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Original Article

Comparison of Polyether vs. Wax Occlusal Registration Materials for Evaluating Occlusal Reduction Accuracy

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ABSTRACT

Objective: To compare and evaluate the reliability of the occlusal registration wax with poly-ether bite registration material as a guide for occlusal reduction required during tooth preparations.

Study Design: Comparative cross sectional study.

Place and Duration of Study: Armed Forces Institute of Dentistry, Combined Military Hospital, Rawalpindi Pakistan, from July to Dec 2024.

Methodology: This study included 30 abutment teeth requiring tooth preparation for fixed prostheses, and the necessary preparations were performed. Modeling wax strips of specified dimensions were placed onto the cast of the prepared tooth, which was mounted in maximum intercuspation on the articulator before closing it. The thickness of the wax registration was measured at three zones: two functional cusps and the central fossa. Similar measurements were taken using the poly-ether bite registration material and prosthesis at the same zones. The collected data were then tabulated and analyzed statistically using the ANOVA test.

Results: Out of 30 patients, 79.2% were male and 20.8% female. The study compared the thickness of Wax, Polyether, and Prosthesis across three zones. Although no statistically significant differences were found (p=0.738), Polyether had mean values closest to the prepared tooth, indicating more accurate results than Wax. Pairwise comparisons showed the smallest mean difference between Polyether and Prosthesis, suggesting similar thickness to the prepared tooth.

Conclusion: The analysis indicated that poly-ether bite registration material is more suitable than commonly used modeling wax during tooth preparation.

Keywords: Occlusal Reduction, Occlusal Registration Material, Occlusal Registration Wax, Poly-Ether Bite Registration Material.

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INTRODUCTION

The occlusal reduction of abutment teeth is a critical step of tooth preparation for fixed restorations, aiming to conserve tooth structure while ensuring adequate occlusal morphology. Proper occlusal reduction is essential for longevity and success of restoration. A study analyzing crown preparations found that 47.3% exhibited inadequate occlusal clearance.[1] An insufficient reduction, i.e. less than 1.5mm, can lead to restoration failure of up to 30% due to inadequate material thickness,[2] while excessive reduction may compromise prosthesis retention and pulp vitality in about 20 % of cases.[3,4]

Techniques for assessing occlusal reduction are essential for ensuring adequate space for restorative materials while minimizing excessive tooth reduction. Common methods include blotting paper and clearance tabs, which provide a visual indication of clearance but may be inaccurate if the patient does not fully occlude.[5] Modified articulating paper with parallel cuts improves accuracy by better identifying areas requiring adjustment.[6] Additionally, chair-side tooth reduction guides are particularly useful for challenging areas like lingual surfaces of molars, where visibility is limited.[7]

The periodontal probe can also be used to assess occlusal reduction by placing it over occluded wax. This method may be difficult in posterior regions due to limited visibility and access.[8] Calipers can measure wax thickness but may lead to inaccuracies if used improperly. Untrained users might distort the wax record, compromising the measurement's reliability.9 Another method combines pre-measured wax thickness with articulating paper to identify under-reduced areas. However, it does not provide precise information on the actual amount of reduction achieved.[7] The previously mentioned methods all present some limitations in terms of accuracy, accessibility, or complexity.

There is a lack of literature regarding the choice of material for occlusal reduction assessment in local setup. The rationale of this study is to compare the

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accuracy of the most commonly used occlusal registration wax with that of poly-ether bite registration material as a guide for determining occlusal clearance during tooth preparation. This comparison aims to enhance the success rate of the procedure and minimize intra-operative complications, such as extensive chair-side adjustments.

METHODOLOGY

This Comparative cross sectional study conducted after receiving ethical approval from the Ethical Committee of the Armed Forces Institute of Dentistry (IRB Form No. 905/Trg-ABP 1K2) from 1st July 2024 to 30th December 2024. A sample size of 29 was calculated using the WHO sample size calculator based on the 98.2% crown preparation, a 95% confidence level, and a 5% margin of error. However, data were collected from 30 patients using a consecutive sampling technique.

