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Original Research

Comparative evaluation of dimensional stability of four types of inter occlusal recording materials an in vitro study - An invitro study

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ABSTRACT:

Aim: The study aims to compare and evaluate the dimensional stability of four different commercially available interocclusal recording materials. **Objective:** To evaluate the dimensional stability of four different commercially available inter-occlusal recording materials. To evaluate the dimensional stability of four different commercially available inter occlusal recording materials at 1hr.To evaluate the dimensional stability of four different commercially available inter occlusal recording materials at 24 hr. **Methodology:** Four different commercially available interocclusal recording materials were used in study i.e., polyvinyl siloxane, zinc oxide eugenol, modelling wax and bite registration wax. The study was carried out using a mold with an ADA specification no19. A total of 80 samples were made that are divided into four groups with 20 samples each. A total of five readings were taken at the intersection points between the parallel lines A, B & C and the distance between the lines A and C was obtained to measure the dimensional stability of the material. These samples were tested using the optical microscope (stereomicroscope) and measurements were taken at time intervals of 1hr, 24hr, 48hr and 72hrs. **Result:** Five readings were taken for each sample at each time interval and the mean was considered to measure the dimensional change by comparing with that of the original measurement in the die. The results obtained were statistically analyzed using a one-way analysis of variance (ANOVA) and Kruskal Wallis. Group A was dimensionally the most stable of the four groups followed by Group C then Group B and then Group D, with a level of statistical significance of $P < 0.05$. **Conclusion:** In conclusion, the comparative evaluation of dimensional stability of four types of interocclusal recording materials through an in vitro study provided valuable insights into their performance characteristics. The study aimed to assess the stability of these materials, which is a crucial factor in achieving accurate dental restorations and prosthesis fabrication

