trays in producing dimensional changes in the impression by using perforated and non-perforated ring trays. Alginate impressions were made on the frustum of cone metal master die with a 7.08 mm base diameter, 7.03 mm top diameter and 9.23 mm height using perforated and non-perforated ring trays with 9.40 mm in diameter and 14.17 mm in height. The dimensional change was determined by comparing the dimension of the dental stone die and its metal master die. The results showed that the percentage of dimensional changes that occured by using perforated ring tray were (+) 0.56±0.40 on the top area, (-) 3.54±2.92 on base area and (+) 1.54±0.83 in height, respectively. As compared to using non-perforated ring trays, the percentage of dimensional changes that occured were (-) 0.49±0.49 on top area, (-) 8.76±3.95 on base area and (+) 1.19±0.71 in height, respectively. There was a significant difference in the direction of the dimensional changes on both the top areas, but not on the base areas and height.

Key words: Impression, dimensional change, perforated and non-perforated ring tray.

INTRODUCTION

Dimensional changes usually occur in impressions either during impression taking or after. It produces a difference in the dimensions between the poured model and the object, which results in an unfit restoration.[1-3]

There are several factors that cause dimensional changes to occur such as the type of impression materials used, friction between the impression material to the teeth, proportion of the filler, bulk of impression material or the size of trays, type of impression trays, time of impression removal, the manner of impression removal, the die systems, time of pouring or different storage time, effects of chemical antiseptic and disinfection methods.[4-16] During impression taking, the dimensional changes that occur from the impression material used is due to the type, bulk, properties of impression materials, and the time of impression removal.[4,5,7-11]

Phillips[1] stated that certain stresses are

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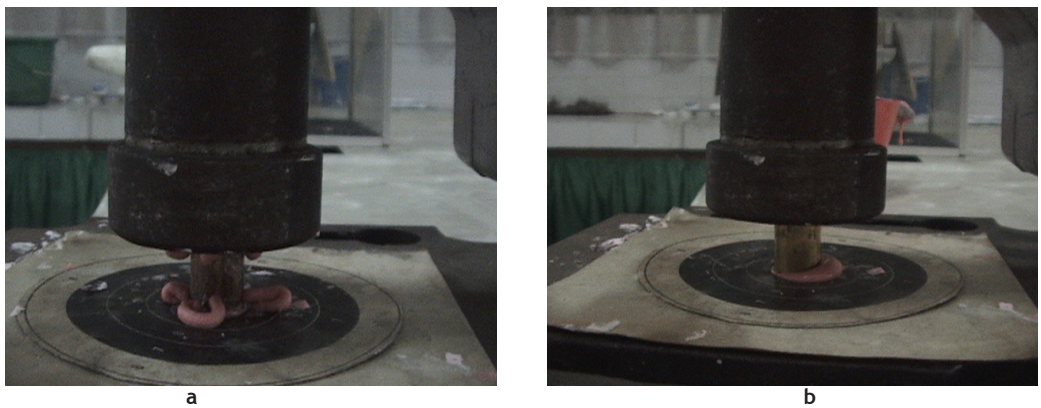
always introduced during gelation. Masri et al.[17] obtained that all impression materials used produce some pressure during impression taking.

The objectives of this research is to describe the property of the impression material during impression taking by using perforated and non-perforated trays and to discuss the role of the perforations on the wall of the ring tray in releasing stresses or pressure within the impression material that causes dimensional changes.

METHODS AND MATERIALS

The Aroma Fine DF III normal set lot no. 0610111 alginate was used as the impression material and the Moldano, Heraeus, type 3 dental stone lot No. 1100-770 was used in producing the dental stone die. A metal master cast with a cone shaped frustum measuring 7.08 mm at the base diameter, 7.03 mm at the top diameter and 9.23 mm in height was used as the object of impression. Metal rings measuring 9.40 mm in diameter and 14.17 mm in height were used as the impression trays. One of the trays had eight 1 mm diameter holes on the interior wall, 1.7 mm from the margin of ring. The other ring trays had no such holes.

