International Journal of Medical Toxicology & Legal Medicine Volume 27, No. 5, 2024
e-ISSN: 0974-4614
p-ISSN: 0972-0448
https://doi.org/10.47059/ijmtlm/V27I5/048

Evaluation of Cervical Microleakage of Different Restorative Materials in Class V Restorations: in vitro Study

Zanbaq Azeez Hanoon[1], Amal Qasim Ahmed[2], Sattar Jabbar Abdul-Zahra Al-Hmedat[3], Salah M.Ibrahim[4*]

[1]Department of Conservative Dentistry, Faculty of Dentistry, University of Kufa, Najaf, Iraq,
Email: zanbaqa.ali@uokufa.edu.iq
[2]Department of Prosthodontics, Faculty of Dentistry, University of Kufa, Najaf, Iraq ,
Email:amalq.baqqal@uokufa.edu.iq
[3]Department of Conservative Dentistry, Faculty of Dentistry, University of Kufa, Najaf, Iraq,
Email: satarj.alhemedat@uokufa.edu.iq
[4]Department of Oral Surgery, College of Dentistry, Kufa University, Iraq,
Email: salahm.abrahem@uokufa.edu.iq
*Corresponding Author

Received: 16.09.2024 Revised: 10.10.2024 Accepted: 26.11.2024

ABSTRACT
Aim: The purpose of this study was to evaluate the cervical microleakage ofMicro-hybrid (Charisma Classic), Nano-hybrid (EsCom 100)and Nano-ceramic (ZENIT) resin composites for class V restorations.
Materials and Methods: Forty-five human upper 1st premolars were randomly divided into three study groups (n = 15). Standardized class V cavity preparation was carried out on the buccal surface of each tooth sample. After cavity preparation, acid etching of the cavities was performed with 37% phosphoric acid etchant gel. Single Bond Universal Adhesive was applied to the etched enamel and dentin. A dental composite instrument was used for composite filling. After finishing and polishing the class V composite restorations, the samples were kept in distilled water for 2 weeks at 37°C. All the specimens were subjected to a thermocycling procedure (500 cycles at 5-55°C) and then immersed in 2% methylene blue dye for two days. All specimens were blocked with clear acrylic before sectioning. The means of cervical microleakage were recorded using a digital microscope and the ImageJ software.
Results: The lowest mean amount of microleakage was recorded for Group C (66.4380 ± 4.66391), which was restored with the ZENIT composite, while the highest mean amount of microleakage was recorded for Group A (92.7673±3.40694), which was restored with the Charisma classic composite. The Tukey HSD results showed that the type of composite filling material had a highly significant effect on marginal microleakage ($P \leq 0.01$).
Conclusions: Althoughnone of the tested restorative materials completely sealed the cervical margin,theZENIT nanoceramic composite showed significantly less marginal microleakage than the EsCom 100 nanohybrid and Charisma classic microhybrid composites.
Clinical significance:The potential to improve patient outcomes by providing data that supports the selection of composite resins like ZENIT to minimize microleakage and enhance the long-term success and aesthetics of Class V restorations. This contributes to more predictable and durable restorative dentistry.

Keywords: Class V restoration, Resin composite, Cervical microleakage, Charisma classic, EsCom 100,ZENIT, Thermocycling.

1. INTRODUCTION

Dental caries is a major public health problem, affecting people of all ages (1). The primary goal of restorative dentistry is to restore the tooth to its form and function, and composite resins remain the preferred choice of many dentists due to their positive characteristics, such as aesthetics, adhesion, and tooth structure preservation (2,3). However, resin composites have several limitations, including method sensitivity, polymerization shrinkage, and the possibility of microleakage and secondary caries (4).

Microleakage is the clinically undetectable passage of bacteria and bacterial products, fluids, molecules, or ions from the oral cavity along the various spaces present in the cavity restoration interface (5). Two major properties of dental light-cured composites that have to be improved are polymerization shrinkage and shrinkage induced stress. This results in marginal gap formation, leading to microleakage. If the contraction forces exceed the bonding strength at the interface, the resulting interfacial space can lead to staining, marginal leakage, postoperative sensitivity, and recurrent caries (6).