Inclusion Criteria: The inclusion criteria for this study consisted of patients requiring posterior full coverage fixed partial dentures, with abutment teeth that exhibited good anatomical contours. Additionally, only patients with unrestored opposing natural teeth against the teeth to be prepared were selected, ensuring that the maximum intercuspation position can be reliably and consistently reproduced.

Exclusion Criteria: The study excluded patients with poor neuromuscular control, severe dental attrition, significantly malaligned teeth, or supraerupted opposing teeth.

Informed written consent from the patients was obtained. Demographic details, including name, age, gender, and contact information, were collected using data collection forms. Following a thorough history and clinical examination, patients were selected based on the inclusion criteria. Basic principles of tooth preparation were adhered to during all tooth reductions. Impressions were made using polyvinyl siloxane impression material (Deli-Bite) and casts were poured in Type-IV dental stone (Elite Stone) according to the manufacturer's instructions.

The maxillary cast was securely mounted on a semi-adjustable articulator (Bioart A7 plus articulator) Two strips of modeling wax (Metro wax) were uniformly softened in a water bath at 45°C and then layered on top of each other before being placed onto the cast of the prepared tooth mounted on the articulator. Once the wax cooled and hardened to room temperature, the articulator was opened, and the wax record was carefully removed. The thickness of the wax registration was then measured at three zones: the two functional cusps (mesial and distal, designated as zone I and zone II) and the central fossa (zone III), using a wax measuring gauge (round ended Dental Iwanson Guage). The same procedure was repeated with the DELI-BITE poly-ether occlusal registration material.

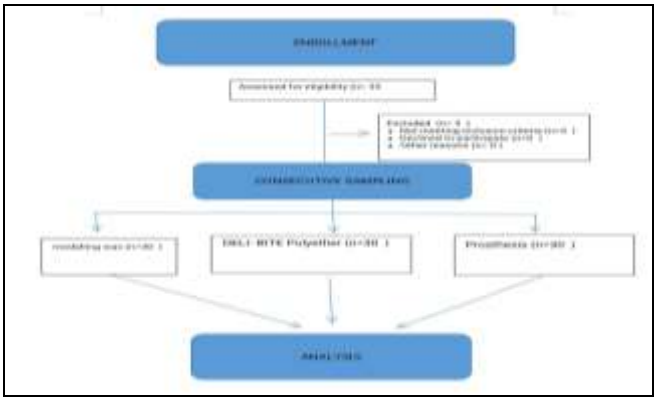


Figure 1: Patient Flow Diagram

For occlusal registration material (Deli-Bite) the cartridge was loaded into the dispensing gun, and after purging a small amount to ensure even flow, a disposable mixing tip was attached. As the trigger was pressed, the components were automatically mixed within the tip, producing a homogeneous paste that can be applied directly onto the occlusal surfaces, mounted on the articulator, and the articulator was closed. After the material was set, it was removed and the thickness of the material at three different already selected zones was measured as shown in Figure-2.



Figure 2: Thickness measurement of wax record and prosthesis using Essago SBC instruments; wax and polyether with round-ended caliper, prosthesis with sharp-ended gauge.

Conventional protocol was followed in laboratory procedures, and prosthesis is obtained for cementation. The prosthesis was then be seated on the cast, mounted on the articulator and the intercuspation was adjusted and checked by the central pin contact to the incisal guide table. The thickness of the prosthesis was then be measured in the above mentioned three selected zones and such measurements were repeated 3 times for standardization.

Data was entered and analyzed on Statistical Package for Social Sciences version 28:00. Data (thickness of wax, polyether and prosthesis at three zones; zone-I, zone-II, zone III) was normal according to the applied normality test, the Shapiro-Wilk test. Frequency and percentage were calculated for the gender distribution of study sample and mean and standard deviations were calculated for the thickness of wax, polyether and prosthesis. Repeated measure ANOVA was applied to find the mean and pairwise comparisons within the subjects applied with wax, polyether and prosthesis at three zones (I, II, and III), and *p*-value was considered significant at ≤0.05.

