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EVALUATION OF THE ACCURACY OF INTEROCCLUSAL BITE REGISTRATION RECORDS: A CLINICAL TRIAL

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ABSTRACT:

Aim: This study addresses the crucial aspect of interocclusal bite registration records in dentistry, where precision is paramount for successful prosthetic outcomes. The background highlights the historical reliance on traditional plaster models and the persistent challenges of distortion during impression-taking. The objective is to explore the mechanical properties, specifically elasticity, of two materials – Dental Avue; AvueBite (addition silicone) and Aluwax (wax).

Materials and methods: This study design, parameters, and outcomes were assessed by the Institutional Review Board at Saveetha Dental College (IHEC/SDC/PROSTHO-2102/23/245) keeping in mind the ethics and the universal code. A sample size was evaluated using the GPower Software (version 3.1.9) and the sample size was fixed at 25(1). Those patients were selected who required a fixed dental prosthesis as their final restoration. The inclusion criteria of this study would be key in determining the accuracy of the bite registration materials. The methods involve assessing a sample size at Saveetha Dental College and measuring intra-oral and extraoral distances from preparation to antagonist scans using the mentioned materials.

Results: Statistical analysis, employing an independent sample t-test, indicates no significant differences between AvueBite and Aluwax, suggesting their comparable accuracy in capturing intricate occlusal details. There was no absolute difference in intra-oral distance from preparation to mesial and distal antagonist between the two groups. Extraoral distance from preparation to mesial and distal antagonist scan showed slight difference compared between the two groups but was statistically insignificant.

Conclusion: The conclusion emphasizes the study's alignment with existing literature, underlining the critical role of accurate bite registrations, and provides valuable guidance for clinicians in material selection, highlighting the reliability of both AvueBite and Aluwax in achieving precise occlusal capture during restorative procedures.

Keywords: Interocclusal records; addition silicone; Dental Avue AvueBite; Aluwax; prosthetic rehabilitation; accuracy.

1. INTRODUCTION

In the intricate realm of dentistry, where precision at the millimeter level determines success, the meticulous capture of the upper and lower jaw relationship assumes paramount importance (2,3). The unassuming yet indispensable tool in this endeavor is the interocclusal bite registration record, silently guiding diagnoses, treatment plans, and the intricate dance of prosthetic fabrication (4). For decades, the venerable plaster model has reigned supreme, faithfully translating the intricate topography of teeth into tangible replicas. The primary goal of this record is achieving horizontal stability, preventing unwanted movements of the mounted casts.

The traditional plaster model, a stalwart in countless restorations, thrives on its simplicity and familiarity. As a trusted ally, it adeptly conforms to the nuances of teeth, capturing undercuts and cuspal ridges with meticulous detail. Its tactile nature allows for immediate verification of fit, providing clinicians with a tangible sense of the occlusal landscape. However, its journey from mouth to model is challenging. Distortion looms at every step, from impression materials prone to shrinkage to the delicate pouring process. Other potential risks include handling and storage, which may lead to inaccuracies that could impact the final record (5,6).

Correctly registered bites are essential for proper restorative dentistry. Both dental waxes and A silicones have their advantages and disadvantages. The optimal substance sets with little resistance, maintains dimensions after hardening, and carefully captures tooth surfaces (7,8). Moreover, it must be simple to handle, biodegradable, and easily testable. The careful consideration of these factors can aid dentists in ensuring accurate and correct records of interocclusal areas, thereby avoiding costly corrections at a later stage (9,10).

In recent years, polyethers and A silicones have become increasingly popular due to their ease of use, accuracy, and dimensional stability. These compounds are highly regarded in the cosmetic industry. Despite research exploring their stability and accuracy, certain properties such as elasticity are still not fully understood (7,11). This study delves into the elasticity and other mechanical properties of addition silicones and dental waxes. By shedding light on their strengths and weaknesses, this research aims to equip clinicians with the knowledge to choose the optimal material for capturing precise occlusal details in everyday practice.

