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Study Evaluating the Effect of Tray Type on the Cast Accuracy an Invitro Study

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ABSTRACT: The tray supports the initially fluid impression material in mouth which sets by physical or chemical change. After setting, the tray containing impression material removed from the mouth is poured with dental stone to form the stone casts.
Purpose:This study was conducted to determine the effect of tray type and size on the cast accuracy.
Materials and methods: twenty casts were made from perforated and rimlock trays. Digital Vernier caliper was used to measure the marks on stone casts and compared with the master cast. The data collected was analysed statistically and subjected to paired students t test ($\alpha<0.05$).
Results: tight fitting perforated trays produced more accurate casts than loose fitting perforated and loose and tight fitting rim lock trays.
Conclusion: the size and type of tray affect the cast accuracy significantly.
Key words: impression, dimple, tray

I. INTRODUCTION:

Many dental appliances are constructed outside the patient's mouth on models of the hard and/or soft tissues. The accuracy of 'fit' and the functional efficiency of the appliance depends upon how well the model replicates the natural oral tissues. The accuracy of the model depends on the accuracy of the impression in which it was cast.
The impression stage is the preliminary of the several stages involved in the fabrication of dentures, crowns, bridges, orthodontic appliances etc. It is of great importance, therefore, that inaccuracies are minimized at this stage; otherwise they will be carried through and possibly compounded later on.
Tray is the mechanical device used to carry, control and confine the impression material in the mouth. The tray is needed as initially fluid impression materials require the support. After placing in the patient's mouth, the materials undergo 'setting' by either a chemical or physical process. After 'setting', the impression is removed from the patient's mouth and the cast is replicated in dental stone.
Aims and objectives: This study was conducted to determine the effect of tray type and size on the cast accuracy.

II. MATERIALS AND METHODS:

The master cast preparation:

An Ivorine maxillary dentulous model (Columbia Dentoform Corp., New York, N.Y.) was chosen as the standard. The reversible hydrocolloid was used to duplicate the model in low fusing alloy (Melotte's metal). A twist drill was used to ditch the dimples in the master cast to provide reproducible reference marks. The dimples were located in the

1. Distobuccal cusp right maxillary first molar (A),
2. The buccal cusp of right maxillary first premolar (B),
3. Supracingular area of left maxillary central incisor (C),
4. Buccal pit of left maxillary second molar (D),
5. The mucobuccal fold at the depth the left maxillary second molar (D'),
6. The midbuccal surface of left maxillary first premolar (E)
7. The mucobuccal fold at the depth of left maxillary first premolar (E'),
8. The axioincisal line angle of right lateral maxillary incisor (F)
9. The mucobuccal fold at the depth of right lateral maxillary incisor (F')

Selection of trays

Two Rim-Lock trays and two perforated trays were selected to make the impressions for this study. The trays that fit the master cast so that there was 2-4 mm thickness of impression material in the critical areas of measurement were grouped as tight

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fitting. The trays classified as "lose fitting." fit the master cast to allow 5 to 8 mm thickness of impression material in the area of measurement.
Impression material: The irreversible hydrocolloid was used to make the impressions Jeltrate (L. D. Caulk Co.).

Impression making:

Twenty impressions were made with each tray on the metal master cast. The manufacturer's instructions were followed to mix the required amount of water at room temperature with prepackaged alginate. The trays were loaded, seated on the master cast, and allowed to set for 8 minutes to compensate for the difference between mouth temperature and room temperature. The impressions were removed from the master casts by releasing the seal with a blast of air in the palatal region and then a snap removal in the direction most parallel to the long axis of the teeth.

Pour the casts:

Vacuum mixed dental stone was vibrated into the impression immediately after it was removed from the master cast. The water/powder ratio recommended by the manufacturer was followed and room temperature water was used. The impression with the stone was placed in a humidor and allowed to set for a period of 45 minutes before separation.

Measuring the casts:

The digital Vernier caliper was used to measure the replicated dimples on the reproduced stone casts. All the measurements made on the stone casts were compared with the master cast measurements. The measurements made and compared on the stone cast and master cast are divided into two groups

Group I: the horizontal measurements

i. A-B
ii. A-C and
iii. B-C

Group II: the vertical measurements

i. D-D'
ii. E-E' and
iii. F-F'

The data collected was analysed statistically and subjected to paired students t test ($\alpha<0.05$).

III. RESULTS:

The casts produced with tight fitting perforated were more accurate than those produced with tight fitting rim lock as shown in table no. 1. There is statistically significant difference between the horizontal and vertical deviations of stone cast made by tight fitting perforated and tight fitting rim lock trays from master cast except in B-C deviations.

