Research Article

An In Vitro Study To Evaluate The Linear Dimensional Stability Of Interocclusal Recording Materials At Various Time Intervals.

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ARTICLE INFO

Background: Since beginning of the era of dentistry various materials routinely used for registration of occlusal relationships. In this research, three polyvinylsiloxane interocclusal recording materials have been compared to previously utilised interocclusal recording materials, such as Aluwax, in terms of linear dimensional change over time. In order to determine the best time for articulation and prevent vertical and horizontal discrepancies in the interocclusal relationships of the casts, it is necessary to evaluate and compare the linear dimensional stability of interocclusal recording materials at different time intervals. Method: An ADA specification No. 19 stainless steel die was made. 20 samples in total were created with each group. At 1, 24, 48, and 72 hrs. intervals, the samples were examined under a stereomicroscope with a 10X magnification. Three readings were taken for each sample, and the mean was used to calculate the linear dimensional change. ANOVA, the Paired T test, and Tukey's post hoc analysis were used to statistically analyse the results. Conclusion: It is required to select a material that takes into account both the clinical condition and the articulation time. The time factor affects the dimensional stability of four interocclusal record materials. As time increases, the dimensional stability decreases.

Keywords: Bite registration material, dimensional change, interocclusal record, linear dimensional change.

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INTRODUCTION:
“An interocclusal record is the registration of the positional relationship of the opposing teeth or the jaws to each other.” (GPT 8) [3]
Interocclusal records are of two types: Centric relation records and Lateral interocclusal records. [4]
In accordance with Warren and Capp, the fundamental primary strategy should be to make the interocclusal record at the appropriate occlusal vertical dimension, use a precise, dimensionally stable recording medium, and choose an adequate mandibular guide technique. [5]
Indirect restorations should be carefully constructed so that their placement in the mouth will be in harmony with the pre-existing stomatognathic system. [6]
That prostheses might be put in the patient's mouth without occlusal adjustment if the appropriate material-technique combination for producing interocclusal recordings were used. [7]
Accuracy in the articulation of the patient's diagnostic or working casts is necessary to establish appropriate occlusion in a dentate or edentulous patient. The exact position of the maxillomandibular joint is recorded in an interocclusal record. Under a variety of circumstances, including handling and storage, it should be able to maintain great precision. [1]
A successful restoration relies greatly on accurately documenting and transmitting existing occlusal records. When the restoration involves the terminal tooth, then an interocclusal record becomes necessary. [3]
For maxilla-mandibular registration techniques, a variety of materials have been utilized, including wax, acrylic resin, zinc oxide eugenol pastes, modelling compound, and plaster. Elastomeric substances like polyether and polyvinylsiloxane are currently used extensively for the same purpose. [8] Although these recording materials essentially resemble impression materials, they have been altered to offer them different handling properties. [9] Although a lot of research has been done on the stability and accuracy of parent impression materials [10], very little has been done on jaw relation registration materials.
The linear dimensional accuracy is also accountable for errors after the material sets and during transfer of the records on the articulator. For the interocclusal recording medium to avoid any inconsistencies between maxillomandibular registration and cast mounting, it becomes a crucial property. [11] The linear dimensional change between commonly used interocclusal recording materials has been compared in this work i.e., Aluwax to newly developed material such as three variants of polyvinylsiloxane materials for interocclusal recordings taken at various times (1, 24, 48, 72 hrs).
MATERIALS AND METHOD
A master die made of stainless steel was created in accordance with ADA specification no 19 (Fig-1). Polyvinylsiloxane and Aluwax (Fig-2) were manipulated according to manufacturer’s instructions and the specimens were prepared at room temperature. A square glass plate measuring 4 x 4 inches that was covered in polyethylene sheet served as the die's covering. In order to force the material out, hand pressure was used for 5 seconds at first, followed by maintaining a weight of 500 g to mimic biting pressure.
The entire assembly, the stainless steel die, and the weight were immersed in a thermostatically controlled water bath set at 36 ± 1°C to mimic ambient temperature. Each assembly was left in the bath for the duration of the material's setting time plus a further three minutes to assure polymerization, if the material was elastomeric. The material was separated from the die by removing the ring after being removed from the water bath. With the use of a Bard Parker knife, the extra flash was cut away. At 28 ± 2°C, room temperature, the samples were kept in a moisture-free polyethylene bag. Three parallel lines with a separation of 2.5 mm were drawn on the surface of the prepared specimens, which had dimensions of 30 mm in diameter and 3 mm in height, these three lines were designated as X, Y, and Z. After that, each material was used to prepare the 20 samples (Figs 3, 4, 5 and 6).
Each sample was measured between the parallel lines X and Z using a stereomicroscope (Fig. 7) at a 10X magnification to determine the linear dimensional stability. Three fixed points were used to calculate the separation between the two parallel reference lines, X and Z. For statistical analysis, the three readings' mean was calculated. Readings were taken at intervals of 1, 24, 48, and 72 hours for each of the 20 samples in each group. Values were measured in mm. The separation between the X and Z lines on stainless steel die was 5
mm. Linear dimensional change were measured by (Distance between X and Z line on stainless steel die) – (Distance between X and Z line on sample) at different time interval.