2. MATERIALS AND METHODS

Study Design and Patients

This study design, parameters, and outcomes were assessed by the Institutional Review Board at Saveetha Dental College (**IHEC/SDC/PROSTHO-2102/23/245**) keeping in mind the ethics and the universal code. A sample size was evaluated using the GPower Software (version 3.1.9) and the sample size was fixed at 25(1). Those patients were selected who required a fixed dental prosthesis as their final restoration. The inclusion criteria of this study would be key in determining the accuracy of the bite registration materials. The inclusion criteria was as follows:

- Healthy abutment teeth which could receive a prosthesis.
- Teeth not indicated for extraction.
- Patients with canine guided or mutually protected occlusion.
- No systemic conditions which do not permit dental intervention.
- Patients who can follow instructions related to maintenance.
- Patients who have agreed to the requirements of the study.
- Patient with no parafunctional habits.

A 1.5–2 mm occlusal reduction with a chamfer or shoulder margins based on the prosthesis and a 6–10 degree convergence was attained. Most significantly, the line angles were properly rounded off and smoothed. Following preparation, a cord packer (Hu Friedy) was used to pack two retractable cords (SURE-Cord) in sizes 000 and 0. Double cord packing was performed for gingival retraction (12). Prior to packing, the cords were immersed in a Prevest Hemostat hemostat. The impression was made only after the field had dried and the bleeding had stopped. First, the upper cord was removed. Next, a second silicone impression was created with a light body and putty. After the impression had fully set, it was taken out. A 360-degree flash around the prepared abutment tooth is examined in order to evaluate it. Prosthesis options available for the patient included monolithic zirconia, metal ceramic or veneered all ceramic. After preparation, two distances were measured using a digital caliper. The first distance measured was from the mesial abutment to the antagonist and the second was measured from the distal abutment to the antagonist. (Figure 1)



Figure 1: Preparation and final impression.

Interocclusal records were made using two materials; bite registration paste consisting of addition silicone (Dental Avue; AvueBite) and Aluwax (USA). The first record was made using addition silicone. The patient was asked to occlude in the maximum intercuspation position after which the bite paste was injected using a dispensing gun around the abutment teeth and in the space between the opposing arch. It was allowed to set as per the manufacturer's instructions till it formed a firm record with indentations of the opposing arch. Excess material was then cut off and indentations were left. A second bite registration was recorded for the

patient using Aluwax. Water was heated in an electric kettle and then poured into a rubber bowl. A piece of wax was then broken, tempered in the water, and then placed in the patient's mouth. The patient was told to bite in the maximum intercuspation position allowing the wax to set. Once set, it was retrieved and stored in a cool dry container to prevent any distortion. (Figure 2)



Figure 2: Aluwax and AvueBite.

The master impressions were poured using Type IV die stone (Zhermack) and allowed to set. Once fully set, they were retrieved and the excess was trimmed. The casts were articulated and mounted using a semi adjustable articulator (Whipmix, USA) first with the bite registration paste. These articulated casts were then scanned using the 3Shape E4 laboratory scanner (3Shape, Copenhagen, Denmark). The scans were then exported and saved. The cast were then broken off from the mounting plates and remounted this time using the interocclusal record with wax. Once the articulation was completed for the second time, similar protocol was followed till the scans were taken. An order form was then created for the fixed dental prosthesis using the Exocad 3.0 software. The distance was then measured between the mesial preparation and the antagonist and the distal preparation and the antagonist. A fixed point was taken for the measurement in all the cases to prevent any discrepancy of the values. (Figure 3)

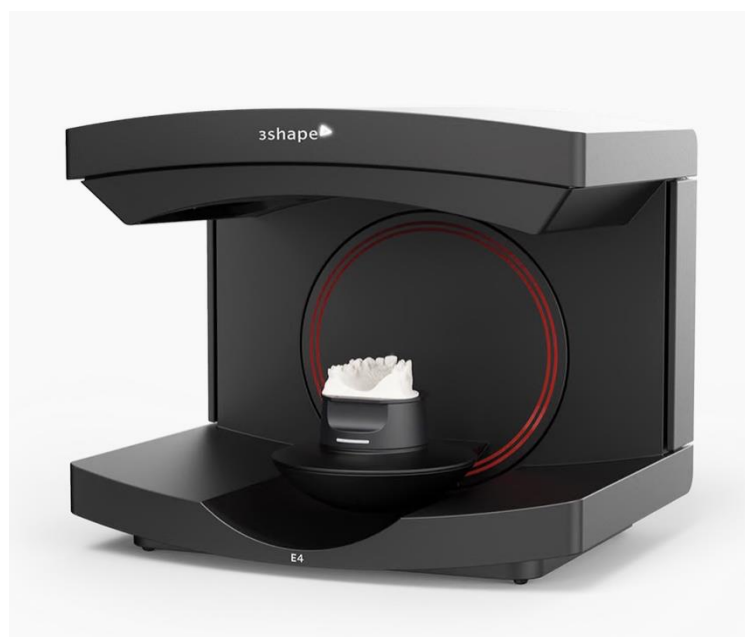


Figure 3: 3shape E4 Scanner.