Currently, several materials with enhanced formulations, characteristics and appearances have made the placement of direct composites more reliable and predictable (7). These materials include microhybrid, nanohybrid and nanoceramic composite materials. In microhybrid composites, the particle size of traditional composites is reduced to create hybrid composites, which resolves the significant problems of long-term aesthetics and mechanical properties (8,9). Hybrid composites are among the best restorations for posterior teeth. Barium glass, with an average particle size of 0.5 to 1.0 microns, is currently the most popular filler. To enhance handling properties and reduce stickiness, a small amount of microfiller is applied (10,11). Additionally, with less than a few micrometres of glass filler particles and small quantities of colloidal silica particles (10–50 m and 10–50 nm), the latest generation of hybrid composites has shown lower shrinkage, improved polishing efficiency, and improved aesthetics (12,13). An example of a microhybrid composite that was used in this study is Charisma Classic (Microglass® II).

Newer composite materials have been developed with the help of nanotechnology. This technology involves the production of inorganic fillers for composites. By using chemical and physical methods, filler particles of quartz, fused glass, and ceramics are transformed into nanometric particles (ranging in size from 0.1 to 100 nm) (14,15). Currently, there are 2 types of composites produced with nanotechnology: nanofilled resins, whose composition involves particles and clusters (known as nanoclusters), and nanohybrid resins, which combine nanofillers with small particles, similar to those found in microhybrid resins (15). An optimal distribution of different particles of varying sizes allows an increase in the inorganic content of the composite resin, consequently leading to a potential decrease in polymerization shrinkage (14). An example of a nanohybrid composite used in this study is Escom 100.

Nanoceramic composites were developed by combining nanotechnology with methacrylate-modified polysiloxane. Glass fillers ranging in size from 1.1 to 1.5 mm made up 76% of the overall weight of the nanoceramic composite resins. Hence, nanoceramic manufacturing, according to the manufacturer, has superior esthetics and handling properties. It is well established that the esthetic properties and polishing ability of a substance increase as the size of the filler particles decreases and the percentage of particles by weight increases (15). The ZENIT composite was used as a nanoceramic composite in this study.

Hypothesis

The type of composite filling material will have a significant effect on marginal microleakage of class V composite restorations.

Null hypothesis

There will be no difference in the levels of microleakage between different types of resin composites.

2. MATERIALS AND METHODS

2.1. Materials and equipment

The compositions of the resin composite materials for restoring class V cavities are presented in Table 1.

2.2. Tooth collection and grouping

A total of 45 maxillary 1st premolars free from caries and cracks after extraction for orthodontic purposes were used in this in vitro study. Extracted teeth were selected from patients ranging 18 to 35 years after the research protocol was analyzed and approved by the Ethical Research Committee of the Faculty of Medicine, Kufa University. These teeth were subjected to visual examination by blue light transillumination to ensure that the crown of each tooth was free of any cracks. After cleaning and removing the residue of the attached soft tissue, the teeth were subjected to hand scaling and polishing with pumice paste free from fluoride (Produits Dentaires S.A., Switzerland). Saline was used as the solution for storing the teeth at room temperature until the time of the experiment **(16)**.

The teeth were divided randomly into three groups (n =15) based on previous studies (17,18).

Group A: Class V cavity was restored with Charisma classic microhybrid composite (Microglass II) and shade A2 (Kulzer, Germany).

Group B: Class v cavity were restored with EsCom 100 nanohybrid composite, shade A2 (Spident, Korea).

Group C: Class V cavity were restored with the ZENIT nanocerceramic composite shade A2 (President Dental, Germany).

2.3. Class V cavity preparation procedure

Standardized class V cavity preparation was performed for each tooth on the buccal surface, which was subsequently filled using three different composite filling materials (Figure 1). All cavities were prepared 2 mm above the cemento-enamel junction to maintain the restoration within enamel boundaries and without beveling to avoid the risk of losing thin cervical enamel (19). The dimensions of the prepared cavities were as follows: occlusogingivally (2 mm), mesio-distally (4 mm) and axial depth (1.5 mm) (20).

