The effect of using sectional stock tray on the accuracy of gypsum cast

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ABSTRACT

Patients with restricted mouth opening are a common occurrence in prosthodontic practice. Sectional impression technique was simplified manipulation and decreased patient's trauma. The aim of study is to compare between the impression done by using sectional and full arch stock trays, and to evaluate volumetric changes in the abutments of partially edentulous arch and the linear dimensional changes between the abutments of stone casts at different intervals of time.

The measurements were done by using 3D (IOTA 1203, DEA) machine on (80) die stone casts prepared after taking an impression (two-step technique) of hand mix Dorisil and Supersil addition silicone impression materials using a special mold and test apparatus.

There was low significance in the volumetric differences among casts produced from sectional stock trays in relation to that produced from full arch stock trays. Little linear dimensional changes between abutments of casts prepared from sectional stock tray of an average 0.031mm were found. According to these results, sectional trays can be used instead of full arch trays in clinical cases of restricted mouth opening.

Key words: Stock trays, die stone, silicone, 3D measurement.

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الخلاصة

هناك حالات سريرية، آلتي تتعلق بمشكلة تحديد نسبة فتحة الفم ,وخاصة الحالات المرضية المتعلقة بأمراض المفصل الفكي و العمليات الجراحية آلتي لها علاقة بصغر فتحة الفم. لتجنب الأضرار بصحة المريض , تحتاج هذه الحالات إلى خصوصية في تحديد نوع و طريقة العلاج للتعويضات الصناعية. تهدف هذه الدراسة إلى استخدام طريقتين لأخذ الطبعة النهائية وذلك باستعمال نوعين من جهاز الطبعة (قوس كامل, ومقطعي) لحالات الفقدان الجزئي للأسنان لقياس التغيرات في حجم الأسنان الساندة والتغيرات الخطية بين الأسنان الساندة في فترات مختلفة من الزمن وعلى (٨٠) من قوالب الجبس الصلب تم تحضيرها بعد أخذ طبعة (بطريقة ثنائية الخطوة) من مادتي (Hand mix Dorisil, and Supersil addition silicon impression trials) باستعمال قالب وجهاز خاصين للفحص.

من خلال نتائج الدراسة وجد أن هناك دلائل إحصائية أقل في التغيرات الحجمية في القوالب المنتجة من جهاز الطبعة المقطعي مقارنة بالقوالب المنتجة من جهاز الطبعة الكامل. وتغيرات خطية قليلة بين الأسنان الساندة في القوالب المنتجة من جهاز الطبعة المقطعي وبمعدل (٠,٠٣١ ملم). واستنادا إلى نتائج هذه الدراسة بإمكان الطبيب استعمال جهاز الطبعة المقطعي بدلا من جهاز الطبعة الكامل في الحالات السريرية آلتي يعاني فيها المرضى من مشكلة صغر فتحة الفم.

INTRODUCTION

Patients with extensive head and neck injuries due to trauma and/or extensive surgical procedures often exhibit a severely limited ability to open the mouth. Sectional impression technique done by sectional tray simplified tray manipulation and decreased patient's trauma[1].

The effect of using either sectional or full arch stock tray on the accuracy of resultant elastomeric impression has always been a point of discussion[2,3].

Distortion in impression materials is crucial for restorative dentistry[4,5]. Production of exceptional crowns, fixed and removable partial dentures requires the use of impression materials, and trays that accurately

record prepared teeth and their relationship to adjacent oral structures [6,7,8]. In the field of prosthodontics, accurate stone casts are needed to make restoration and to examine occlusion. Although in recent years three-dimensional measurements have been done to analyze precisely the distortion of stone cast, little is known about the three-dimensional accuracy of the impressions themselves as well as about how stone casts are affected by the tray type, or tray design [9,10,11,12].

The aims of this study were to evaluate the effect of using sectional stock tray and full arch stock tray on:

- Volumetric changes in die stone casts produced from addition silicone impression material.
- The accuracy and dimensional stability of die stone cast derived from silicone impression at different time intervals.
- Linear dimensional changes between the abutments.