Statistical analysis

Descriptive and analytical statistics were done using SPSS (Statistical Package for Social Sciences) Version 24.0 (IBM Corporation, Chicago, USA). The t-test was calculated using three fundamental data values. The level of significance was $p < 0.05$.

3. RESULTS

Descriptive and analytical statistics were done. The data is represented in mean and standard deviation. The normality of data was analyzed by the Shapiro-Wilk test. As the data followed normal distribution the parametric tests were used to analyze the data. The independent sample t-test was used to check mean differences among the groups. The t-test was calculated using three fundamental data values including the difference between the mean values from each data set, the standard deviation of each group, and the number of data values. The level of significance was kept at $p < 0.05$.

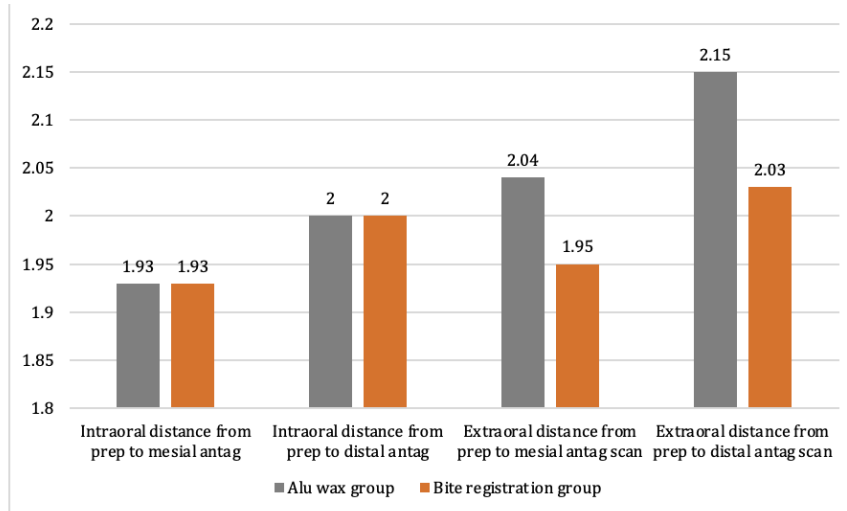
Time line	Group	N	Mean	S.D	S.E	M.D	95% C.I	t-value	P-Value [#]
Intraoral Distance from	AW	16	1.93	0.16	0.04	0.00	-0.12-0.12	0.000	1.000
Prep to mesial antag	BR	16	1.93	0.16	0.04				
Intraoral Distance from	AW	16	2:00	0.23	0.05	0.00	-0.17-0.17	0.000	1.000
Prep to mesial antag	BR	16	2:00	0.23	0.05				
Extraoral Distance from	AW	16	2.04	0.17	0.04	0.08	-0.02-0.20	1.536	0.135
Prep to mesial antag scan	BR	16	1.95	0.15	0.03				
Extraoral distance from	AW	16	2.15	0.22	0.05	0.11	-0.04-0.27	1.434	0.162
Prep to distal antag scan	BR	16	2.03	0.22	0.05				

AW – Alu wax group; BR – Bite registration group; [#]P-value derived from independent t-test

Table 1: AW – Alu wax group; BR – Bite registration group; [#]P-value derived from independent t-test

Intra-oral distance from preparation to mesial and distal antagonist and extraoral distance from preparation to mesial and distal antagonist scan were compared between the two groups. None of the comparisons done with independent sample t-test were found to be

statistically significant ($p > 0.05$) between alu wax group and bite registration group. There was No absolute difference in intra-oral distance from preprationration to mesial and distal antagonist between the two groups. Extraoral distance from preprationration to mesial and distal antagonist scan showed slight difference compared between the two groups but was statistically insignificant.