The alginate was mixed with a powder to water ratio of 3.2:6 and the dough was then poured into the ring till it was sufficiently extended. The impression was made by inserting the metal master die into the alginate dough till the base of master die contacted the edge of ring. Once the impression was harden, it was detached from the master die and the dental stone die was made soon after. Measurements of the base diameter, top diameter and height of the metal master die and dental stone die were taken using a Digimatic caliper (Mitutoyo, Japan).



a b

Figure 1. The direction of flow of the impression material during impression taking: (a) By using perforated ring tray; (b) By using non-perforated ring tray.

Table 1. The measurement of the top diameter of the stone dies using perforated ring tray.

Stone Die No.	Master die (mm)	Stone die (mm)	ΔL (mm)	ΔL (%)	x (%)	SD
	7.03					
I		7.01	(-)0.02	(-)0.28	(+)0.56	0.40
II		7.02	(-)0.01	(-)0.14		
III		7.02	(-)0.01	(-)0.14		
IV		7.07	(+)0.04	(+)0.56		
V		7.05	(+)0.02	(+)0.28		
VI		7.08	(+)0.05	(+)0.71		
VII		7.04	(+)0.01	(+)0.14		
VIII		7.09	(+)0.06	(+)0.85		
IX		7.03	(+)0.00	(+)0.00		
X		7.04	(+)0.01	(+)0.14		

Note: (-) reduction in size, (+) elongation in size

Table 2. The measurement of the base diameter of the stone dies using perforated ring tray.

Stone die No.	Master die (mm)	Stone die (mm)	ΔL (mm)	ΔL (%)	x (%)	SD
	7.08					
I		7.08	0.00	(-)0.00	(-)3.54	2.92
II		7.08	0.00	(-)0.00		
III		7.10	(+)0.02	(+)0.28		
IV		6.90	(-)0.18	(-)2.54		
V		6.97	(-)0.11	(-)1.15		
VI		6.97	(-)0.11	(-)1.15		
VII		7.04	(-)0.04	(-)0.56		
VIII		7.01	(-)0.07	(-)0.99		
IX		7.03	(-)0.05	(-)0.71		
X		7.04	(-)0.04	(-)0.56		

Table 3. The measurement of the height of the stone dies using perforated ring tray.

Stone die No.	Master die (mm)	Stone die (mm)	ΔL (mm)	ΔL (%)	x (%)	SD
	9.23					
I		9.37	(+)0.14	(+)1.52	(+)1.54	0.83
II		9.36	(+)0.13	(+)1.40		
III		9.38	(+)0.15	(+)1.63		
IV		9.46	(+)0.23	(+)2.49		
V		9.45	(+)0.22	(+)2.38		
VI		9.43	(+)0.20	(+)2.17		
VII		9.45	(+)0.22	(+)2.38		
VIII		9.28	(+)0.05	(+)0.54		
IX		9.28	(+)0.05	(+)0.54		
X		9.26	(+)0.03	(+)0.33		

RESULTS

During the impression taking procedure, the alginate was pushed out through the holes of the ring as shown in Figure 1. Using the non-perforated ring as the impression tray, the impression material was pushed out through the holes at base and top areas only, but by using the perforated ring tray, the impression material was released through the additional holes on the interior wall of the ring tray as shown in Figure 1.

The measurements of the top diameter, base diameter and height of the metal master and dental stone die are as follows: The measurement of the top diameter of the stone dies using perforated ring tray showed an elongation in size as much as 0.56%±0.40. The measurement of the base diameter of the stone dies using the perforated ring tray showed a reduction in size as much as (-) 3.54%±2.92. The measurement of the height of the stones dies using the perforated ring tray showed an elongation in height as much as (+) 1.54%±0.83. The measurement of the top diameter of the stone dies using non-perforated tray showed a reduction in size as much as (-) 0.49%±0.49. The measurement of the base diameter using non-perforated ring tray showed a reduction in size of as much as (-) 8.76%±3.95. The measurement of the height of the stone dies using non-perforated ring tray showed an elongation in size of as much as (+) 1.19%±0.71.