MATERIALS AND METHODS

Materials used in this study are listed in table (1). Two types of stock trays were used, sectional metal perforated stock tray No. 2, and full arch metal perforated stock tray (China MEHECO Pharmaceuticals and chemicals Imp. and Exp. Corporation).

A total of 80 die stone casts were produced (40 casts from each type of tray), using special master model having only right and left 1st premolars, and 2nd molars, and test apparatus [13].

Table (1): Materials used in the definitive study

Materials	Manufacturer	Class	Batch No.
Dorisil(addition silicone Hand –mix	Dorident, Austria	Putty type	138199
Supersil (addition silicone) Hand –mix	Dorident, Austria	Light body	160199
Silky Rock (Gypsum)	WipMix Louisville U.S.A.	Die stone (high strength)	78598002

The sectional stock tray was attached to the upper part of test apparatus by the same method of attachment of full arch stock tray to record the impression of half part of master model which was fixed on the center of the lower part of test apparatus. The impression material was manipulated according to manufacture's instructions; the base/catalyst ratio was carefully controlled. The two step (Putty-wash) technique was used in which putty type material was used in primary impression, the standard spacer (3M Dental products, St. Paul, MN) was placed over the master model to provide space for light body material. The test apparatus with impression was placed in an incubator at (37°C +/- 1°C) during the setting time to simulate the mouth temperature under constant pressure.

After setting, the impression was removed from the master model using the vertical handle of test apparatus. The light body material (base and catalyst) was manipulated according to manufacture's instructions, and loaded to the plastic rubber syringe and injected into prepared areas, around the abutments of master model and on the tray impression, the final impression was taken. The test apparatus was placed in the incubator mentioned above for the indicated setting time.

Impressions that were not poured immediately were stored in an incubator at (23°C +/- 1°C) according to ADA specification no. 19[13] for each bench set time evaluated (1 hour, 24 hours, and 1 week).

Impressions were poured with die stone according to manufacturer's instructions. All stone casts were allowed for setting for 1hour, and allowed drying for 24 hours before measurement procedure.

The measurements in three axis of master model and stone dies were done by special program prepared for this study, to measure all the abutments and the distance between them using "IOTA 1203, DEA" machine.

The results were subjected to statistical analysis test using statistical mean and standard deviation, analysis of variance at 1% and Dancan's Multiple Range test.

RESULTS AND DISCUSSION

Volumetric changes in the abutment size were calculated by special computerized program designed for this study. Mean of volumetric changes and standard deviation of master model and (80) stone dies is shown in table (2) and figures (1) and (2).

Table (2): Mean of volumetric changes, and standard deviation for master model and die stone casts

Sample		No.	Volume			
			Premolar mm^3		Molar mm^3	
			Mean	SD*	Mean	SD*
Master model		1	100.466	0.0509	196.831	0.0568
Full stock tray	Immediate	10	97.478	0.0219	189.419	0.0756
	1 hour	10	92.284	0.0214	185.663	0.0112
	24 hours	10	93.806	0.0146	192.008	0.0166
	1 week	10	85.561	0.0207	192.235	0.0148
Sectional tray	Immediate	10	94.263	0.0072	181.436	0.019
	1 hour	10	94.925	0.0245	180.935	0.0157
	24 hours	10	93.259	0.022	185.595	0.0303
	1 week	10	94.630	0.053	185.208	0.041

*SD: Standard deviation.

