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Evaluation of the Dimensional Accuracy of Polyvinylsiloxane Impressions with and without Tray Adhesive – An-in Vitro Study

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Abstract:

Mechanical retention for elastomeric impression materials is provided in stock trays, even though manufacturers typically recommend the use of an adhesive. The aim of this study was to evaluate the dimensional stability of polyvinylsiloxane impression materials with and without tray adhesives using stock trays. A total of 20 impressions were made, (i.e. 10 using tray adhesives and 10 without tray adhesives).

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Introduction:

In the recent era vinyl polysiloxane (VPS) impression materials are among the most popular non-aqueous elastomeric impression materials used in dentistry[1]. They provide excellent detailed surface reproduction, dimensional stability, elastic recovery and ease of manipulation[2,3].However the accuracy of this impression material is absolutely useless if it detaches from the impression tray while withdrawing from the undercut areas of the oral tissues.

Various tray adhesives have been introduced to strengthen the bond between tray and impression material to withstand the stresses and prevent the detachment of impression material from the tray during withdrawal from mouth. More accurate and consistent impressions are obtained when adhesives are employed[4-7].

Tray adhesives recommended for silicone impression materials are composed of poly(dimethylsiloxane) and ethyl silicate. Poly(dimethylsiloxane) adheres to the silicone impression material, whereas ethyl silicate forms hydrated silica that bonds with tray material physically resulting in an accurate and consistent impression.

Stock trays have many retentive holes to hold the impression material in place. The objective of this study was to evaluate if the retentive holes provide enough interlocking for the impression material so as to avoid the use of a tray adhesive.

Materials and Methods:

1. Typhodont model (Nissin Dental Products Inc, Kyoto Japan).
2. Mani Diamond Bur- BR-46.
3. Digital Vernier caliper (Safeseed Electronic Digital Vernier Caliper).
4. Perforated dentulous stock trays.
5. Virtual tray adhesive ivoclair vivadent.
6. Kulzer Variotime Easy Putty & Light Flow.
7. Cellophane sheet.
8. Type 3 dental stone (Kalabhai Karlson Pvt. Ltd. Ultra rock).

A total of 10 elastomericimpressions (Kulzer Variotime Easy Putty & Light Flow) of a mandibular typhodont model (Nissin Dental Products Inc, Kyoto Japan) was taken. In the mandibular typhodont model, a single ditch cut was made using a number 6 round bur in the central fossa of the third molar on each side (38,48).

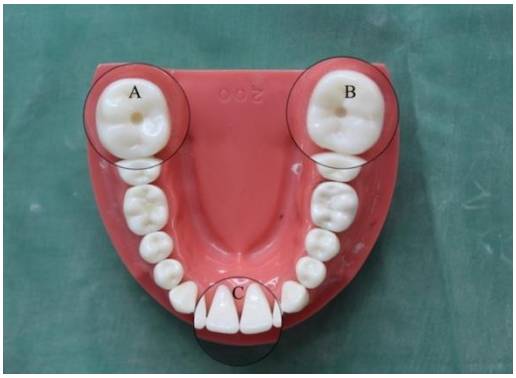
A.  B. 

Figure 1: A.Mandibular typhodont model (Nissin Dental Products Inc, Kyoto Japan) B. Typhodont model showing the reference points A,B,C.

Measurements were taken using reference points A,B, C. “A” being the ditch cut in tooth number 48, “B” being the ditch cut in tooth number 38 and “C” being the midpoint between tooth number 41 and 42. Measurements were made using a digital Vernier caliper. The distance from point A to B was 45.9mm, the distance from point A to C was 53mm, the distance from point B to C was 53.6mm. The measurements taken on the typhodont model was the control group.

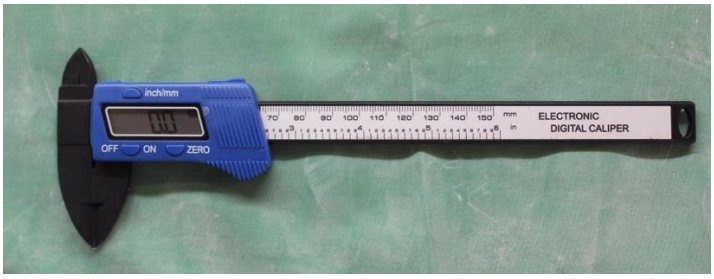


Figure 2: Digital Vernier caliper.

