

Comparative Evaluation of the Accuracy and Dimensional Stability of Three Interocclusal Recording Materials- An In Vitro Study

Running title - Study on accuracy of inter arch record material

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ABSTRACT

AIMS: To compare accuracy and dimensional stability of 3 inter occlusal recording materials, as a function of time. Method of study 3 commercially available inter occlusal recording materials investigated in this study were chemically bite registration wax, bis acrylic and polyvinylsiloxane. A mold of ADA specification no 19 was used. Samples of 10 specimen each were made. Specimen were disc shaped, 0.3 cm in thickness and 3cm in diameter, with 3 parallel lines on surface A, B, C equally separated by 2.5 mm. They were immersed in $36\pm 1^{\circ}\text{C}$ water bath for setting time plus 3 minutes. Distance between lines A and C were measured with universal measuring microscope at 1, 24, 48, 72, 168 hr time intervals and the values were statistically analysed.

RESULTS: Polyvinyl siloxane was found to be the most accurate and dimensionally stable followed by bis acrylic and bite registration wax.

CONCLUSION: All materials exhibited maximum accuracy and dimensional stability in the initial stages but decreased as the time factor increased. Dimensional stability was influenced by both material and time factors, and difference exhibited by the materials were statistically significant at 1, 24 and 48 hrs.

KEY WORDS: Inter occlusal recording materials, accuracy, dimensional stability, occlusion, articulation.

INTRODUCTION

The fabrication of an immaculate prosthesis requires the articulator to simulate the patient's mandibular movements as closely as possible¹. Mounting casts in an articulator is an important part in the process of making prosthetic works where the quality and accuracy of the interocclusal recording material is crucial². Inter occlusal recording material registers the occlusal relationship between natural or artificial teeth for planning occlusal rehabilitation and for construction of removable and fixed partial dentures. An inaccuracy in the interocclusal arch registration, results in an improper presentation of patients existing maxilla-mandibular relationship, leading to errors in the diagnosis and treatment and occlusal errors in the final prosthesis^{3,4}.

Waxes and poly vinyl siloxanes are the most commonly used interocclusal recording materials in the present scenario. Interocclusal recording materials are basically similar to impression materials, but are modified to give good handling characteristics with the addition of plasticizers, fillers and catalysts. However, whether these modifications in the parent impression materials result in altered properties in accuracy and dimensional stability are unknown. In the above context, the purpose of the present in vitro study was to evaluate and compare the accuracy of wax, acrylic and poly vinyl siloxane interocclusal recording materials to record the inter arch relationships and their dimensional stability as a function of the time.

MATERIALS AND METHODS

Three interocclusal recording materials were investigated. The polyvinyl siloxane material was Imprint bite. The dimethacrylate based material was Luxa bite. The interocclusal recording wax was Aluwax.

The materials used in the study were divided into three groups.

Aluwax Bite registration wax (Aluwax dental product) - Group A

Bis acrylic bite registration paste (Luxabite,DMG) -Group B
Polyvinylsiloxane (Imprint Bite ,ESPE)-Group C.

Aluwax dental wax is a sophisticated composite material which contains powdered aluminum to increase the integrity of the compound and provide the heat retention properties needed for efficient modeling. Luxabite is an automix bite registration material based on bis –acrylates. Imprint Bite is a fast setting addition reaction silicone (poly vinyl siloxane) material used for bite registration.

The test was carried out using a die and mold of ADA specification No. 19 . Die consists of a ruled block made up of stainless steel with 31 mm height and 38 mm diameter. A smaller cylindrical portion (riser) projects from this with 3mm height and 30 mm in diameter. Over this three vertical lines are inscribed which are named A, B ,C with a gap 2.5 mm between them .Two horizontal lines c d and c'd' are also inscribed at a gap of 12.5 mm each from the midline . Mold consists of a cylindrical stainless steel ring 6mm in height and snugly fits to the riser portion of the die .