[Fig-7]: Stereomicroscope

Statistical Analysis

The mean and standard deviation were computed for each measurement for each group. With the help of one-way analysis of variance (ANOVA), paired T tests, and Tukey's post hoc analysis, values obtained in each group were statistically analysed to estimate the probability value (P value). P value of 0.05 was used to determine the statistical significance level.

RESULT

Linear dimensional changes were obtained after testing were analyses with one-way analysis of variance (ANOVA) using statistical software (SPSS version 12 software, SPSS Inc. Chicago, IL) on a personal computer. The means and standard deviation were recorded for each group. Significant differences between the groups were determined using the Tukey post-hoc test.

[Table 1]: Shows comparison of linear dimensional changes in between the Groups and within the Groups by one-way ANOVA.

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>Degree of freedom</th>
<th>Mean sum of square</th>
<th>F value</th>
<th>*P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hr</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Between Groups</td>
<td>0.081</td>
<td>3</td>
<td>0.027</td>
<td>28.295</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Within Groups</td>
<td>0.071</td>
<td>76</td>
<td>0.001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>0.152</td>
<td>79</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1 compares the linear dimensional changes within and across groups using a one-way ANOVA. Mean square was calculated with formula MS=SS/DF. Where SS= sum of square and DF= degree of freedom (n-1).

<table>
<thead>
<tr>
<th>Time</th>
<th>Between Groups</th>
<th>Within Groups</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hrs</td>
<td>0.059</td>
<td>0.079</td>
<td>0.138</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>76</td>
<td>79</td>
</tr>
<tr>
<td>48 hrs</td>
<td>0.022</td>
<td>0.062</td>
<td>0.084</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>76</td>
<td>79</td>
</tr>
<tr>
<td>72 hrs</td>
<td>0.030</td>
<td>0.048</td>
<td>0.078</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>76</td>
<td>79</td>
</tr>
</tbody>
</table>

With this statistical values probability value was calculated which was found significant for one of the four groups.

Table 2: Shows comparison of four Groups with respect to differences in linear dimensional changes at different time interval by Tukey post-hoc test.

<table>
<thead>
<tr>
<th>Dependent variable</th>
<th>Group (I)</th>
<th>Group (J)</th>
<th>P value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 hour</td>
<td>1</td>
<td>2</td>
<td>0.996</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>0.000</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>0.987</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>3</td>
<td>0.000</td>
<td>S</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4</td>
<td>1</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4</td>
<td>0.000</td>
<td>S</td>
</tr>
<tr>
<td>24 hours</td>
<td>1</td>
<td>2</td>
<td>0.933</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>0.000</td>
<td>S</td>
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<tr>
<td></td>
<td></td>
<td>4</td>
<td>0.03</td>
<td>S</td>
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<tr>
<td></td>
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<td>0.000</td>
<td>S</td>
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<tr>
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<td>0.124</td>
<td>NS</td>
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<tr>
<td></td>
<td>3</td>
<td>4</td>
<td>0.000</td>
<td>S</td>
</tr>
<tr>
<td>48 hours</td>
<td>1</td>
<td>2</td>
<td>0.409</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>0.030</td>
<td>S</td>
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<tr>
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<td></td>
<td>4</td>
<td>0.242</td>
<td>NS</td>
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<td>4</td>
<td>0.987</td>
<td>NS</td>
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<td>3</td>
<td>4</td>
<td>0.000</td>
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<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>0.760</td>
<td>NS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>0.000</td>
<td>S</td>
</tr>
</tbody>
</table>
Table 2 shows comparison of four Groups with respect to differences in linear dimensional changes at different time interval by Tukey post-hoc test. Turkey post-hoc procedure for Group-1(Futar-D polyvinyl siloxane) with comparison to other groups at different time interval where group 1 shows statistical significant value only with group 3(jet bite) showing P value <0.05. at 1,48 and 72 hrs while at 24 hrs shows statistical significant value with group 3 and group 4(Aluwax). Procedure for Group-2 (Imprint) shows statistical significant value for group 3 at 1,24 and 48 hrs and significant value with group 3 and 4 at 72 hrs. Procedure for group 3 shows statistical significant value with group 4 at 1 ,24 ,48 and 72 hrs showing <0.05.