The samples were mounted on a dental surveyor (Paraline, Dentaurum, Germany). Initially, the cavity outlines were marked by a green marker (Stabilo, China) (Figure 1a). The cavity was prepared by using the square edge diamond wheel bur ISO No. 806 314 043- 524040 (NTI-Kahla GmbH, Germany) with a high-speed water-cooled hand piece (NSK, Japan) that was fixed to the vertical arm of a modified dental surveyor to standardize the cavity preparation (Figure 1b). The bur was perpendicular to the long axis of the tooth and positioned so that the gingival margin of the produced cavity was 2 mm above the cemento-enamel junction, as measured with a digital caliper (InSize, Austria). Preparation was performed by penetrating the bur until the shank contacted the tooth surface. The resulting cavity was considered a template for defining the mesio-distal and occlusogingival margins for final cavity preparation (21).
The cavity depth was standardized by using tungsten carbide fissure bur No. 256 (Komet, Germany), which was also used to correct the cavity floor. A color marker (Stabilo, China) and digital caliper (InSize, Austria) were used to mark the bur to provide a visual reference at a depth of 1.5 mm (22). The preparation was performed within the defined margins, and the bur was prepared to a marked depth in all areas (Figure 1c). Alcohol was used to remove the color marker from the cavity margins by gently wiping the color, and the cavity was not beveled (Figure 1d). For every five preparations, a new bur was used to maintain the efficiency of cutting(23).

2.4. Restorative Procedure
After the cavity was prepared for each tooth, it was dried using a gentle air blast. Acid etching of the cavity was performed with 37% phosphoric acid etchant gel (SDI Super Etch, SDI, Australia) following the manufacturer's instructions. The acid etchant gel was applied for 15 s and then rinsed for 10 s. Excess water was blotted using a cotton pellet, leaving the cavity moist (Figure 2a,b). Single Bond Universal Adhesive (3M ESPE, USA) was applied to the etched enamel and dentin using a fully saturated disposable brush for 15 seconds with gentle agitation, followed by gentle air thinning by an airsyringe for 5 seconds to evaporate the solvents and light curing for 15 seconds (Figure 2c,d).
Charisma Classic Microhybrid composite (Microglass II), shade A2, EsCom 100 Nanohybrid composite, shade A2 andZENIT Nano-Ceramic composite, shade A2 were appliedto the cavities of Group A, Group B, and Group C respectively with composite titanium instruments (DenTag S.r.l, Italy) in one increment to reduce polymerization stress (15).
The samples were then light cured for 40 seconds according to the manufacturer's instructions with an LED light curing device (Perfection Plus, UK) at a high intensity of approximately 800 mW/cm² at a distance of 2 mm from the surface of the LED tip to ensureadequate polymerization of the resin composite. Glycerine gel (Cosmodent, USA) was applied over the last layer before curing to eliminate the oxygen inhibitory layer (Figure 2e,f). The composite restoration was then finished and polished with a composite polishing disc (POLISHING DISC DENCO PACK/40, Germany) (Figure 2g,h).
The finished samples were stored in distilled water for two weeks at 37°C. In an effort to simulate the environment of the oral cavity, all samples were subjected to thermal cycles. An automatic thermocycling device (Nobel dental, Iraq) was used to perform the procedure with 500 cycles in water by cycling them between two water containers by keeping the temperature of the 1st container at 5 ± 0.5°C and the other container at 55 ± 0.5°C, with a dwell time of at least 20 seconds (24) based on the recommendations made by the International Organization for Standardization (ISO TR 11405). Nail varnish was used on each specimen to paint all the surfaces of the tooth and veneer to avoid dye penetration from these areas except 1 mm around the veneer cervical margin. All the specimens were placed in a flat container, 2% methylene blue dye was added, and the teeth were kept in the dye for 48 hours (Figure 3a).
In this study, the evaluation of microleakage was performed at the cervical margin only as the it showed higher microleakage mean values compared to the occlusal margins (7). This was performed by quantitative measurement of dye leakage from the cervical cavosurface margin of the class V restoration toward the pulpal floor directly through a vertical sectioning procedure, which is an extremely advantageous tool that helps reduce software and repositioning errors and permits an undisturbed view of marginal leakage. To reduce the chances of specimen destruction during the sectioning procedure, acrylic resin was used to embed the specimens (Figure 3b)**(25,26)**.
During the sectioning procedure, a single position for the seating of the samples in the sectioning machine (Microtome, MT-4 Diamond cutoff saw, USA) was selected in an attempt to create a standardized cutting area through the sample. Specimens were split longitudinally in a bucco-lingual direction through the middle of the restoration. The thickness of the cutting blade used during the cutting procedure was 0.3 mm.The cut divided the tooth bucco-palataly into two pieces (mesial and distal). The long axis of the sample was marked using color marker pen on the acrylic base before blocking which kept the cut perpendicular to the long axis of the tooth. For standardization purpose, only mesial section was taken for this study to measure the cervical microleakage. A digital microscope (Shenzhen Weikexiu Technology, China) was used to estimate the micro- leakage between the composite and the tooth in the cervical area. To view and measure the marginal leakage precisely, a magnification of 230× was selected, and the ImageJ software was used to measure the microleakage.Calculation