The individual materials were manipulated according to the manufacturer's instructions. All materials were conditioned at ambient room temperature for at least 24 hr prior to testing. Materials that were supplied in automixing cartridges, Imprint bite and Luxabite were dispensed through the mixing tips attached to the cartridges .

For the wax, the method was modified by submerging it in a 45°C water bath for five minutes using a 5 ml glass syringe. This was done by breaking the wax and putting it in to the syringe before melting.

After homogenous mixing, the bite registration materials were carried to the die and placed in to the mold. The die was inverted on to a 4 x 4 inch square glass plate covered with a polyethylene sheet. Hand pressure was applied for five seconds initially to express the materials, followed by application of a 500 g weight to further remove excess materials. The mold, the stainless steel die and the weight were submerged in a $36 \pm 1^\circ\text{C}$ water bath to simulate oral conditions. Each assembly remained in the bath for the manufacture's suggested minimum setting time plus an additional three minutes to ensure polymerization of the material. For addition silicone and acrylic bite registration paste it was 5 minutes but for bite registration wax it was longer i.e ,about 6 minutes .Upon removal from the water bath, the mold assembly was removed from the stainless steel die .The impression shall be pressed out of the mold using the riser . All the excess material (Flash) was trimmed by using a Bard Parker blade .The specimens were transferred with impression side up, to a flat plate dusted with talcum powder .

A total of 30 samples were made with each group consisting of ten samples.

Specimen were divided into 3 groups

Group A –Specimen made of Aluwax

Group B – Specimen made of Luxabite

Group C – Specimen made of Imprint bite

Specimens were in the form of a disk measuring 0.3 cm in thickness and 3 cm in diameter with three parallel lines on the surface. These three lines were named A, B and C which are equally separated by a distance of 2.5 mm. The reproduction is considered satisfactory when the appropriate line is reproduced continuously for the full 25 mm between cross lines .Observation was made immediately after separation of mold and die, under low angle illumination without magnification.

The distance between the parallel lines A and C was measured using a universal measuring microscope. The magnification used for the measurement was 30X. The distance between the two parallel reference lines A and C was measured at five fixed points. The mean of the five readings was used for calculation for each sample. Readings were recorded for all ten samples of each group at intervals of 1, 24, 48 and 72 hrs and 168hrs.

The mean measurement of the distance AC in each sample was compared to the corresponding measurement of 4708.81 micrometer in the standard stainless steel die measured under the same measuring microscope. The measurements made with the aid of edges of cross lines performed each time in the same way measuring the same distance. All three interocclusal record materials were tested under the same conditions. All the measurements and collection of data were made by the same individual, to ensure accuracy and to eliminate individual variability in the study.

The mean values and the standard deviations of the measurements were computed, associated with different materials and different times under which the study was performed.

The mean percentage dimensional change at various time intervals were calculated as follows:
(Initial reading– final reading) X 100

Initial reading It is a convenient parameter in assessing the level of shrinkage activity for a material at any given time after set. All data was statistically analyzed using SPSS software version 10. For comparison between the groups, ANOVA was done. On getting a p -value $\leq .05$ in ANOVA, a post hoc comparison test namely Turkey test was done, to find out the better group.

TABLE I - Mean and Standard deviation of linear dimensional change in comparison with die at various time intervals.

		Mean dimensional change in%	Std. Deviation	
1HR	Aluwax luxabite Imprint bite	-1.952 .69416 .01869	2.7561 2.5170 3957	2.
24HR	Aluwax luxabite Imprint bite	-1.98237 .58172 .03016	2.5890 2.7481 5381	2.
48HR	Aluwax luxabite Imprint bite	-2.05 .08337 .10461	2.4776 2.8544 4394	2.
72HR	Aluwax luxabite Imprint bite	-2.225 .22648 .01094	2.1732 2.3228 5847	2.
168HR	Aluwax luxabite Imprint bite	2.34 .46251 .08188	2.5992 2.5045 7359	2.