Impressions were made using addition silicone putty and light body (Kulzer Variotime Easy Putty & Light Flow).A total of 20 impressions in a stock tray was made using dual stage impression technique with cellophane sheet acting as a spacer. The first 10 impressions were made with a tray adhesive and the next 10 without a tray adhesive. The tray adhesive was left to dry as per the manufacturers instructionsbefore making the impression.

A. 

B. 

Figure 3: A. Kulzer Variotime Easy Putty & Light Flow. B Virtual tray adhesive ivoclair vivadent.

After the impression was made, casts were poured using Type 3 dental stone (Kalrock, Kalabhai Karlson Pvt. Ltd. Ultra rock) after 30 minutes. The casts were poured with the help of a vibrator (AmDentalStore D-Vibrator) so as to capture all the surface details of the impression and as bubble-free as possible. Each cast was numbered A1-10 (to indicate the use of a tray adhesive) and NA1-10 (to indicate not using a tray adhesive).

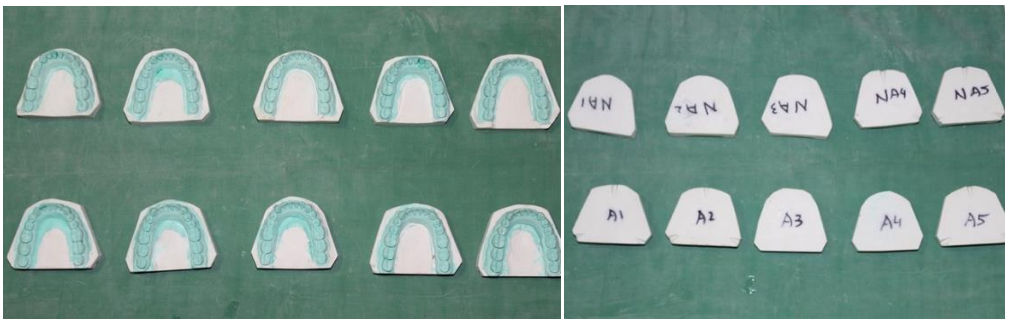


Figure 4: Casts made with tray adhesive (A1-10) and without tray adhesive (NA 1-10).

Results:

The measurements of the reference pointsA, B,C noted for the typhodont model and each cast is given in a tabular column (table 1).

TABLE 1

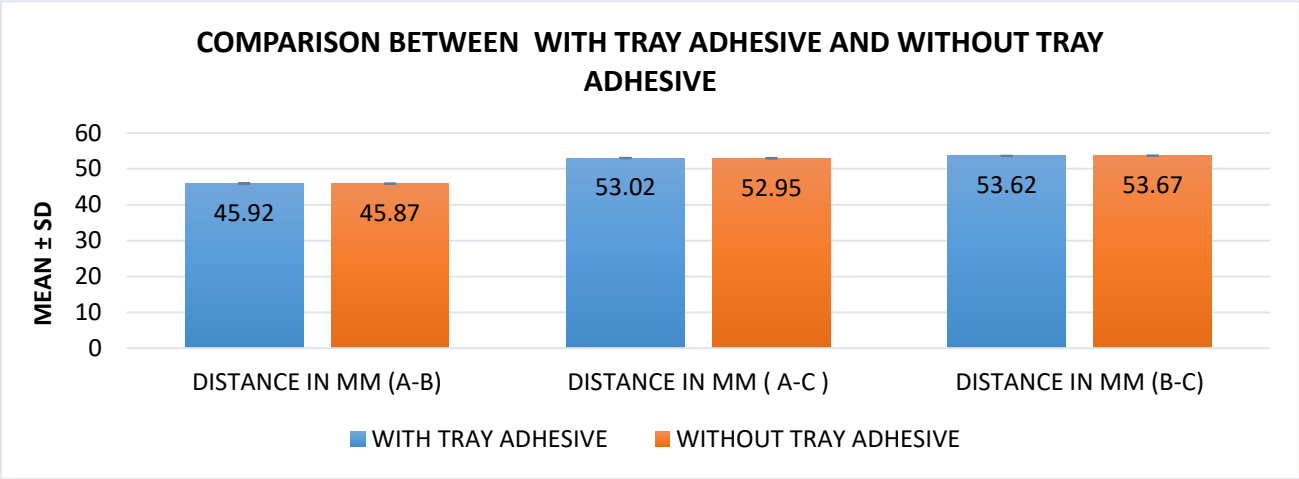
VARIABLE	DISTANCE IN MM (A-B)	DISTANCE IN MM (A-C)	DISTANCE IN MM (B-C)
CONTROL GROUP	45.9	53.0	53.6
WITH TRAY ADHESIVE 1	45.9	53.0	53.6
WITH TRAY ADHESIVE 2	45.9	53.0	53.6
WITH TRAY ADHESIVE 3	45.9	53.1	53.7
WITH TRAY ADHESIVE 4	46.0	53.0	53.6
WITH TRAY ADHESIVE 5	45.9	53.0	53.6
WITH TRAY ADHESIVE 6	45.9	53.1	53.6
WITH TRAY ADHESIVE 7	45.9	53.0	53.7
WITH TRAY ADHESIVE 8	46.0	53.1	53.6
WITH TRAY ADHESIVE 9	46.0	52.9	53.6
WITH TRAY ADHESIVE 10	45.8	53.0	53.6
WITHOUT TRAY ADHESIVE 1	45.9	52.8	53.6
WITHOUT TRAY ADHESIVE 2	45.9	52.8	53.7