RESULTS

Total of thirty study subjects were included, among them 79.2% were males and 20.8% were females.

Comparison of the thickness of three different materials, Wax, Polyether, and Prosthesis, across three zones (Zone-I, Zone-II, and Zone-III) in a sample of 30 measurements has been depicted in Table-I. The findings indicate that in all the three Zones, the mean thickness values for Wax, Polyether, and Prosthesis were not significantly varied (p=0.738). However, the mean values of thickness measured by using polyether (Zone-I: 1.196±0.52 mm, Zone-II: 1.296±0.58 mm, Zone-III: 0.946±0.55 mm) are close to the prepared tooth measurements which suggest more favorable and accurate results for polyether than that of wax (Zone-I: 1.208±0.53 mm, Zone-II: 1.233±0.49 mm, Zone-III: 1.902±0.48 mm) and prosthesis (Zone-I: 1.296±0.35 mm, Zone-II: 1.263±0.36 mm, Zone-III: 0.996±0.33 mm).

The pairwise comparison of materials within each zone further confirms the absence of statistically significant differences in thickness across materials, as all p-values exceed the conventional significance threshold of 0.05. However, the mean difference is least for poly-ether-prosthesis (1.196 vs. 1.296; -0.010; p=0.403) which suggests comparable thickness with the prepared tooth.

Table-I: Comparison of Thickness Measurements Among Wax, Polyether, and Prosthesis in Different Zones (n=30)

Zone(s)	Material	Mean±SD (mm)	*p*-value
Zone-I	Wax	1.208±0.53	0.738
	Polyether	1.196±0.52	
	Prosthesis	1.296±0.35	
Zone-II	Wax	1.233±0.49	0.902
	Polyether	1.296±0.58	
	Prosthesis	1.263±0.36	
Zone-III	Wax	1.902±0.48	0.520
	Polyether	0.946±0.55	
	Prosthesis	0.996±0.33	

Table-II: Pairwise Comparison of Thickness Measured in Different Zones (n=30)

Zone(s)	Material (I-J)	Comparison	Mean Difference (I-J) (mm)	*p*-value
Zone-I	Wax - Prosthesis	1.208 vs. 1.296	-0.087	0.559
	Polyether - Prosthesis	1.196 vs. 1.296	-0.010	0.403
	Wax - Polyether	1.208 vs. 1.196	0.012	0.935
Zone-II	Wax - Prosthesis	1.233 vs. 1.263	-0.029	0.809
	Polyether - Prosthesis	1.296 vs. 1.263	0.033	0.811
	Wax - Polyether	1.233 vs. 1.296	-0.062	0.687
Zone-III	Wax - Prosthesis	1.902 vs. 0.996	0.096	0.430
	Polyether - Prosthesis	0.946 vs. 0.996	-0.050	0.702
	Wax - Polyether	1.902 vs. 0.946	0.146	0.298

**Group 1: Wax, Group 2: Polyether, Group 3: Prosthesis*

Mean thickness distribution of Wax, Polyether, and Prosthesis across three zones is illustrated in figure-3. The data indicates that in Zone-I, the mean thickness is relatively similar among the three materials, with Wax measuring 1.208, Polyether 1.196, and Prosthesis 1.296, reflecting minimal variation. Zone-II follows similar trend and again showing almost no substantial differences. However, in Zone-III, a noticeable difference emerges. Wax exhibits the highest thickness, significantly exceeding Polyether and Prosthesis. This suggests that Wax tends to have greater thickness variability in different zones, especially in Zone-III, compared to the other materials, which remain relatively consistent.

DISCUSSION

The study evaluated the thickness of three commonly used materials—Wax, Polyether, and Prosthesis—across three distinct zones of a prepared tooth (Zone-I, Zone-II, and Zone-III), using a sample of 30 measurements. The results revealed no statistically significant differences in the mean thickness values among the three materials across all zones (p=0.738). These findings suggest that, overall, the materials

perform comparably in terms of dimensional thickness.