One way ANOVA

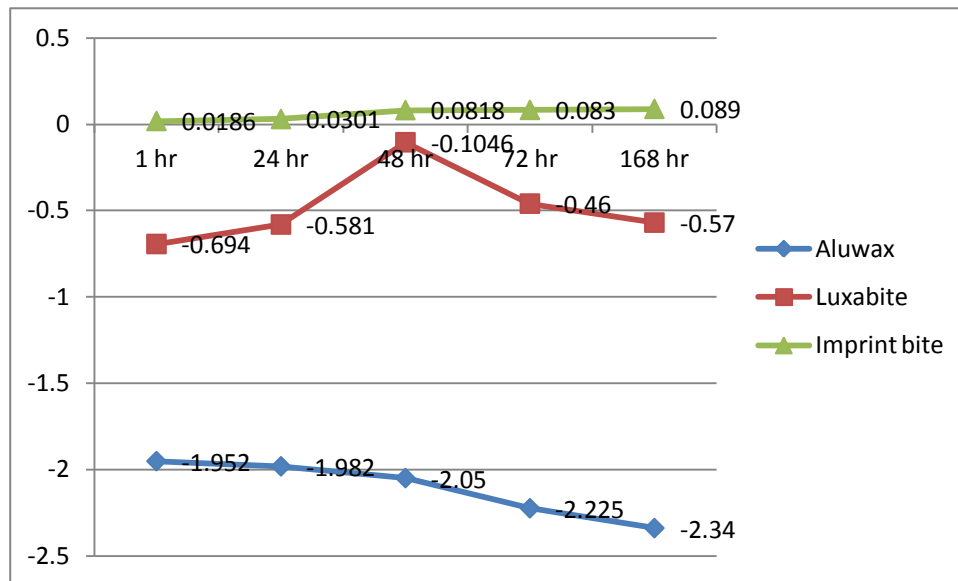
	F	
HR-1	2.86	.38
HR-24	3.126	.045
HR-48	3.428	.023
HR-72	2.389	.078
HR-168	2.158	.102

TABLE 2- One way Analysis of variance comparison

	F value	Probability
1hr	2.86	.038
24hr	3.126	.045
48hr	3.428	.023
72hr	2.389	.078
168 hr	2.158	.103

TABLE - III: Turkey HSD Test for multiple comparisons between groups

		Significance		
		1HR	24 HR	48 HR
ALUWAX	Luxa Bite Imprint Bite	.040 .027	.043 .030	.044 .033
LUXABITE	Aluwax Imprint Bite	.040 .043	.043 .045	.044 .039
IMPRINT BITE	Aluwax Luxa Bite	.027 .043	.030 .045	.033 .039



RESULTS

The mean values of specimen made of Imprint Bite (Group C) showed the maximum accuracy with the master die followed by Luxabite (Group B). Group A specimen made of Aluwax were the least accurate. The mean dimensional changes exhibited by group A specimens were -1.952%, -1.982%, -2.05%, -2.225%, -2.34% respectively at 1 hr, 24 hr, 48 hr, 72 hr and 168 hr respectively.

Group B exhibited mean dimensional changes of -.694%, -.581%, -.1046%, -.46%, -.57% at the same time intervals respectively. Group C had mean dimensional changes of .0186%, .0301%, .0818%, .083%, .089% at the time intervals 1 hr, 24 hr, 48 hr, 72 hr and 168 hrs respectively.

Among the three groups Group C was the most dimensionally stable followed by Group B and Group A. Imprint Bite was clinically found the most accurate, on all the measured intervals of time showing very small dimensional changes from the stainless steel die. There were alternate expansions and contractions in Group C also, but it was quite negligible. The Imprint Bite exhibited the maximum accuracy and dimensional stability over the time, but the stability decreased with the passage of time.

Group A Aluwax showed a constant contraction all through the time intervals and was the least accurate with much % mean dimensional change. Clinically it showed maximum variation from stainless steel die at all intervals of time and mean dimensional change increased progressively through out the measured time intervals in a negative manner indicating significant contraction of the specimen.