was achieved at first to each specimen by measuring the graphic paper known distance and entering its value in µm. Predetermined measuring points at each area where the dye found at the cervical margin were chosen for each specimen. ImageJ software was used to measure the area of microleakage at the cervical margin after setting scale for measuring the area of microleakage in µm (Figure 4). The mean of three readings was taken for each sample(21,27)

2.5. Statistical analysis

Statistical analysis was carried out by SPSS 2021 to check the distribution of the data, and the results of the test showed that the data were normally distributed and that differences in the data did not affect the overall results. Descriptive statistics were employed to compare the means of marginal microleakage among the different composite filling materials. Tukey's HSD test was used to detect whether there were significant effects of the type of composite restoration on marginal microleakage.

3. RESULTS

A total of 45 samples were measured, and the cervical microleakage of class V for each sample of the experimental groups was measured three times. The minimum and maximum mean and standard deviation of the microleakage values were calculated and are shown in Table 2.

The lowest mean of microleakage was recorded for Group C (66.4380 µm), which was restored with the ZENIT composite, while the highest mean value of microleakage was recorded for Group A (92.7673 µm), which was restored with the Charisma Classic composite. The Tukey HSD results (Table 3) showed that the type of composite filling material had a highly significant effect on marginal microleakage ($P \leq 0.01$).

4. DISCUSSION

This in vitro study investigated cervical microleakage in Class V restorations using three distinct resin composite materials: Charisma Classic (a microhybrid composite), EsCom 100 (a nanohybrid composite), and ZENIT (a nanoceramic composite). The results revealed statistically significant differences in microleakage, with ZENIT exhibiting the lowest mean values, followed by EsCom 100, and Charisma Classic demonstrating the highest. This finding strongly supports the primary hypothesis that the type of composite material significantly impacts microleakage. The observed disparities underscore the critical importance of material selection in achieving clinically successful and long-lasting restorations, particularly in challenging anatomical sites such as the cervical margin.

The superior performance of ZENIT in minimizing microleakage is likely a consequence of several intrinsic material properties. Firstly, the nanoceramic filler technology employed in ZENIT is believed to contribute significantly to reduced polymerization shrinkage stress. The substantially smaller particle size of its nano-fillers, compared to the micro-sized fillers in Charisma Classic, results in a more homogeneous stress distribution within the composite matrix during the polymerization process (28, 29). This optimized stress distribution minimizes the formation of internal stresses and the subsequent tendency for the composite to contract away from the cavity walls, thereby significantly reducing the formation of marginal gaps (30, 31). Secondly, the high filler loading characteristically found in nanoceramic composites (83 wt%, 70 vol% for ZENIT) further contributes to diminishing shrinkage and enhances the overall mechanical properties of the restoration, improving its structural integrity and resistance to degradation (32, 33). EsCom 100, being a nanohybrid composite, also benefits from the smaller filler particle size compared to the microhybrid Charisma Classic, leading to a lower microleakage level compared to the microhybrid. Nevertheless, the observed differences between EsCom 100 and ZENIT could stem from variations in the resin matrix composition, filler type, and overall filler load (34, 35, 36). These differences could influence the viscoelastic properties of the materials and their ability to flow and adapt to the cavity walls, ultimately affecting the marginal seal.