Despite the lack of statistically significant variation, closer examination of the mean values highlights noteworthy trends. Among the three materials, Polyether demonstrated the closest approximation to the original dimensions of the prepared tooth, indicating its superior accuracy in replicating clinical anatomy. This observation is further reinforced by the pairwise comparisons, where the mean difference in thickness between Polyether and Prosthesis was the smallest, suggesting that these materials provide more comparable and reliable thickness measurements than Wax.

The zone-wise analysis offers additional insight into material behavior. In both Zone-I and Zone-II, the mean thickness values for Wax, Polyether, and Prosthesis were relatively consistent, showing minimal variability. However, in Zone-III, a distinct pattern emerged—Wax exhibited a noticeably greater thickness compared to both Polyether and Prosthesis. This suggests that Wax may be prone to increased dimensional variability, particularly in regions that may present more complex anatomical features or require greater adaptability.

The findings align with those of Patel *et al.,* who found that polyether impression materials maintained dimensional accuracy and surface detail reproduction even after exposure to various chemical agents used in gingival retraction. This suggests that polyether's dimensional stability is robust under different clinical conditions.[11] Additionally, a review article by Rameez *et al.,* discussed the clinical implications of elastomeric impression materials, highlighting polyether's hydrophilic nature, dimensional stability, and excellent detail reproduction. These properties make polyether a preferred choice among clinicians.[12]

The greater deviation observed in Wax, especially in Zone-III, may be attributed to its physical properties, such as thermal expansion, manual handling characteristics, or susceptibility to deformation. These factors can compromise the accuracy of wax patterns in critical zones, potentially affecting the fit and function of the final prosthesis.

Tooth preparation is a critical step that involves careful removal of tooth structure to create an optimal environment for restoration.[10] It is crucial for ensuring sufficient material thickness, which directly impacts functional occlusion, as achieving functional occlusion is crucial for restoration longevity.[3] According to Dilafruz K., proper methodologies and careful removal of tooth structure help prevent premature contacts and interferences, ultimately contributing to the success of restorative treatments.[13]

Mount GJ *et al.,* stated that Conservation of tooth structure is crucial in restorative dentistry, particularly in Prosthodontics, where tooth reduction is necessary to accommodate restorations. High-speed rotary instruments, like diamond burs, must be used cautiously to avoid excessive reduction and pulp damage. The materials used, such as metal or porcelain, require specific thicknesses to ensure mechanical integrity. If the thickness is insufficient, there is a higher risk of prosthesis failure due to wear and fracture under mechanical stress. While the conservation of tooth structure is paramount, Adequate bulk in restorations is essential to withstand occlusal forces, maintain harmonious occlusion, and prevent periodontal issues. This balance is crucial for the long-term success of the prosthesis.[14,15]

The design of occlusal surfaces in restorative dentistry is crucial for maintaining adequate clearance and functional morphology, which directly impacts the retention and strength of restorations. A well-formed occlusal surface that mimics natural inclined plane patterns help prevent over-shortening of the preparation, thereby preserving retention and structural integrity as described by Manoharan P.[16] Additionally, proper reduction under anatomical grooves ensures sufficient space for functional morphology, enhancing the restoration's longevity and performance. According to Guo Y *et al.,* inadequate clearance, on the other hand, increases the risk of perforation and excessive wear, particularly during finishing procedures or in the oral environment.[17]

Lee JH. stated that Adequate occlusal clearance is essential in restorative dentistry to ensure the longevity and functionality of dental restorations. Proper occlusal reduction is vital for creating sufficient space for restorative materials, particularly in crown fabrication.[7] Insufficient reduction, especially in areas with limited visibility like the lingual surfaces of molars, can lead to complications. Materials used for measuring clearance also play a crucial role, as dental waxes, prone to thermal expansion, can result in inaccurate measurements.[17] In contrast, poly-ether bite registration material has demonstrated higher accuracy in guiding occlusal reduction compared to

traditional wax, minimizing discrepancies in the final prosthesis as stated by Joshi *et al*.[12]

