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Evaluation of accuracy of dies obtained from impressions in four different impression trays using addition silicone impression material – An in vitro study

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Abstract

Introduction: Accurate reproduction of the prepared tooth/teeth is of utmost importance in the fabrication of fixed prostheses. Inaccuracies in the replication process will have an adverse effect on the fit and function of the final prosthesis. An accurately fitting fixed dental prosthesis is dependent on the accuracy of dental impressions.

Aim: To evaluate and compare the buccolingual dimensions of dies fabricated from four different impression trays using PVS impression material.

Methods: Mandibular 1 st molar tooth was prepared and 10 impression each with plastic full arch tray, plastic sectional tray, plastic dual arch tray and acrylic custom tray were made and dies fabricated. The buccolingual measurement was measured with digital caliper, compared statistically anaylzed

Result: A statistically significant difference ($P < 0.001$) was observed between the dimensions of control and the study group dies produced using different trays. When compared with the control group, the amount of deviation was high in plastic sectional(7.02mm) tray followed by plastic dual tray(6.95mm), plastic full(6.84mm) arch tray and custom tray(6.77mm), in that order which is statistically significant.

Conclusion: Dies fabricated from the impression made with acrylic custom tray showed maximum accuracy followed by plastic full arch tray, plastic dual tray and plastic sectional tray.

Keywords: PVS, Prosthesis, Anova and Post Hoc Tukey

Introduction

Accurate reproduction of the prepared tooth/teeth is of utmost importance in the fabrication of fixed prostheses. Inaccuracies in the replication process will have an adverse effect on the fit and function of the final prosthesis. Polyvinyl siloxane impression materials are widely popular because of their combination of excellent physical properties, handling characteristics and dimensional stability. They are therefore used for making an impression in fixed partial denture in routine clinical practice. Impression trays are broadly classified as stock trays and custom trays. There are different types of stock trays available. Stock tray is a metal or plastic prefabricated impression tray typically available in various sizes and used principally for preliminary impressions. Custom tray is an individualized impression tray made from a cast obtained from a preliminary impression; it is used in making a final impression. Sectional tray is a metal or plastic prefabricated impression tray used to make impression in the sectional area.

Dual tray is a metal or plastic tray used to make an impression of the prepared teeth, the opposing arch and the occlusal relationship of teeth in maximum intercuspation simultaneously.

Arash Shisheyan and Hamed Amrai state that in recent times there has been a propensity to use plastic stock trays rather than custom-made ones or the metallic tray to make impressions for crowns, bridges and implants. Also, these plastic trays have been utilized in different forms, for instance, a half arch or triple technique or a full arch in combination

with different materials with different viscosities. Tray rigidity and material thickness are among many variables that have been reported as important factors in making precise impressions. It has been indicated that the tray should be rigid enough to withstand the forces generated during the impression procedures 1.

The aim of this study was to compare the accuracy of working dies made from impressions using a plastic dual tray, plastic sectional tray, plastic full arch tray and custom tray.

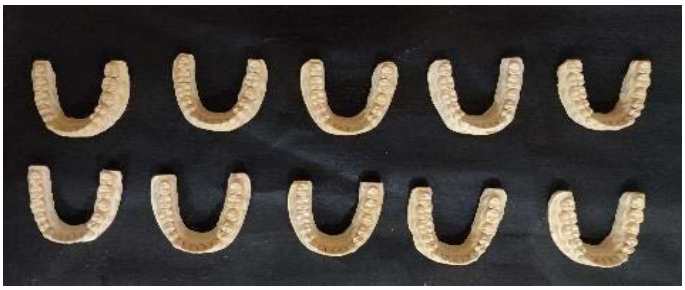
Materials and Method

Control Group -Maxillary and mandibular teeth were embedded in the dento form base and articulated with maximum intercuspation. The mandibular left first molar was prepared to receive the metal crown, 1.5 mm reduction of the functional cusp and 1mm reduction of the nonfunctional cusp. 1.5 mm reduction of the axial surface of the tooth was done and functional cusp bevel was given on the buccal cusp of the molar. After the preparation, grooves were placed on the buccal and lingual surfaces of the tooth. The notch of the groove was used as the reference points for measurement of the buccolingual dimension of the tooth. This was assigned as control group A.