The clinical implications of this research are considerable. Class V restorations, especially at the cervical margin, present unique challenges owing to limited enamel support and increased susceptibility to microleakage. This vulnerability directly increases the risk of various complications, including postoperative sensitivity, recurrent caries, marginal staining, and eventual restoration failure (37, 38). The substantially lower microleakage demonstrated by the ZENIT nanoceramic composite suggests it could significantly enhance the long-term clinical success of Class V restorations. Clinicians can leverage this finding to improve patient outcomes by choosing restorative materials specifically engineered to minimize shrinkage and maximize the integrity of the marginal seal. This approach could potentially translate into improved restoration longevity, reduced treatment costs associated with recurrent caries or restoration failure, and increased patient satisfaction due to more durable and aesthetically pleasing restorations.

Despite its strengths, this in vitro study possesses limitations that must be acknowledged. The highly controlled laboratory setting, while providing excellent reproducibility and standardization, cannot completely mimic the intricate biological and mechanical forces present in the oral cavity. Factors such as the interaction with the oral microbiome, the presence of saliva, and the cyclic loading resulting from mastication were not considered and may influence the in vivo behavior of these composites. The utilization of extracted teeth, while providing a degree of standardization, may not fully represent the inherent variability in tooth structure and properties observed in vivo. Moreover, the specific adhesive system used (Single Bond Universal Adhesive) could potentially impact the results, and the investigation was limited to just three composites. Expanding the range of materials evaluated would enhance the generalizability of the findings. Future research should, therefore, incorporate in vivo clinical trials with larger sample sizes, including a wider spectrum of restorative materials and adhesive systems, to comprehensively assess the long-term clinical performance and to fully ascertain the relative merits of different composite systems under realistic oral conditions. Further investigation into the influence of different polymerization techniques and the role of various bonding agents would further enhance our understanding of the factors affecting microleakage (39, 40, 41, 42, 43, 44, 45).

5. CONCLUSIONS

Within the limitations of this in vitro study, it can be concluded that the type of composite filling materials had a highly significant effect on class V cervical microleakage. Compared with the Charisma Classic, EsCom 100, the ZENIT nanoceramic composite showed significantly lower marginal microleakage.

Funding

The authors received no financial support for the research, authorship, or publication of this article.

Conflict of interest

We have no conflicts of interest to disclose regarding this article. The opinions expressed are solely those of the authors and have not been influenced by any financial or personal relationships.

Regulatory Statement

This article did not involve the use of any hazardous materials, living organisms, or any procedures that could harm the environment. There was no need to comply with any specific regulatory laws or regulations regarding occupational health and safety or the environment. All necessary measures were taken to ensure compliance with ethical research practices and laboratory safety.