DISCUSSION

When planning occlusal rehabilitation and creating removable and fixed partial dentures, interocclusal recording materials play a crucial role in attaining occlusal harmony by recording the occlusal relationship between natural and/or artificial teeth. Making a prosthesis requires an appropriate transfer of the interocclusal relationship to the articulator. Working casts should be mounted with the least amount of pressure possible if interocclusal recording materials are being employed. The record should be as thin as possible, and the best recording medium should compress with the least amount of distortion possible.

In order to mount the casts on the articulator at a convenient time in a clinical setting or to accommodate the transit time needed when transferring them from a clinic to a laboratory, stability of the interocclusal record is generally required. This movement might occur from a village to a town or from a town to a city. In extreme situations, it could even occur across different states or countries.

In accordance with Warren and Capp, the fundamental primary strategy should be to make the interocclusal record at the appropriate occlusal vertical dimension, use a precise, dimensionally stable recording medium, and choose an adequate mandibular guide technique.

In this work, the interocclusal record materials' linear dimensional stability was tracked throughout time. Time intervals were determined by factors such as how long it took to transport the interocclusal record material to a distant laboratory or how long it took for the cast to be articulated in the laboratory. The elastomeric materials utilised for interocclusal recording experience dimensional variations as a result of a number of circumstances. The major factor for dimensional change is the loss of volatile substance i.e., hydrogen gas over time which causes polymerization shrinkage. According to a study by Myerson, there is a connection between weight loss brought on by volatile loss and linear changes in interocclusal recording materials.

At each time interval jet-bite was most found to be dimensionally stable among these four interocclusal recording materials followed by Futar-D and imprint. Aluwax was the least dimensionally stable. Futar-D and imprint were having almost similar linear dimensional changes at above mentioned different time interval.

A good interocclusal record and accurate articulation of the patient's diagnostic or working casts are requirements for the creation of a clinically appropriate prosthesis during the restorative phase of any dental therapy. Working castings with correct articulation require less time to modify the occlusion. The effectiveness of the restoration and the operational cost of therapy are directly impacted by this. Therefore, the insertion of an indirectly produced prosthesis intraorally with the appropriate registration material and procedure would require little occlusal modification.
CONCLUSION

- It is required to select a material that takes into account both the clinical condition and the articulation time.
- The time factor affects the dimensional stability of four interocclusal record materials. As time increases, the dimensional stability decreases.
- When compared to Aluwax, polyvinylsiloxane (Futar-D, Imprint, and Jet-bite) materials are more dimensionally stable. And from these 3 polyvinylsiloxane material Jet bite is more dimensionally stable than Imprint and Futar-D. Futar-D and Imprint are found to have almost similar dimensional stability.
- Polyvinyl siloxane material dimension change is statistically significant at the 5% level.
- Linear dimensional changes in polyvinylsiloxane materials are due to polymerization shrinkage as material loses volatile components as time elapses. And in Aluwax changes in linear dimensions are due to release of internal stresses.
- Aluwax is a reliable material only when it is used within 1 hour as linear dimensional stability decrease as time elapses.
- Jet bite is more dimensionally stable than the other 3 materials and Futar-D has more surface hardness than other 3 materials at 1 hr, 24 hrs, 48 hrs and 72 hrs.

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REFERENCES


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