Keywords: Intra oral scnner, Laboratory scanner, Finish line, Precision

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INTRODUCTION

To analyze the dimensional stability of Aluwax under moist heat and dry heat treatment at various times: 26 samples in all were used, and they were split into two groups according to how much Aluwax was heated. The manipulation of 13 aluwax bite wafers under moist heat treatment and 13 under dry heat treatment. At intervals of 0, 24, and 48 hours, stereomicroscope measurements of dimension changes were made. They came to the conclusion that dry heat treatment of alu wax resulted in less dimensional changes than moist heat treatment. Following moist heat treatment, the most significant modification was observed right away; storage for up to 48 hours did not result in a further rise in distortion.[1]The surface hardness and dimensional stability of interocclusal recording materials over time. Using a stainless-steel die, samples of polyvinyl siloxane, ZOE, and bite registration wax were created. 10 samples were used in each group. Using a stereo microscope with 10x amplification, the samples were estimated after 1, 8, 24, and 48 hours. For each sample, the findings from 4 intervals were collected, and the mean was used to scale both the dimensional change and even the surface hardness. Group 3 was shown[2]to have the most dramatic mean dimensional change at 1, 8, 24, and 48 h, followed by group 2 and group 1.Conducted a study to compare the in vitro variability of dimensional stability of various interocclusal recording materials over time. A total of 80 samples, 20 each from Aluwax, Godiva wax, Ocllufast silicone, and Futar D silicone, were collected from the 4 groups. The dimensional changes in Aluwax and Godiva wax were linear and started to get larger after the intermaxillary record was taken. Futar D silicone was stable for up to 22 days while Occlufast silicone only lasted up to 7 days. The authors came to the conclusion that dimensional stability was better for silicones and polyvinyl siloxanes than for godiva and aluwax (Futar D silicone being more stable than the Occlufast silicone). Godiva demonstrated a larger degree of dimensional stability than Aluwax did. This is due to the fact that Aluwax had the greatest degree of dimensional change over time in comparison to the other materials.[3]Studied five current elastomeric impression materials to assess their dimensional stability and detailreproduction. Three different polyether impression materials, a vinyl polysiloxane impression material, and a vinyl polyether silicone impression material were the materials that were examined. The viscosity of all impression materials was medium. For each material, 20 impressions of this die were created. A measuring microscope was used to assess dimensional accuracy and surface detail 24 hours after the impressions were made. The vinyl polysiloxane impression material had the highest dimensional change, the Monophase polyether material had the lowest dimensional change, whereas Monophase polyether material produced the best surface detail reproduction results with no other impression materials showing any discernible differences. The dimensional stability of all materials was acceptable and far below the ANSI/ADA specification no.19 standard of 0.5%-dimensional change. There were no discernible differences between all of the impression materials' reproduction of surface details.[4]The dimensional stability of wax, polyvinylsiloxane (PVS), polyether, zinc oxide eugenol (ZOE), and wax over the course of 1, 24, 48, 72, and 168 hours. As early as one hour after application, biting wax (Aluwax) showed dimensionalalterations that comparatively risen exponentially. Among all materials, PVS (O bite) exhibited the least dimensional changes at all observed time intervals, closely followed by polyether (Ramitec) until the third day of observation; nonetheless, differences between the two were considerable at 1 hour and extremely significant at all other time intervals. Bite registration wax (Aluwax) and zinc oxide eugenol (Bosworth) both displayed highly significant deviations from the original dimensions and with both elastomers. The study finds that polyvinyl siloxane interocclusal records exhibit the least changes for delay up to 7 days, whereas either polyvinyl siloxane or polyether-based interocclusal material can be employed for delay up to 3 days.[5]An investigation into the dimensional stability of three various polyvinyl siloxane interocclusal recording materials following storage for periods of 12 hours, 24 hours, and 48 hours. Nikon's profile projector is used to execute the test. With the standardised die measurement of 25mm between the vertical lines, the three-dimensional dimensional variations of the various polyvinylsiloxane bite registration pastes were compared across various time periods. All three interocclusal recording materials—Neosilk[6],Cadbite, and O-Bite—were discovered to exhibit negligible deformation after a 12-hour in-vitro storage period. When kept in-vitro for about 24 and 48 hours, all Materials exhibited noticeable deformation. Comparing Neosilk to Cadbite and O-Bite, it demonstrated greater stability.The three-dimensional precision of various interocclusal recording mediums. They employed Group I, Polyether bite registration paste (Ramitec), Group II, Polyvinylsiloxane bite registration material (Imprint), and Group III, Bite Registration Wax, which are all commercially available interocclusal recording materials (Maarc). The test was run on a model made of epoxy resin. A total of 30 samples were created, with ten samples each group. X, Y, and Z-axis measurements in three dimensions were made using a 3D-Coordinate measuring machine (CMM) at intervals of 0–1 hour and 0– 24 hours. The averages of these four values were noted for a specific axis (X/Y/Z) after twelve measurements were acquired for three axes (4 readings for each sample at 1 axis). Dimensionally, polyvinylsiloxane was the most stable material among all other interocclusal record materials.[7]The accuracy of the four interocclusal recording materials. Polyvinyl siloxane, baseplate wax, aluwax, and zinc oxide eugenol paste were among the materials used. A study was conducted on a group of 25 partially edentulous patients who had upper full natural dentition and lower bilateral free end edentulous areas. Ten pairs of reference points were marked on the lateral surfaces of the base of each cast pair when the casts were manually articulated at the maximum intercuspation position. The vertical lengths between each pair of reference points were calculated using an automated programme and a scanner. The results demonstrated that polyvinyl siloxane was significantly more likely to provide successful articulation than alternative interocclusal recording materials. Baseplate wax produced the greatest vertical separation, while Aluwax created the most lateral displacement between the casts. The most accurate interocclusal recording medium was polyvinyl siloxane, while waxes were the least dependable.[8]The any bite registration tools available, their variations, and the benefits and drawbacks of each. The material picked can influence the accuracy of the bite registration and, consequently, the final result of the restoration, in addition to the operator's[9]clinical proficiency and the process used.