Table 4. The measurement of the top diameter of the stone dies using non-perforated tray.

Stone die no.	Master die (mm)	Stone die (mm)	ΔL (mm)	ΔL (%)	x (%)	SD
	7.03					
I		7.03	(+)0.00	(+)0.00	(-)0.49	0.49
II		7.01	(-)0.02	(-)0.28		
III		7.02	(-)0.01	(-)0.14		
IV		7.01	(-)0.02	(-)0.28		
V		6.99	(-)0.04	(-)0.57		
VI		7.00	(-)0.03	(-)0.43		
VII		7.05	(+)0.02	(+)0.28		
VIII		6.98	(-)0.05	(-)0.71		
IX		7.03	(+)0.00	(+)0.00		
X		7.00	(-)0.03	(-)0.43		

Table 5. The measurement of the base diameter using non-perforated ring tray

Stone die no.	Master die (mm)	Stone die (mm)	ΔL (mm)	ΔL (%)	x (%)	SD
	7.18					
I		7.04	(-)0.14	(-)1.94	(-)8.76	3.95
II		7.05	(-)0.13	(-)1.81		
III		7.07	(-)0.11	(-)1.53		
IV		7.08	(-)0.10	(-)1.39		
V		7.09	(-)0.09	(-)1.25		
VI		7.10	(-)0.08	(-)1.11		
VII		7.15	(-)0.03	(-)0.42		
VIII		7.02	(-)0.16	(-)2.22		
IX		7.09	(-)0.09	(-)1.25		
X		7.10	(-)0.08	(-)1.11		

DISCUSSION

The results observed from the study above showed that dimensional changes occurred at all of the measured areas. The direction of the dimensional changes was antagonistic at the top area, where there was an elongation in size when using perforated tray, but reduction in size when using the non-perforated tray.

Phillips[1] stated that dimensional changes may occur during the gelation process, where certain stresses arose in hydrocolloids impression material during impression taking. Coincidentally, Masri et al.[17] obtained that all impression materials produce pressure during impression taking. They utilized three transducers that were imbedded in the oral analog, one at the mid palate area and the others at the right and left ridge maxillary first premolar areas.

This investigation showed a contradiction in the direction of dimensional change at the top area. There was an elongation in size in the direction of dimensional change when using the perforated tray. It seems that the stresses that occur within the impression material were released partly by loosening and the flow of the impression material through the holes in the wall of ring tray. On the other hand, by using non-perforated tray the direction of dimensional change showed a reduction in size. This is probably due to the stresses that occur within impression material that work to expand the impression material after impression taking. All of the measurements suggest the possibility that pressure or stress within the impression material may be one of the several factors that produce dimensional change.

Table 6. The measurement of the height of the stone dies using non-perforated ring tray.

Stone die No.	Master die (mm)	Stone die (mm)	ΔL (mm)	ΔL (%)	x (%)	SD
	9.23					
I		9.41	(+)0.18	(+)1.95	(+)1.19	0.71
II		9.31	(+)0.08	(+)0.87		
III		9.38	(+)0.15	(+)1.63		
IV		9.45	(+)0.22	(+)2.38		
V		9.34	(+)0.11	(+)1.19		
VI		9.25	(+)0.02	(+)0.22		
VII		9.39	(+)0.16	(+)1.73		
VIII		9.26	(+)0.03	(+)0.33		
IX		9.30	(+)0.07	(+)0.76		
X		9.31	(+)0.08	(+)0.87		

The base area also showed some quantity with a similar direction in the dimensional change. Similar dimensional changes have been observed for the height measurements as well.

CONCLUSIONS

This study indicates that the holes on the wall of ring trays facilitate the impression material to flow in variable directions during impression taking. The flow of the impression material facilitate the possibility of stress or pressure to be released within the impression material in causing changes in the impression dimensions.

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