According to Wieckiewicz *et al.,* Addition silicones and polyether are highly effective bite registration materials in dentistry due to their superior mechanical properties and dimensional stability. Addition silicones exhibit high stiffness, characterized by low percent strain in compression, which ensures resistance to deformation under pressure.[18] Naumovski *et al.,* stated that these materials also demonstrate excellent dimensional stability, maintaining their shape with minimal change even after 7 days, making them reliable for accurate dental restorations.[19] According to MadanShetty P *et al.,* Clinically, these materials are favored for bite registration due to their outstanding detail reproduction and tear strength, which are essential for capturing precise occlusal relationships in fixed prosthodontics.[20] Additionally, their versatility is enhanced by various formulations that offer different viscosities and handling characteristics, catering to specific clinical requirements as described by Araújo CC de.[21]

In contrast, the dimensional stability and better flow characteristics of Polyether likely contribute to its more consistent performance across all zones. The clinical implication of these findings emphasizes the potential advantages of Polyether over Wax in situations where precise reproduction of tooth structure is essential, such as in the fabrication of definitive prostheses.

This suggests that poly-ether registration material offers greater accuracy than wax. However, statistical analysis showed that the thickness differences between wax and polyether in the three zones were not statistically significant. When considering the required thickness of restorative material, ranging from 1.0 to 2.0 mm, the percentage discrepancy between wax and polyether could be crucial, despite statistical tests indicating insignificance. These findings support the continued use and preference of Polyether in clinical settings where dimensional precision is critical.

Therefore, the poly-ether bite registration material is more dependable than modeling wax for evaluating clearance requirements during tooth preparation. However, this study has several limitations. It was conducted in vitro using articulated casts rather than in a clinical (in vivo) setting, which may not accurately replicate the oral environment. A semi-adjustable articulator was used, limiting the simulation of complex mandibular movements. Additionally, the evaluation was restricted to centric occlusion, without consideration of eccentric records such as protrusive and lateral movements. The study compared only two bite registration materials—polyether and modeling wax—excluding other commonly used materials like silicone-based or resin-based options. The future research with a larger sample size is recommended to gather data using other available bite registration materials. Further studies could be conducted in vivo and using eccentric records as well.

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CONCLUSION

On combination of all the three zones it has shown a statistically significant difference between the thickness of the wax record and the porcelain fused to metal prosthesis while the difference between the thickness of poly-ether bite registration material and porcelain fused to metal prosthesis was not statistically significant. Hence, an inference can be drawn that poly-ether bite registration material is most suitable material when compared with commonly used modeling wax during the tooth preparation.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

SK & MS: Data acquisition, data analysis, critical review, approval of the final version to be published.

MNN & SS: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

SK & MM: Conception, data acquisition, drafting the manuscript, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

REFERENCES

1. Bennett GW, Jarecke L, Wordekemper L, Sundine M. Analysis of occlusal clearance of crown preparations in a predoctoral clinical setting. J Dent Educ 2025; 89(3): 370-374. https://doi.org/10.1002/jdd.13737
2. Tiu J, Al-Amleh B, Waddell JN, Duncan WJ. Clinical tooth preparations and associated measuring methods: a systematic review. J Prosthet Dent 2015; 113(3): 175-184.