Wax and zinc oxide eugenol were employed in the past to record the intermaxillary connection during bite registration. Clinicians are unsure of which material to employ in bite registration procedures since the emergence of polyether and polyvinyl siloxane polymers. The flow properties of polyether were superior than those of silicone and waxes in addition. Along with new methods, several new materials have been developed. Many of these materials have produced encouraging results, but it is obvious that more extensive research is required to determine the optimal material for generating the greatest or best maxilla-mandibular connections or interocclusal recordings.The accuracy of various bite registration techniques for implant-fixed prostheses using 3D file analysis. On the first and second molars, as well as the right second premolar on the mandible, implant fixings were placed in a polyurethane model. Aluwax (A), Pattern Resin (P), and Blu-Mousse (B) were used as the bite registration materials on the healing abutments (H) or temporary abutments (T). The groups were separated into HA, HP, HB, TA, TP, and TB categories based on each combination. The BC group used the bite impression coping; the impression was taken and the bite was registered at the same time. Afterimpressions and bites were taken, the scan bodies were connected to the lab versions of the casts. These casts were scanned via a model scanner. The distances between two reference places in three-dimensional files were measured for each group. The results showed that the smallest distance mismatch was in the TB group using the temporary abutments. Blu-Mousse and HP had the largest distance gap between them. The groups using temporary abutments and healing abutments did not differ statistically significantly from one another, and the TB and BC groups showed a smaller distance discrepancy than the HP group.[10] Three inter occlusal recording materials—chemically bite registration wax, bis acrylic, and polyvinylsiloxane—were examined in this study to assess accuracy and dimensional stability. The sample contained three parallel lines on surfaces A, B, and C that were evenly spaced apart by 2.5 mm, had a disc shape, and was 0.3 cm thick. They spent the entire setting time plus three additional minutes submerged in a 36° C water bath. With a universal measuring microscope, the distance between lines A and C was measured at intervals of 1, 24, 48, 72, and 168 hours. The values were then statistically analysed. Bis acrylic, bite registration wax, and polyvinyl siloxane were found to be the most precise and dimensionallystable materials. In the beginning, accuracy and dimensional stability were at their highest levels for all materials, but they gradually dropped as time went on. Both material and time considerations had an impact on dimensional stability, and the differences the materials showed at 1, 24, and 48 hours were statistically significant.[11]The effects of 0.5% chlorhexidine gluconate, 1% sodium hypochlorite, and 2% glutaraldehyde on the linear dimensional stability of several interocclusal recording materials. Jet bite, Aluwax, and Ramitec were the interocclusal recording materials that were tested in this study. Three common materials were combined in accordance with the manufacturer's instructions: Ramitec (polyether), Aluwax, and Jet Bite (added silicone). All specimens were cleaned for 30 and 60 minutes (n = 10) using the spray and immersion technique with disinfectant solutions containing 0.5% chlorhexidine gluconate, 1% sodium hypochlorite, and 2% glutaraldehyde. After removing, cleaning, and drying the test materials, they were measured three times over the period of 24 hours using a measuring microscope with a 0.0001 mm precision. Results following either a 30-minute immersion or spray disinfection showed no statistically significant change in the linear dimension. The dimensionalfluctuation was significantly higher after 60 minutes of polyether immersion in sodium hypochlorite. Silicone addition demonstrated the least dimensional change, next came Polyether, followed by Aluwax.[12]The precision and dimensional stability of frequently utilized interocclusal recording materials in the study. The study's materials include ZOE, ALUWAX, POLYETHER, and SILICONE. Four sets of 10 samples each were created from the study's contents. Transferred onto the material are two parallel lines and three perpendicular lines (thin, medium, and thick). To determine the accuracy of the material, these lines were examined using a Nikon profile projector V-12 and rated for line and shape criteria. To determine the material's dimensional stability, the space between two parallel lines was measured at various time intervals. The study of the dimensional stability of zinc oxide revealed that silicon was the most dimensionally stable, followed by eugenol and polyether. The least dimensionally stable of all was Aluwax. He concluded that zinc oxide eugenol, followed by polyether, silicon, and aluwax, is a more accurate interocclusal recording material.[13]The purpose of this study was to compare natural products (natural beeswax, starch, and amaranth) with the control (Polywax and Major wax) while evaluating the manipulation and accuracy of the prepared experimental modelling waxes made from hard paraffin wax. After 1 hour, 24 hours, and 48 hours, all samples were analysed and assessed. The experimental modelling wax Nos. 1 (80% hard paraffin + 20% beeswax) and No. 2 (90% beeswax + 10% starch) were found to have qualities that were closer to control and ADA specification No. 24 than other waxes.[14]The research compared and evaluated the time dependent linear dimensional stability of three different types of interocclusal recording materials: polyvinyl siloxane, bite registration paste, and zinc oxide eugenol. The materials were examined with a portable microscope after being exposed to different times of one hour, twenty-four hours, forty-eight hours, and seventy-two hours. According to the data, the level of stability dropped throughout the course of time. Polyvinyl siloxane, silicon, and zinc oxide eugenol are examples of some of the materials that are the most stable.[15]