WITHOUT TRAY ADHESIVE 3	45.8	53.0	53.7
WITHOUT TRAY ADHESIVE 4	45.9	53.0	53.7
WITHOUT TRAY ADHESIVE 5	45.8	52.9	53.8
WITHOUT TRAY ADHESIVE 6	45.9	52.9	53.6
WITHOUT TRAY ADHESIVE 7	45.9	53.0	53.6
WITHOUT TRAY ADHESIVE 8	46.0	53.1	53.7
WITHOUT TRAY ADHESIVE 9	45.8	53.0	53.6
WITHOUT TRAY ADHESIVE 10	45.8	53.0	53.7

The mean value, standard deviation and independent sample tests of the distances between A-B, A-C, B-C are given in a tabular column (table 2).

TABLE 2 **Group Statistics**

	GROUP	**N**	**Mean**	**Std. Deviation**	**Independent Samples Test**
DISTANCE IN MM (A-B)	WITH TRAY ADHESIVE	10	45.920	.0632	.105
	WITHOUT TRAY ADHESIVE	10	45.870	.0675	.105
DISTANCE IN MM (A-C)	WITH TRAY ADHESIVE	10	53.020	.0632	.072
	WITHOUT TRAY ADHESIVE	10	52.950	.0972	.072
DISTANCE IN MM (B-C)	WITH TRAY ADHESIVE	10	53.620	.0422	.062
	WITHOUT TRAY ADHESIVE	10	53.670	.0675	.062



The inference is that there is no statistical difference between the two groups (i.e. with tray adhesive and without tray adhesive).

Thus the null hypothesis is accepted that there is no statistical significance between the two groups.

Discussion:

Polyvinyl siloxane impression materials, also known as addition silicones, exhibit exceptional dimensional stability because no by products are formed during polymerization reaction and can be poured at convenience of the operator.

Whatever the accuracy of material may be, there will be dimensional changes in the die if the material detaches from the tray during removal from the oral cavity. The detachment of impression material from the tray may prevent the impression material to return to its original shape thus, resulting in distorted die, wax pattern, and casting.

The tray adhesive for silicone impression materials has polydimethylsiloxane and ethyl silicate. Polydimethylsiloxane sticks to the silicone impression material whereas ethyl silicate forms hydrated silica that bonds to the impression tray material physically. A solvent like a methyl acetate dissolves the tray and bonds with it. The retention depends on the ability of the solvent to dissolve the tray. The solvent must evaporate completely to expose a layer of adhesive to bond with the impression material. As a result, the tray adhesive is left to dry for some time before the impression material can be loaded.