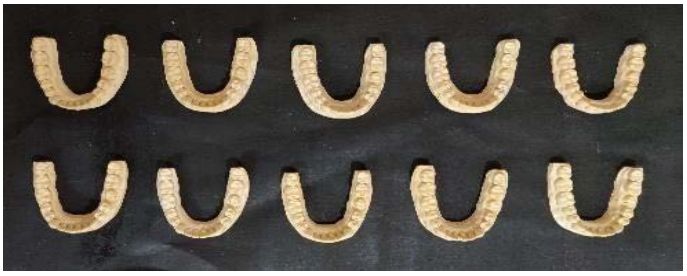
GROUP I - Dies fabricated from impressions made with plastic dual impression trays

GROUP II - Dies fabricated from impressions made with plastic sectional impression trays

GROUP III - Dies fabricated from impressions made with plastic full arch impression trays



GROUP IV - Dies fabricated from impressions made with acrylic custom impression trays



All the impressions were poured with die stone (type IV gypsum product). To standardize the effect of the setting expansion of the improved stone, the water powder ratio was critically matched with the manufacturer's recommendation and a product of similar batch number was used to pour all the impressions. The opposing arch was not poured in the dual- arch impressions. The stone dies were retrieved from the impressions after a setting time of 2 h, examined for clinical acceptability and labeled.

The cast was allowed to dry for 48 hours and then the measurements were done. Measurement was done with a digital caliper, each measurement was done 3 times and the mean was recorded for buccolingual dimension. The buccolingual dimension of the control group was compared with the buccolingual dimensions of other groups. The data were statistically analyzed using one way ANOVA and POST HOC TUKEY test.

Result

The buccolingual dimension was measured using a digital caliper. Each reading was taken 3 times.

Table 1: Descriptive Statistics of Buccolingual Dimensions

Groups	N	Mean	±Std. Deviation	Std. Error	95 % Confidence Interval for Mean	
					Lower Bound	Upper Bound
CONTROL	10	6 . 74	0 . 00	0 . 000	6 . 74	6 . 74
DUAL TRAY	10	6 . 95	0 . 01	0 . 004	6 . 94	6 . 96
SECTIONAL TRAY	10	7 . 02	0 . 01	0 . 006	7 . 01	7 . 03
FULL ARCH TRAY	10	6 . 84	0 . 02	0 . 006	6 . 82	6 . 85
CUSTOM TRAY	10	6 . 77	0 . 01	0 . 004	6 . 76	6 . 78

The mean of the control group is 6.74mm, the mean of group I is 6.95 ± 0.01mm, the mean of group II is 7.02 ± 0.01mm, the mean of group III 6.84 ± 0.02mm the mean of group IV is 6.77 ± 0.01mm.

Table 2: Intergroup comparison of buccolingual dimension between all groups using one way anova

Groups	Mean	±Std. Deviation	F	P Value
CONTROL	6.74	0.00	536.375	0.00*
DUAL TRAY	6.95	0.01		
SECTIONAL TRAY	7.02	0.01		
FULL ARCH TRAY	6.84	0.02		
CUSTOM TRAY	6.77	0.01		

*Statistically significant at p<0.05

This table represents the intergroup comparison of the buccolingual dimension between all groups.

A statistically significant difference (P < 0.001) was observed between the dimensions of control and the study group dies produced using different trays. When compared with the control group, the amount of deviation was high in plastic sectional(7.02mm) tray followed by plastic dual tray(6.95mm), plastic full(6.84mm) arch tray and custom tray(6.77mm), in that order which is statistically significant.

Table 3: Multiple comparison of buccolingual dimension between various groups using tukey post hoc test

(I) GROUP	(J) GROUP	Mean Difference (I- J)	Std. Error	P Value
	DUAL TRAY	- 0 . 20 *	0 . 007	0 . 000
	SECTIONAL TRAY	- 0 . 27 *	0 . 007	0 . 000
CONTROL	FULL ARCH TRAY	- 0 . 09 *	0 . 007	0 . 000
	CUSTOM TRAY	- 0 . 02 *	0 . 007	0 . 008
DUAL TRAY	SECTIONAL TRAY	- 0 . 07 *	0 . 007	0 . 000
	FULL ARCH TRAY	0 . 10 *	0 . 007	0 . 000
	CUSTOM TRAY	0 . 18 *	0 . 007	0 . 000
SECTIONAL TRAY	FULL ARCH TRAY	0 . 18 *	0 . 007	0 . 000
	CUSTOM TRAY	0 . 25 *	0 . 007	0 . 000
FULL ARCH TRAY	CUSTOM TRAY	0 . 07 *	0 . 007	0 . 000

*Statistically significant at p<0.05

This table represents the comparison of the buccolingual dimension of all the groups.

In comparing the buccolingual dimension between various groups, the custom tray dies showed less deviation with the control group, when compared with the other study groups and plastic sectional tray dies showed high deviation with control group dies when compared to the other study groups.