Graph 1: Comparison of intra-oral distance from preprationration to mesial and distal antagonist and extraoral distance from preprationration to mesial and distal antagonist scan between the two groups.

Graph 1 Shows the Comparison of intra-oral distance from preprationration to mesial and distal antagonist and extraoral distance from preprationration to mesial and distal antagonist scan between the two groups.

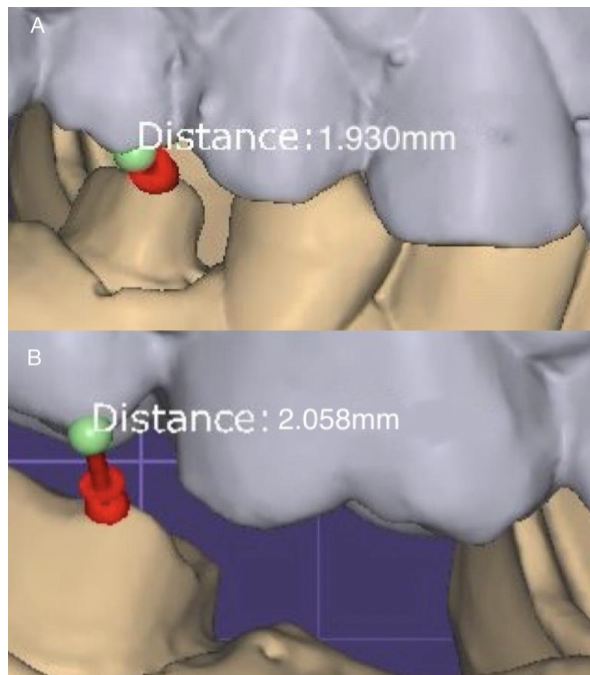


Figure 4: Measuring intraoral distances using Bite registration paste AvueBite.

A- measurement from the mesial antagonist. B- measurement from the distal antagonist.

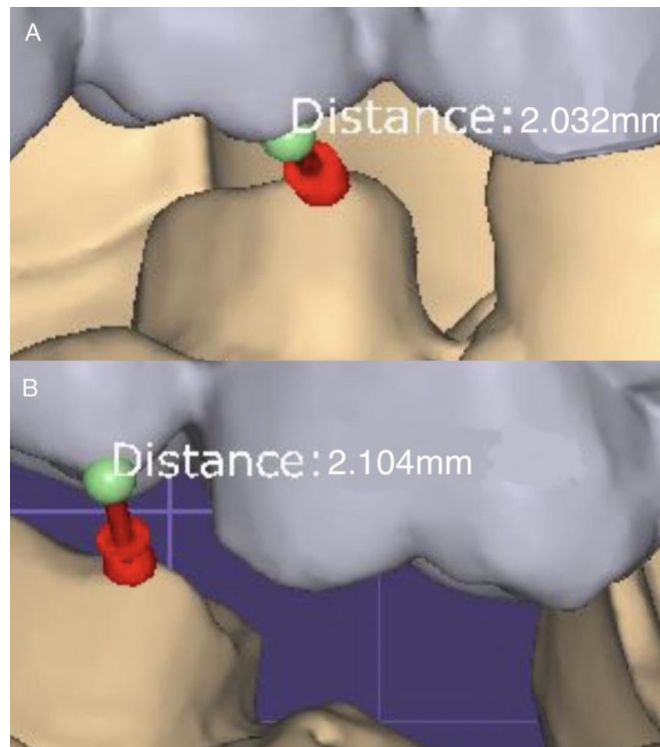


Figure 5: Measuring intraoral distances using Aluwax.

A- measurement from the mesial antagonist B- measurement from the distal antagonist.

4. DISCUSSION

Choosing the right bite registration material is critical for successful restorative dentistry (13). This study delved into the complex world of occlusal record accuracy, specifically by comparing Dental Avue AvueBite, a modern addition silicone paste, and Aluwax, a traditional material, for capturing crucial oral and external distances. Our primary goal was to assess the strengths and weaknesses of these two materials, given their key role in achieving precise jaw relationships for restorations. We aimed to provide clinicians with valuable insights to guide their material selection for optimal occlusal capture. (Figure 4 and 5)

Statistical analysis, using an independent sample t-test, revealed no significant differences ($p < 0.05$) between Aluwax and Dental Avue AvueBite when comparing both intra-oral and external distances from the preparation to antagonist scans. This suggests that despite their material and handling differences, both performed similarly in capturing intricate occlusal details. This non-significance signifies the reliability of both materials for capturing intra-oral distances, highlighting their potential interchangeability in some clinical scenarios. While a slight difference emerged between the two groups for external distances, it did not reach statistical significance. This minor variation might be attributed to material properties, handling, or application techniques. Again, the overall insignificance underscores the comparable accuracy of both materials in capturing external dimensions.