This study was undertaken to assess the need for tray adhesives in a stock tray, as they already have numerous retentive holes which holds the impression material in place. In this study the dimensional stability of polyvinyl siloxane impressions was assessed with and without tray adhesives. A total of twenty impressions were made of a typhodont model; ten impressions were made using tray adhesive as per the manufacturers instructions and ten impressions were made without using tray adhesives. Type III gypsum product was poured in the impressions after 30 minutes. The measurements from the reference points A, B, C were made using a digital Vernier caliper. The mean, standard deviation and independent sample tests were done using SPSS software.

For distance **A-B** (in mm) with tray adhesive and without tray adhesive the **mean** was found to be 45.920, 45.870, the **standard deviation** was found to be 0.0632, 0.0675, the **independent ttest** was found to be 0.105, 0.105 respectively.

For distance **A-C** (in mm) with tray adhesive and without tray adhesive the **mean** was found to be 53.020, 52.950, the **standard deviation** was found to be 0.0632, 0.0972, the **independent ttest** was found to be 0.72, 0.72 respectively.

For distance **B-C** (in mm) with tray adhesive and without tray adhesive the **mean** was found to be 53.620, 53.670, the **standard deviation** was found to be 0.0422, 0.0675, the **independent t test** was found to be 0.062, 0.062 respectively.

The inference is that there is no statistical difference between the two groups (i.e. with tray adhesive and without tray adhesive). Thus the null hypothesis is accepted that there is no statistical significance between the two groups.

Tjan AH and Whang SB[5]conducted a study "comparing effects of tray treatment on the accuracy of dies" concluded that no appreciable differences were found in the complete crowns among the three tray treatments on the first pours.

T. J. Bomberg et al[6]reportedthat adequate retention of impression material in the tray is necessary for consistent results. Complete application of impression material adhesive is a critical step in the impression process to assure accurate and consistent results. The results are enhanced, both in accuracy and consistency, when the adhesive is used in a perforated tray.

Ramandeep Kaur et al[7]reported that Tray adhesives should be applied to prevent polymerization shrinkage of impression materials and to obtain dimensionally accurate dies. The maximum tensile strength of all the tray adhesives was obtained when they were dried up to 20 minutes.

While correlating the data of this study to the clinical situation, it should be kept in mind that neither the effects of the saliva, lips, cheek, and tongue in containing the impression material could be simulated nor the influence of the occlusal force.

Conclusion:

Within the limitations of this study following conclusion can be drawn. There is no significant difference in the dimensional stability between the two groups (i.e. with tray adhesive and without tray adhesive).The Mean was found to be 53.620, 53.670 for distance B-C (in mm),53.020, 52.950 for distance A-C (in mm), 45.920, 45.870 for distance A-B (in mm) withatray adhesive and without a tray adhesive respectively.

The use of perforated trays aids in mechanical interlocking and thereby may negate the use of an adhesive. The handling and setting properties of the material are also critical in determining the accuracy of an impression.It may be concluded that the role of an adhesive in a perforated tray does not have any significant difference in the accuracy of the impression.

References:

1. Frazier KB, Mjör IA. The teaching of all ceramic restorations in North American dental schools: materials and techniques employed. J Esthet Dent. 1997;9(2):86–93.
2. Craig RG, Urquiola NJ, Liu CC. Comparison of commercial elastomeric impression materials. Oper Dent. 1990;15(3):94–104.
3. Chee WW, Donovan TE. Polyvinyl siloxane impression materials a review of properties and techniques. J Prosthet Dent. 1992;68(5):728–732.
4. Nicholson JW, Porter KH, Dolan T. Strength of tray adhesives for elastomeric impression materials. Oper Dent. 1985;10(1):12–16.
5. Tjan AH, Whang SB. Comparing effect of tray treatment on the accuracy of dies. J Prosthet Dent. 1987;58(2):175–178. doi: 10.1016/0022-3913(87)90172-7.
6. Bomberg TJ, Goldfogel MH, Hoffman W, Jr, Bomberg SE. Considerations for adhesion of impression materials to impression trays. J Prosthet Dent. 1988;60(6):681–684.
7. Kaur R, Kumar M, Jain S, Jindal N. Comparative Time-Dependent Evaluation of Dimensional Accuracy of Dies Using Different Tray Adhesives: An In Vitro Study. Dental Journal of Advance Studies. 2018 Dec;6(02/03):106-11.