Hence the dies fabricated with impressions from custom tray were more accurate than the dies fabricated with the impression of other trays.

Discussion

One of the important steps in the impression is the selection and preparation of an appropriate tray. A technique resulting in insufficient accuracy of Impression causes distortion and complication that consequently result in compromised fit. Proper contouring of the intended crown/bridge depends upon a good positive replica of the prepared tooth/teeth to fabricate which, the impression must be made precisely after selecting the appropriate impression tray and an impression material that would record the details accurately. In fixed prosthodontics, polyvinyl siloxane is the material of choice to make final impression for the prostheses. Several factors affect the accuracy of impression materials. They include impression material`s manipulation, thermal changes after removal, type of impression material, impression retention in the tray, tray deformation, impression tray design, sufficient and uniform space in the impression tray, impression material thickness, impression technique and impression removal1. Two important factors in impression precision are related to the rigidity and dimensional stability of the tray. The tray should be stiff and stable enough so as not to be affected during insertion and removal of the tray-impression complex from the mouth. Any tray

deformation, especially elastic deformation, will lead to distortion and subsequent ill -fitting prosthesis. The operator must assess and ensure that a 3 - dimensional space of 2 mm is available between the intaglio surface of the impression tray and the prepared and unprepared teeth while making an impression with elastomers. Regarding the types of impression trays, a plethora of impression trays is available for the clinician. While each type of impression tray has its own advantages and indications, it is often found in clinical practice that the operator may, unintentionally utilize a type of impression tray that may not be indicated for that particular application; this can result in a compromised positive replica and therefore the selection of an appropriate impression tray is very much essential. The choice of an impression tray also depends upon the type of impression material intended to be used e.g., while using agar for impression, water -cooled trays have to be used. Given a situation where polyvinyl siloxane is the impression material and when 4 different impression trays can be used, a need was felt to assess which type of impression tray would be better suited to obtain maximum accuracy and hence this study was undertaken. Proper tray selection is necessary so that the appropriate details of the subjacent tissues are registered in the impression. There should not be any distortion of the impression tray either during the time of impression registration or subsequent to removal of the impression until the working cast is obtained from it. Metal or metal-reinforced trays are pre-manufactured and are available in different sizes for patients with various teeth sizes and arch sizes. When a tray of heavy body impression material is seated, the force of compaction by the operator can push the impression material against the walls of the tray laterally and against the floor of the impression tray. A rigid tray can accommodate this force 10. Despite this advantage, the space in stock tray would be uneven. If a stock tray is used for the final impression, putty and light body combination has to be used. This will not only consume more impression material but is also prone to distortion. Since there is uneven space within the stock tray, uneven shrinkage (of polymerization) of the material may occur within the confines of the impression tray. Cognizant of this point, for the present study, metal trays were not selected and special tray fabricated with auto polymerizing resin was used. Sectional trays were taken up for the study as, in day-to-day practice, patients with gagging or restricted mouth opening will be benefitted from the use of sectional trays. In the present study, dies fabricated from sectional tray impression showed a statistically significant difference from the control as well as other groups. Arash shisheyan et al (2016), after conducting a study concluded that dies fabricated from impressions made with sectional trays had distances that were different from the master model. The results of the present study are in agreement with the results of their study. Differences in distances up to 90 μm between abutments for a fixed partial denture have been estimated as clinically acceptable because the periodontal ligament space measures from 100 to 250 μm3. Extrapolating the results of the present study, in terms of micrometers, the following points are observed. Dies from plastic dual tray impressions showed a discrepancy of 210 μm, dies from plastic sectional tray impressions 280 μm, dies from plastic full arch tray impressions 100 μm, dies from acrylic custom tray impressions 30 μm. Hence for clinically acceptable dies, sectional impression trays can be dispensed with. Probably microscopic variation in length could have an influence in an edentulous situation where the quantity of impression material is more and so could be prone to shrinkage due to polymerization. Great distortions of trays have been shown in a study conducted by Arash shisheyan et al when comparing plastic stock