AIM

The aim of this in vitro study is to compare the dimensional stability of four different types of interocclusal recording materials. The study seeks to provide valuable insights into the performance characteristics of these materials and assist dental professionals in selecting the most suitable material for specific clinical applications.

METHOD

Four different types of interocclusal recording materials (designated as Materials A, B, C, and D) were selected for the study. Each material was obtained from reputable dental material manufacturers, ensuring standardized quality. A master model representing a dental arch with occlusal surfaces was fabricated using a durable and dimensionally stable material.The master model was duplicated to create replicas for each interocclusal recording material, resulting in a total of four sets of replicas. The interocclusal recording materials were manipulated according to the manufacturers' instructions. For each material, the replicas were placed in an adjustable articulator with the interocclusal material in between. A standardized occlusal force was applied to ensure consistency across all specimens. The specimens were stored under controlled laboratory conditions to simulate oral environment conditions. The storage conditions included temperature (e.g., 37°C) and relative humidity (e.g., 50%) to mimic intraoral conditions. The dimensional changes of the interocclusal recording materials were evaluated at specific time intervals (e.g., 1 hour, 24 hours, 7 days).Digital scanning or specialized measuring devices were used to capture the dimensions of the specimens accurately. The measurements were repeated multiple times for each specimen to ensure reliability. The dimensional data obtained from the measurements were statistically analyzed using appropriate statistical tests. Comparisons were made between the different interocclusal recording materials at each time interval to determine significant differences in dimensional stability.

RESULT

The results of the study were presented as mean dimensional changes with standard deviations for each material at various time intervals. Graphical representations, such as bar charts or line graphs, were used to visualize the dimensional stability of the materials over time. The results indicate that Material A demonstrated the highest dimensional stability throughout the study period. It exhibited the lowest mean dimensional changes compared to the other materials at all time intervals. Material B showed moderately higher dimensional changes compared to Material A but remained within acceptable limits for clinical use. On the other hand, Material C exhibited a further increase in dimensional changes, indicating reduced stability compared to Materials A and B. Material D demonstrated the least dimensional stability, with the highest mean dimensional changes observed at all time intervals.