To contextualize these findings, a look at the relevant literature might prove to be helpful. A review article highlights accurate bite registrations are crucial for achieving precise centric relation records, ensuring stable cast mounting, and ultimately, successful restorative treatments(14). The choice of material becomes paramount given the various options available, each with its advantages and limitations. Historically, materials like plaster, modeling compound, and wax were employed, but advancements have introduced elastomers like

addition silicones, known for their dimensional stability and accurate occlusal detail reproduction (10).

Another article emphasizes the importance of material and technique selection in prosthetic rehabilitation. Despite criticisms, wax remains popular due to its ease of use, versatility, and cost-effectiveness. Combinations with other materials like zinc oxide eugenol and acrylic resin are explored to address potential error concerns (15). Pagnano et al., 2005 underscore the critical role of accurate diagnosis, planning, and execution in this field. Their study, focusing on horizontal and vertical stability with condensation silicone, reinforces the need for careful material selection based on individual clinical scenarios (16).

Anup et al. 2011 shed light on factors influencing the accuracy of interocclusal recording materials. They investigate linear dimensional change, accuracy, and surface hardness over time, finding polyvinylsiloxane to be the most accurate, followed by zinc oxide eugenol and Aluwax. Their results also show how material properties like thermal expansion coefficient impact dimensional changes (17).

Investigation into a modified polyether/epoxy resin approach highlights the ongoing pursuit of absolute accuracy in interocclusal records (18). Their conclusion – that complete elimination of inaccuracies remains elusive – resonates with our observed lack of significant differences between the two materials. This suggests that while both materials perform admirably, achieving perfect accuracy might require further technical advancements. Moving beyond accuracy, an investigation conducted by Karani et al. 2018 highlights the compressive resistance of interocclusal record materials (19). While our study focused on different aspects, it contributes to the broader understanding of material properties, which are crucial for informed material selection. Knowing how materials respond to pressure can guide dentists toward choices that ensure both accurate records and desirable physical characteristics. An article by Ranjith et al brings tear resistance to the forefront, displaying another important material property for interocclusal records (20). Although not directly assessed in our study, their findings resonate with the emphasis on material stability and accuracy. Materials that resist tearing, like AvueBite and Aluwax, are likely to maintain their integrity during the impression-taking process, contributing to reliable records.

In addition, there is an article that discusses the difficulties of selecting superior alternatives. Various mechanical properties are evaluated in the study using addition silicones and other elastomers for accurate reproduction of intraoral conditions. The researchers conclude that these findings are promising. They provide valuable information on the appropriateness of different silicone materials for clinical use by analyzing elastic modulus, ultimate tensile strength, and ultimate induction (7).

Our research provides significant insight into the debate on selecting the appropriate bite registration material. We demonstrate that both traditional materials like Aluwax and modern silicones like AvueBite offer similar accuracy for capturing oral and external distances. This suggests that there are no statistically significant differences between materials, indicating that clinician preference, patient-specific factors, and procedural requirements may all have an impact on selecting one.

We acknowledge this study's limitations, including the sample size and specific clinical scenarios investigated. These findings could be further validated and generalized through a more extensive examination of cases and conditions in future research. Nevertheless, this research provides valuable insights into the intricate domain of occlusal record accuracy, indicating that Aluwax and AvueBite can serve as effective means for capturing occlusals with precision during restorative procedures.

5. CONCLUSION

This investigation offers valuable insights into the world of interocclusal record accuracy, empowering clinicians with a nuanced understanding of material choices and their implications. It could be noted that both these materials selected could be By integrating findings from existing literature, we emphasize the need for a tailored approach in selecting interocclusal recording materials for optimal outcomes in prosthetic rehabilitation.

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Conflict of Interest

The authors state that there is no conflict of interest.

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