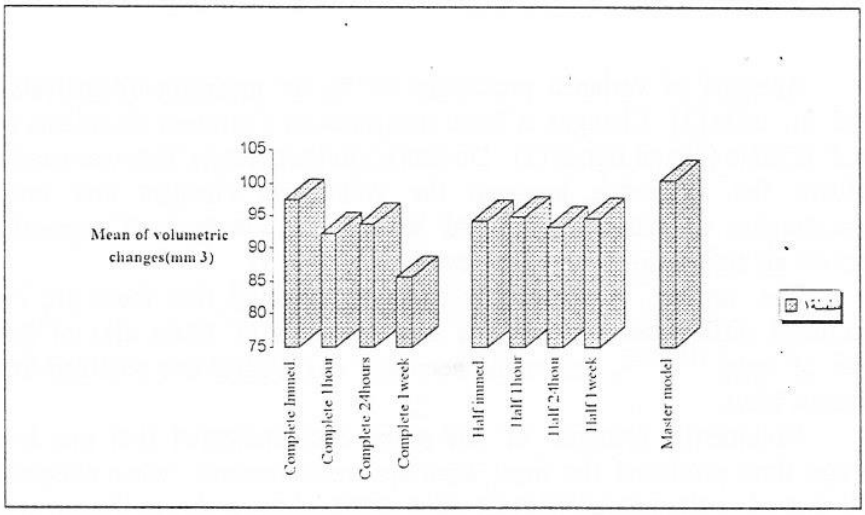

Figure (1): Volumetric changes in the premolars of casts produced by using full arch and sectional stock trays

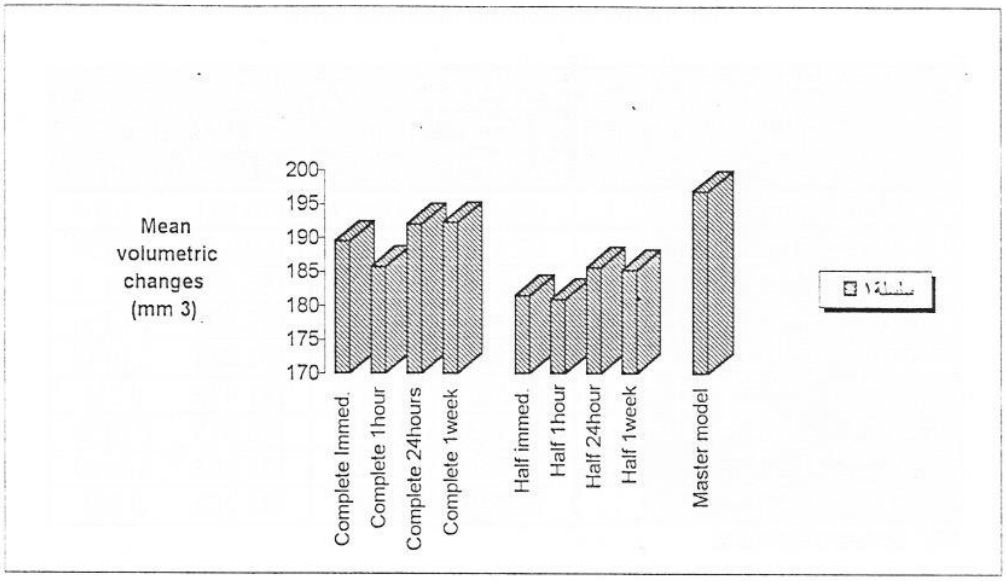

Figure (2): Volumetric changes in molars of stone casts
Produced by using full and sectional stock trays

Analysis of variance procedure at 1%, and mean square analysis is listed in table (3). Changes in linear measurements between abutments are listed in table (4) and figure (3). Duncan's Multiple Range Test was used to evaluate the difference between the volumetric changes and linear measurements of master model and stone dies of two types of impression trays for all periods of storage time evaluated (table 5).

The results of volumetric changes indicated that there are low significant differences between the measurements of stone dies of both types of trays [15,16,17], and more accuracy in the casts was obtained from sectional trays.

Volumetric changes of die stone casts indicated that one hour storage time produced the most accurate measurements when compared with that of master model (table 2) using sectional trays, due to the retention of the materials to the tray, and viscoelastic properties of elastic impression materials[18,19]. The differences in volume of premolar abutments of stone dies have smaller size than that of master model (figures 1 and 2) due to usage of two step (putty-wash) impression technique which leads to a restoration that would be tight during seating. [20,21,22,23].