https://doi.org/10.12659/MSM.943401
3. Aldowish AF, Alsubaie MN, Alabdulrazzaq SS, Alsaykhan DB, Alamri AK, Alhatem LM, et al. Occlusion and Its Role in the Long-Term Success of Dental Restorations: A Literature Review. Cureus 2024; 16(11): e73195. https://doi.org/10.7759/cureus.73195
4. Qureshi N, Imran Z. Principles and concepts of occlusion in restorative dentistry. Int J Oral Craniofac Sci 2023; 9(1): 1-7. https://dx.doi.org/10.17352/2455-4634.000059
5. Wasea PR, Rakshana D, Andharea KV, Manoharan PS. Occlusal clearance indicators-A review of clinical technique. J Clin Prosth Impl 2023; 5(1): 11-13. https://doi.org/10.55995/j-cpi.2023002
6. Afrashtehfar KI, Brägger U, Igarashi K, Belser UC. A modified technique for the intraoral assessment of static occlusal contacts. J Prosthet Dent 2018; 119(6): 909-911. https://doi.org/10.1016/j.prosdent.2017.10.006
7. Lee JH. Chairside fabrication of a tooth reduction guide to ensure adequate occlusal clearance. J Prosthet Dent 2022; 127(3): 515-516. https://doi.org/10.1016/j.prosdent.2020.08.048
8. Khalifa AA, Abdelaal AM, Moustafa MM, Mahran MA. A humble periodontal probe can help implant removal during revision total joint arthroplasty: a technical note. Tech Orthop 2022; 37(4): 283-284. https://doi.org/10.1097/BTO.0000000000000590
9. Sykes LM. A simple method to ensure sufficient occlusal reduction in fixed prosthodontics: clinical. South African Dent J 2009; 64(1): 22-23.
10. Joshi N, Shetty SN, Prasad KD. Comparative study to evaluate the accuracy of polyether occlusal bite registration material and occlusal registration wax as a guide for occlusal reduction during tooth preparation. Indian J Dent Res 2013; 24(6): 730-735. https://doi.org/10.4103/0970-9290.127622
11. Patel KA. Effect of Three Chemical Agents on the Dimensional Accuracy and Surface Detail Reproduction of Polyether Impression Material–An In Vitro Study. J Indian Prosth Soc 2020; 20(Suppl 1): S7. https://doi.org/10.4103/0972-4052.306359
12. Rameez M, Razi S, Farhan F, Kumar B, Rashid H. Clinical implications of elastomeric impression materials used for complete denture construction. Dent Med Res 2018; 6(1): 19-23. https://doi.org/10.4103/dmr.dmr_10_17
13. Dilafruz K. Tooth Preparation as A Crucial Stage In High-Quality Manufacturing Of Dental Restorations. Eur Int J Multidisciplinary Res Management Studies 2024; 4(12): 310-316. https://doi.org/10.55640/eijmrms-04-12-54
14. Mount GJ, Hume WR, Ngo HC, Wolff MS, editors. Preservation and restoration of tooth structure. 3rd ed. Chichester: John Wiley & Sons; 2016.
15. Punj A, Vasudevan S, Reddy PA, Atchuta A. Interdisciplinary Triumph: Molar Preservation through the Unity of Periodontology, Prosthodontics, and Endodontics. J Interdiscip Dent 2024; 14(2): 136-139. https://doi.org/:10.4103/jid.jid_27_24
16. Manoharan P. Occlusal clearance indicators- A review of clinical technique. J Clin Prosthodont Implantol 2023; 5: 11–13. https://doi.org/10.55995/j-cpi.2023002
17. Guo Y, Li J, Liu X, Yue Y, Wei N, Wang M, et al. Case of precise full-mouth occlusal reconstruction guided by digital occlusal function analysis. Hua Xi Kou Qiang Yi Xue Za Zhi West China J Stomatol 2024; 42(3): 394-402. https://doi.org/10.7518/hxkq.2024.2023448
18. Wieckiewicz M, Grychowska N, Zietek M, Wieckiewicz W. Evaluation of the elastic properties of thirteen silicone interocclusal recording materials. BioMed Res Int 2016; 2016(1): 7456046. https://doi.org/10.1155/2016/7456046
19. Naumovski B, Kapushevska B. Dimensional stability and accuracy of silicone–based impression materials using different impression techniques–a literature review. Pril 2017; 38(2): 131-138. https://doi.org/10.1515/prilozi-2017-0031
20. Madanshetty P, Guttal SS, Meshramkar R, Newaskar PS, Anehosur GV, Madanshetty Sr et al. Addition silicone impressions in fixed prosthodontics: clinical standpoints. Cureus 2023; 15(8): e44014. https://doi.org/10.7759/cureus.44014
21. de Araujo CC, da Silva ÁML, Cardoso SAM, Bizarria GC, da Costa OWM, Lima NGC, et al. Elastomericmaterials in dentistry: properties, fundamentals and applications. Seven Editora; 2025.