The casts produced with loose fitting perforated were more accurate than those produced with loose fitting rim lock as shown in table no. 2. There is statistically significant difference between the horizontal and vertical deviations of stone cast made by loose fitting perforated and loose fitting rim lock trays from master cast.

The casts produced with tight fitting perforated were more accurate than those produced with tight fitting perforated as shown in table no. 3. The means of the deviations of stone casts made from tight fitting perforated trays are less than those made from loose fitting perforated trays in vertical and horizontal dimensions. There is statistically significant difference between the horizontal and vertical deviations of stone cast made by tight fitting perforated and loose fitting perforated trays from master cast.

The casts produced with tight fitting rim lock were more accurate than those produced with loose fitting rim lock as shown in table no. 4. The means of the deviations of stone casts made from tight fitting rim lock trays are less than those made from loose fitting rim lock trays in vertical and horizontal dimensions. There is statistically significant difference between the horizontal and vertical deviations of stone cast made by tight fitting rim lock and loose fitting rim locktrays from master cast.

Stat. val	Points of measurement											
	Horizontal measurements						Vertical measurements					
	A-B		A-C		B-C		D-D'		E-E'		F-F'	
	TFPF	TFRL	TFPF	TFRL	TFPF	TFRL	TFPF	TFRL	TFPF	TFRL	TFPF	TFRL
mean	0.0032	0.0047	0.0018	0.0031	0.0017	0.0029	0.0014	0.0022	0.0032	0.0045	0.0027	0.0031

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p-value	<0.001	0.001	0.007	0.002	0.001	0.004

Table no. 1. Tight fitting perforated vs tight fitting rim lock

*TFPF: Tight Fitting Perforated Tray
**TFRL: Tight Fitting Rim Lock

Stat. val	Points of measurement											
	Horizontal measurements						Vertical measurements					
	A-B		A-C		B-C		D-D’		E-E’		F-F’	
	LFPF	LFRL	LFPF	LFRL	LFPF	LFRL	LFPF	LFRL	LFPF	LFRL	LFPF	LFRL
mean	0.0022	0.0027	0.0024	0.003	0.0017	0.0024	0.0014	0.0017	0.002	0.003	0.001	0.0017
p-value	0.001		0.003		0.001		0.001		0.003		0.001	

Table no. 2. Loose fitting perforated vs loose fitting rim lock

*LFPF:Loose Fitting Perforated Tray
**LFRL: Loose Fitting Rim Lock

Stat. val	Points of measurement											
	Horizontal measurements						Vertical measurements					
	A-B		A-C		B-C		D-D’		E-E’		F-F’	
	TFPF	LFPF	TFPF	LFPF	TFPF	LFPF	TFPF	LFPF	TFPF	LFPF	TFPF	LFPF
mean	0.0013	0.0027	0.0024	0.003	0.0017	0.0024	0.0044	0.0077	0.002	0.005	0.004	0.007
p-value	0.001		0.003		0.001		0.001		0.004		0.001	

Table no. 3. Tight fitting perforated vs loose fitting perforated

* TFPF: Tight Fitting Perforated Tray
**LFPF: Loose Fitting Perforated Tray

Stat. val	Points of measurement											
	Horizontal measurements						Vertical measurements					
	A-B		A-C		B-C		D-D’		E-E’		F-F’	
	TFRL	LFRL	TFRL	LFRL	TFRL	LFRL	TFRL	LFRL	TFRL	LFRL	TFRL	LFRL
mean	0.0023	0.0027	0.0014	0.0021	0.0017	0.0024	0.0064	0.0017	0.005	0.003	0.004	0.0017
p-value	0.001		0.003		0.001		0.001		0.007		0.001	

Table no. 4. Tight fitting rim lock vs loose fitting rim lock

* TFRL: Tight Fitting Rim Lock
* LFRL: Loose Fitting Rim Lock

IV. DISCUSSION:

The impression in the perforated trays is mechanically retained throughout the tray via perforations. The impression does not separate from the tray while being removed from the master cast and are stable while as the impression gets separated from the surface of the rim lock tray that results in impression distortion. That is why the casts made from perforated tray are more accurate comparative to those made from rim lock trays.

The tight fitting trays produce more accurate casts comparative to loose fitting trays. The bulk of impression material affects the accuracy of the casts. The greater the bulk of the impression material the greater the shrinkage of impression material and vice versa. The greater the shrinkage the higher the inaccuracy of the casts produced. The loose fitting trays have the greater bulk of impression material comparative to tight fitting trays.

Conclusion the present study revealed that perforated trays produced more accurate casts comparative to rim lock trays.

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