Table (3): Mean square analysis for measurements of stone models

Source of Variance	Degree of Freedom	Mean Square		
		Premolar (volume)	Molar (volume)	Distance Between Abutments
Between models (master and stone models)	8	162.397*	288.897*	0.00962*
Error	81	0.0215	0.1671	0.0005

* Significant at 1%

Table (4): Mean and standard deviation of linear measurements for master model and die stone casts

Sample		No.	Distance between abutments	
			Mean	SD*
Master model		1	17.026	0.0013
Full arch stock tray	Immediate	10	17.063	0.0013
	1 hour	10	17.066	0.0038
	24 hours	10	17.005	0.0133
	1 week	10	17.119	0.003
Sectional arch stock tray	Immediate	10	17.054	0.004
	1 hour	10	17.052	0.015
	24 hours	10	17.061	0.0031
	1 week	10	17.061	0.001

* SD: Standard deviation

The linear distance between the two abutments in stone models prepared from full tray increased with an average of (0.037mm), while the casts prepared from sectional tray showed less changes with an average of (0.031mm). [1,7,20,22,23,24]

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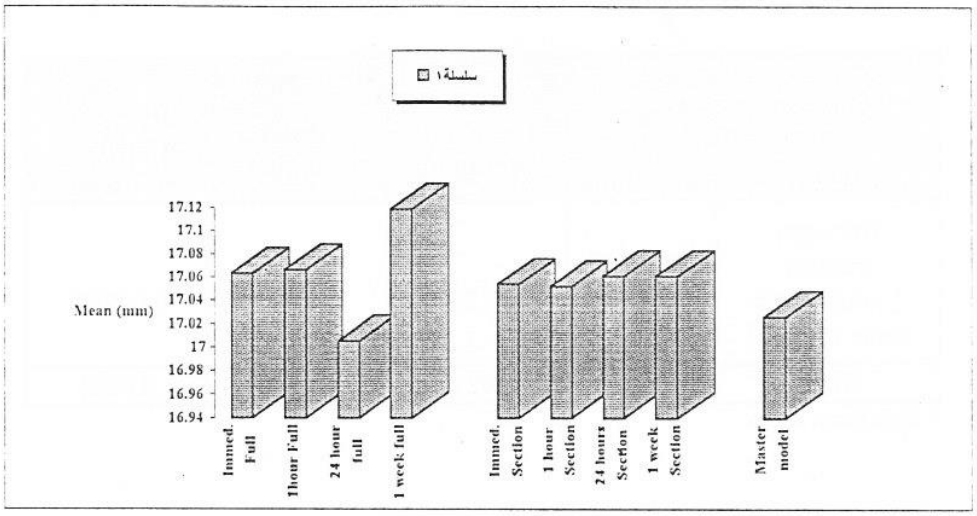

Figure (3): Linear dimensional measurements for Master model and die stone casts

Table (5): Duncan's Multiple Range Test for storage time intervals (Volume and linear measurements).

Samples	Volume (Premolar)	Volume (Molar)	Distance Between Abutments
Master model	100.466^{A}	196.831^{A}	17.026^{D}
Comp.-Immediate	97.478^{B}	189.419^{C}	17.063^{B}
Comp.-1 Hour	92.284^{H}	185663^{D}	17.066^{B}
Comp.-24 Hour	93.806^{F}	192.008^{B}	17.005^{E}
Comp. –Week	85.561^{I}	192.235^{B}	17.119^{A}
Half- Immediate	94.263^{E}	181.436^{F}	17.054^{C}
Half- 1 Hour	94.425^{C}	180.935^{G}	17.052^{C}
Half- 24 Hour	93.259^{G}	185.595^{D}	17.061^{B}
Half- Week	94.630^{D}	184.208^{E}	17.061^{B}

CONCLUSION

The conclusions of this study are as follows:

1. Volumetric changes between the casts produced from sectional stock trays and full arch stock trays were significantly low in relation to master model, so we can select this procedure from the point of materials used.
2. Larger size of abutments showed increased volumetric changes in relation to the small abutment size.
3. A shorter storage time (one-hour) before pouring the impressions taken by sectional and full arch stock trays resulted in improved accuracy, so according to these results we can use sectional stock tray to take impression, also using half of the amount of materials.
4. Linear dimensional distance change between abutments was higher in casts produced by full arch stock tray in relation to that produced by sectional tray.

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