trays with metal trays. While making an impression with putty material, the tray should not contact the buccal or lingual surfaces of the teeth. If the dual tray contacts these tissues, its sides may be forced apart when the patient occludes. When the impression is removed from the patient's mouth, the rebound of the tray's sidewalls results in distortion of the impression 10. The use of dual arch impression technique must be based on sound physical principles. This impression technique is contraindicated in long-span fixed partial dentures, as well as in barly's class III as they require full mouth reconstruction 12. The results of the present study showed that the buccolingual dimension in the dies from all four groups tested was increased when compared with the buccolingual dimension of the control group. The change in dimension could be ascribed to shrinkage of polymerization of PVS and setting expansion of the gypsum material. These findings are in agreement with the results obtained by Breeding and Dixon, Ceyhan et al, and Cox et al 6,7. The more flexible plastic trays provide less rigid support at the borders and they flex outward due to pressure from the impression material during seating on the prepared tooth. Another possible explanation for the increased dimension seen with the plastic dual -arch trays could be a distortion caused by the weight of the die stone when the impression was poured. Only the side of the tray with the prepared tooth was poured in this study. The metal tray and acrylic custom tray would resist to a considerable extent, the flexure due to the weight of the die stone, but the flexible plastic tray may distort 6. The results of the present study showed that the dies fabricated from the impressions in custom trays had maximum accuracy, probably due to the even thickness of the material within the confines of the impression tray. Scope for further study: the statistically significant differences exhibited by the four different groups in the present study can be evaluated for clinical correlation. Further studies in the clinical arena may throw more light.

Conclusion

Dies fabricated from the impression made with acrylic custom tray showed maximum accuracy in buccolingual dimension when compared to control group. Dies fabricated from the impression made with plastic sectional tray showed the least accuracy in buccolingual dimension when compared to the control group.

Dies fabricated from the impression made with plastic full arch tray showed better accuracy than dies fabricated with plastic dual tray.

Reference

1. Arash Shisheyan, Evaluation of Impression Accuracy Making with Different Kind of Tray,Sch. J. App. Med. Sci., July 2016
2. Anthony h. L. Tjan, comparing effects of tray treatment on the accuracy of dies ,the journal of prosthetic dentistry ,1987
3. Naofumi shigeto, evaluation of the methods for dislodging the impression tray affecting the dimensional accuracy of the abutments in a complete dental arch cast ,the journal of prosthetic dentistry 1989
4. Glenn e. Gordon, the effect of tray selection on the accuracy of elastomeric impression materials,the journal of prosthetic dentistry 1990
5. W. P. Saunders, effect of impression tray design and impression technique upon the accuracy of stone casts produced from a putty-wash polyvinyl siloxane impression material, J. Dent. 1991.
6. Larry c. Breeding, accuracy of casts generated from dual-arch impressions, the journal of prosthetic dentistry 2000
7. Jeffrey a. Ceyhan, a clinical study comparing the three-dimensional accuracy of a working die

generated from two dual-arch trays and a complete-arch custom tray, the journal of prosthetic dentistry 2003

8. Eduardo batista franco, effect of storage period on the accuracy of elastomeric impressions, j appl oral sci. 2007
9. Jagan Mohan Reddy, A comparative study of inter-abutment distance of dies made from full arch dual-arch impression trays with those made from full arch stock trays: An in vitro study, Indian J Dent Res, 20(4), 2009
10. Igor J Pesun, Three-way trays: easy to use and abuse,J Can Dent Assoc. 2008
11. Sareen Duseja, Accuracy of Different Elastomeric Impression Materials Using Dual Arch Impression Trays: An In Vitro Study, Advances in Human Biology2014
12. S. George,An in vitro study to evaluate the accuracy of dies obtained from dual-arch impression trays using addition silicone impression material and tray combinations, Journal of Interdisciplinary Dentistry 2015
13. Mansi Arora, Influence of Custom Trays, Dual-Arch Passive, Flexed Trays and Viscosities of Elastomeric Impression Materials on Working Dies, J Clin Diagn Res. 2016
14. Nagam Raja Reddy,Effect of variation of impression material combinations, dual arch tray types, and sequence of pour on the accuracy of working dies: “An in vitro study”, The Journal of Indian Prosthodontic Society , Apr-Jun 2016
15. Poonam R. kulkarni, A Comparative Evaluation of Accuracy of the Dies Affected by Tray Type,Material Viscosity, and Pouring Sequence of Dual and Single Arch Impressions- An In vitro Study, Journal of Clinical and Diagnostic Research. 2017
16. Varun Kumar, Anatomization of various impression techniques in fixed partial prosthodontics,International Journal of Oral Health Dentistry 2018
17. Ashfaq yaqoob,panorama of impression techniques in fixed partial dentures. A systematic review ,international journal of medical dentistry january / march 2018
18. Jiji M. Edakkalathur, A comparative evaluation of plastic and metal impression trays on the accuracy of cast, International Journal of Preventive and Clinical Dental Research 2019
19. Ladan Jamshidy, A Comparative Analysis on the Accuracy of Special and Prefabricated Impression Trays Using Additional Silicone in a Laboratory Model, Dental Hypotheses 2019
20. Dr nithin kumar s.b, impression techniques in fixed prosthodontics - a review, international journal of scientific research, march-2019