Group B Luxa Bite showed an accuracy and dimensional stability in between both other groups. It showed fluctuation in its mean dimensional change at various time intervals, i.e. It showed a contraction at 1 hr, 24 hrs, but it was less when compared to Aluwax. At 48 hrs slight expansion was seen followed by contraction at 72 & at 168 hrs. But every time the mean dimensional change was lower than Aluwax and higher than Imprint Bite. One way ANOVA test was done and at 1 hr the significance was .038, at 24 hrs the significance was .045, at 48 hrs the significance was .023, at 72 hrs the significance was .078 and at 168 hrs the significance was .102.

Since statistical significance was noted for 1 hr, 24 hrs, 48 hrs post hoc comparison Turkey test was performed for comparison between the groups. Statistically significant change was examined between the three groups at all times.

DISCUSSION

The aim of this study was to evaluate and compare accuracy and dimensional stability of 3 inter occlusal recording materials as a function of time. The materials evaluated and compared were Bite registration wax (Aluwax), Bis acrylic bite registration material (Luxabite) and Poly vinyl siloxane bite registration material (Imprint bite).

In the above study Imprint Bite was clinically found the most accurate, on all the measured intervals of time showing very small dimensional changes from the stainless steel die. There were alternate expansions and contractions in poly vinyl siloxane, but it was quite negligible. The Imprint Bite exhibited the maximum accuracy and dimensional stability over the time, but the stability decreased with the passage of time. The percentage dimensional change of

Imprint bite was acceptable according to the limit of .05% suggested by ADA specification no :19 for non aqueous elastomeric impression materials .

Aluwax showed a constant contraction all through the time intervals and was the least accurate with much % mean dimensional change .Clinically it showed maximum variation from stainless steel die at all intervals of time and mean dimensional change increased progressively throughout the measured time intervals in a negative manner indicating significant contraction of the specimen.

Luxa Bite showed an accuracy and dimensional stability in between both other groups. It showed fluctuation in its mean dimensional change at various time intervals, i.e it showed a contraction at 1 hr, 24 hrs, but it was less when compared to Aluwax . At 48 hrs slight expansion was seen followed by contraction at 72 & at 168 hrs . But every time the mean dimensional change was lower than Aluwax and higher than Imprint Bite .

The difference between the three materials were found clinically well evident at all intervals of time. It was statistically significant at 1 hr, 24 hrs and 48 hrs time intervals. Acrylic resins were proved to be dimensionally stable after long term storage and had adequate resistance to closure and high rigidity after setting¹⁰

Elastomers as interocclusal record materials consistently yielded the least error among the materials studied. They are easy to manipulate and do not need a carrier when used in the mouth. They offer little or no resistance to closure, set to a consistency, that makes them easy to trim without distortion, and accurately reproduce tooth details.

A possible limitation of this study is that it takes only the linear measurement as a parameter for determining dimensional stability as in routine clinical situations, while dimensional errors occur in all three dimensions. This maxilla mandibular relationship is not the simple matter of mandibular opening and closing but is a complex relationship which exists in three dimensions. Variations may occur in the vertical, anteroposterior, or mediolateral position.

SUMMARY AND CONCLUSION

Within the limitations of the study, the following conclusion can be drawn:

1. Imprint Bite was found to be the most accurate bite registration material among the three materials checked.
2. Aluwax was found the least accurate among the three, with Luxa bite occupying the mid position in the aspect of accuracy.
3. Imprint Bite exhibited the maximum dimensional stability, followed by Luxabite and Aluwax respectively
4. These findings were both clinically and statistically significant with Imprint Bite showing the minimum mean dimensional change, Aluwax showing the maximum mean dimensional change and Luxabite the mid value .
5. All materials exhibited maximum accuracy and dimensional stability in the initial stages but both the qualities under consideration , decreased as the time factor increased. So best results are obtained when storage time is short.
6. Dimensional stability was influenced by both material and time factors, and difference exhibited by the materials were statistically significant at 1 ,24 and 48 hrs.

Conflict of Interest

This is to certify that I/we –Dr. Arya. S and Dr.Priya Nagar--- do not have any commercial association or financial interest in the publication of this work / contribution. Dr. Arya.S and Dr. Priya Nagar

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