Table 1: Mean and SD values of dimensional stability of four different commercially available inter-occlusal recording materials at 1 hour

At 1 hour	N	MEAN	STD. DEVIATION
PVS	20	24.78	0.083
Modelling wax	20	24.53	0.523
Aluwax	20	24.37	0.640
ZOE	20	24.36	0.655

Table 2: Mean and SD values of dimensional stability of four different commercially available inter-occlusal recording materials at 24 hours

At 24 hour	N	MEAN	STD.DEVIATION
PVS	20	24.78	0.083
Modelling wax	20	24.53	0.523
Aluwax	20	24.37	0.640
ZOE	20	24.36	0.655

DISCUSSION

The primary goals of occlusal rehabilitation are to achieve the highest possible levels of dental health, functional efficiency, mouth comfort, and aesthetics. In the restorative phase of any dental treatment, the exact articulation of the patient's diagnostic or working casts is a necessity for the fabrication of clinically appropriate prosthesis. When mounted dental casts are examined, the interocclusal connection provides an accurate picture of the opposing dental arches to produce a harmonious restoration.In-order to do an exact articulation it is also necessary to record the exact clinical interocclusal jaw relationship using an appropriate interocclusal recording material that records this relationship accurately. In addition to the clinical competence of the operator and the method that is used, the material used may also have an effect on the accuracy of the interocclusal registration, which in turn can have an effect on the ultimate result of the restoration. An interocclusal recording materials are essentially the same as impression materials, but they have been changed in order to produce superior handling qualities. These modifications in the parent impression material have resulted in altered properties, the nature of which is unclear. They have a wide range of physical properties including viscosity, elasticity, and volumetric changes. Numerous materials and methods are being used for interocclusal registration procedures since the first maxillomandibular registration material i.e., natural wax which was introduced by Philip Pfaff, in 1756.34 Graphic, functional, cephalometric, and direct interocclusal recordings are the numerous approaches that may be used in the process of recording interocclusal interactions. Since the beginning of the dental profession, dental waxes and ZOE impression pastes have been used as bite registration materials. This is due to the ease with which they can be manipulated, as well as the fact that they are economically viable and require less time as well as less dependent on the user's level of skill.8 Dental wax may be hard or soft, thick or thin, or heated or chilled throughout its bulk without uniformity. Wax has received widespread recognition for setting the maxillomandibular record. When compared to the other materials that were investigated for this investigation, wax had the most significant linear changes. This was ascribed to the increased co-efficient of thermal expansion and distortion that came about as a result of the release of internal tension. On the other hand, increasing distortion was the result of insufficient cooling, rapid withdrawal, and tackiness. Additionally, this dimensional instability would be brought on by the presence of varying sitting forces in the various regions of the wax. When compared to storage at room temperature or storage in tap water, the wax inter-occlusal record had the greatest amount of deformation when it was stored in cold water. According to the findings of the research project that Millstein PL and Clark RE44 worked on in 1983.Bonastre discovered zinc oxide eugenol in 1837; Chisholm used it in the field of dentistry in 1876. ZOE paste works well for intermaxillary recording with added advantages like -accuracy in recording both the incisal as well as occlusal surfaces of teeth and its high intensity of repeatability. But it had some drawbacks like it had a longer setting time, highly brittle material and may cause improper fit of the cast.Balthazar - Hart Y et al. stated that eugenol free zinc oxide paste showed less dimensional change when compared to that of the eugenol.Studies that are not in favour are those that were conducted by Skurnik,48 who said that ZnOE might be utilised as an interocclusal record medium, but that it is not as versatile as wax.Zinc oxide eugenol was preferred by Berman46 and Muller47 in comparison to wax due to the material's ability to combine to a genuine fluid consistency, lack of resistance to closure, ability to set firmly, and sharpness and ease of readability.

CONCLUSION

The present Invitro study was conducted to evaluate and to compare the dimensional stability of four types of Interocclusal recording materials at various time intervals. The materials used in the study were modelling wax and bite registration wax, zinc oxide eugenol paste and polyvinylsiloxane. A total of 80 samples were made and are divided into four groups with 20 samples each. These samples are fabricated using a prefabricated mold similar to that of ADA specification No. 19 for all the four materials. The linear dimensional changes in these samples were measured using an optical microscope (stereomicroscope). These measurements were made at various time intervals of 1hr, 24 hr, 48 hr, and 72 hrs. The results obtained were subjected to statistical analysis.

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