REFERENCE

1. Sivakumar, J. S. K., Prasad, A., Soundappan, S., Ragavendran, N., Ajay, R., & Santham, K. (2016). Acomparative evaluation of microleakage of restorations using silorane-based dental composite and methacrylate-based dental composites in Class II cavities: An: in vitro: study. Journal of Pharmacy And Bioallied Sciences, 8(Suppl 1), S81-S85.
2. Bajabaa, S., Balbaid, S., Taleb, M., Islam, L., Elharazeen, S., & Alagha, E. (2021). Microleakage evaluation in class V cavities restored with five different resin composites: in vitro dye leakage study. Clinical, cosmetic and investigational dentistry, 405-411.
3. Hussain, S .M., & Khan, F. R. (2016). In-vitro comparison of micro-leakage between nanocomposite and microhybrid composite In class v cavities treated with The self-etch technique. Journal of Ayub Medical College Abbottabad, 28(3), 445-448.
4. Nematollahi, H., Bagherian, A., Ghazvini, K. ,Esmaily, H., & Mehr, M. A. (2017). Microbial microleakage assessment of class V cavities restored with different materials and techniques: A laboratory study. Dental research journal, 14(5), 344.
5. Abidi, S. Y. A., & Ahmed, S. (2016) .An in-vitro evaluation of microleakage at the cervical margin between two different class II restorative techniques using dye penetration method. Journal of the College of Physicians and Surgeons Pakistan, 26(9), 748-753.
6. Swapna, M. U., Koshy, S., Kumar, A., Nanjappa, N., Benjamin, S., & Nainan, M. T. (2015). Comparing marginal microleakage of three Bulk Fill composites in Class II cavities using confocal microscope: An: in vitro: study. Journal of Conservative Dentistry and Endodontics, 18(5), 409-413.
7. Abdullah, A. M., Saed, R., & Jamil, W. E. (2024). Microleakage Evaluation of Self-Adhesive Restorative Materials Applied With Different Bonding Techniques (An in-vitro Study). Egyptian Dental Journal, 70(3), 2739-2751.
8. Khalel, A. M., Ali, M. B., Sadiq, M. A., Ibrahim, S. M., & Ali, S. H. (2024). DMFT and PUFA Indices in First Permanent Molars of Iraqi Children in Najaf City. Dentistry 3000, 12(2).
9. Ravi, R. K., Alla, R. K., Shammas, M., & Devarhubli, A. (2013). Dental Composites-A Versatile Restorative Material: An Overview. Indian Journal of Dental Sciences, 5(5).
10. Hmedat, S., Jaber, Z. A., & Ibrahim, S. M. (2019). Comparison of Shear Bond Strength of Translucent Zirconia Veneers Bond to Enamel among Different Light Intensity (An in Vitro Study). Prof. RK Sharma, 13(3), 425.

11. Rehab, M. H. A. (2022). Effect Of Finishing &Polishing Procedures On The Surface Roughness &Microhardness Of Resin Composite Restorative Materials Benghazi University.
12. Ibrahim, S. M., Al-Hmedat, S. J. A. Z., & Alsunboli, M. H. (2024). Histological Study to Evaluate the Effect of Local Application of Myrtus Communis Oil on Alveolar Bone Healing in Rats. The Open Dentistry Journal, 18(1).
13. Pereira, R. A., Araujo, P. A. d., Castañeda-Espinosa, J. C., & Mondelli, R. F. L. (2008). Comparative analysis of the shrinkage stress of composite resins. Journal of Applied Oral Science, 16, 30-34.
14. Mohammed, M. J., Al-Mizraqchi, A. S., & Ibrahim, S. M. (2024). Oral findings, salivary copper, magnesium, and leptin in type II diabetic patients in relation to oral candida species. International Journal of Microbiology, 2024(1), 8177437.
15. Barretto, I. C., Pontes, L. F., Carneiro, K. K., Araujo, J., Ballester, R. Y., & Silva, C. M. (2015). Comparative analysis of polymerization shrinkage of different resin composites. Matrix, 2, 78-80.
16. Jain, D., Dasar, P. L., & Nagarajappa, S. (2015). Natural products as storage media for avulsed tooth. Saudi Endodontic Journal, 5(2), 107-113.
17. Jordehi, A. Y., Shahabi, M. S., & Akbari, A. (2019). Comparison of self-adhering flowable composite microleakage with several types of bonding agent in class V cavity restoration. Dental research journal,16(4),263-257.
18. Mohamad Kharib A., M., (2024). Evaluation of Class V Cervical Marginal Microleakage Following Restoration by Different Types of Composite Resins. Int ClincMed Case Rep Jour. 2024;3(5):1-13.
19. Majeed, M. A. (2012). Microleakage evaluation of a silorane-based and methacrylate-based packable and nanofill posterior composites (in vitro comparative study). Tikrit Journal for Dental Sciences, 2(1), 19-26.
20. Sadighpour, L., Geramipanah, F., Rasaei, V., & Kharazi Fard, M. J. (2018). Fracture resistance of ceramic laminate veneers bonded to teethwith class V composite fillings after cyclic loading. International journal of dentistry, 2018.
21. Hanoon, Z. A., & Aljuboury, M. R. (2018). Microleakage of Two Porcelain Laminate Veneer Materials with Different Types of Class V Cavity Restoration (A Comparative In-vitro Study). Int. J. Med. Res. Health Sci, 7, 71-76.
22. Irie, M., Tjandrawinata ,R., & Suzuki, K. (2003). Effect of delayed polishing periods on interfacial gap formation of class V restorations. OPERATIVE DENTISTRY-UNIVERSITY OF WASHINGTON-, 28(5), 552-559.
23. Borges, A. F. S., de Sousa Santos, J., Ramos, C. M., Ishikiriama, S. K., & Shinohara, M. S. (2012). Effect of thermo-mechanical load cycling on silorane-based composite restorations. Dental materials journal, 31(6), 1054-1059.
24. Fasbinder, D. J., Dennison, J. B., Heys, D., & Neiva, G. (2010). A clinical evaluation of chairside lithium disilicate CAD/CAM crowns. The Journal of the American Dental Association, 141, 10S-14S.
25. Anadioti, E. (2013). Internal and marginal fit of pressed and cad lithium disilicate crowns made from digital and conventional impressions. The University of Iowa.
26. Chee, H. T., Bakar, W. Z. W., Ab Ghani, Z., & Amaechi, B. T. (2018). Comparison of composite resin and porcelain inlays for restoration of noncarious cervical lesions: An In vitro study. Dental research journal, 15(3), 215.
27. Chang, B., Goldstein, R., Lin ,C. P., Byreddy, S., & Lawson, N. C. (2018). Microleakage around zirconia crown margins after ultrasonic scaling with self-adhesive resin or resin modified glass ionomer cement. Journal of Esthetic and Restorative Dentistry, 30(1), 73-80.
28. Hassan, R. S., Hanoon, Z. A., Ibrahim, S. M., & Alhusseini, N. B. (2024). Assessment of Periodontal Health Status and Treatment Needs Among Dental Students of Al-Kufa University by Using the Community Periodontal Index for Treatment Needs: A Cross-Sectional Study. Dentistry 3000, 12(2).
29. Hilton, T. J. (2002). Can modern restorative procedures and materials reliably seal cavities? In vitroinvestigations. Part 1. American journal of dentistry, 15(3), 198-210.
30. Jacker-Guhr, S., Ibarra, G., Oppermann, L., Lührs, A.-K., Rahman, A., & Geurtsen, W. (2016). Evaluation of microleakage in class V composite restorations using dye penetration and micro-CT. Clinical Oral Investigations, 20, 1709-1718.
31. Al-hmedat, S. J. A. , Al-Ameedee, W. H. M. , Jaber, Z. A. and M. Ibrahim, S. (2025). Comparison of the shear bond strength between composite resin and enamel among different bonding procedure's applications. Journal of Medicinal and Pharmaceutical Chemistry Research, 7(6), 1038-1047. doi: 10.48309/jmpcr.2024.477270.1421
32. Rengo, C., Goracci, C., Ametrano, G., Chieffi, N., Spagnuolo, G., Rengo, S., & Ferrari, M. (2015). Marginal leakage of class V composite restorations assessed using microcomputed tomography and scanning electron microscope. Operative Dentistry, 40(4), 440-448.
33. Mahmoud, S. H., Eltoukhy, R., Elkaffas, A. A., & Salama, R. (2022). Marginal Adaptation of Ormocer, Nanofilled, and Nanoceramic Class V Composite Restorations Subjected to Thermal and load Cycling.

34. Muliyar, S., Shameem, K. A., Thankachan, R. P., Francis, P., Jayapalan, C., & Hafiz, K. A. (2014). Microleakage in endodontics. Journal of International Oral Health: JIOH, 6(6), 99.
35. Cimello, D. T., Chinelatti, M. A., Ramos, R.P., & Palma Dibb, R. G. (2002). In vitro evaluation of microleakage of a flowable composite in Class V restorations. Brazilian dental journal, 13, 184-187.
36. Sujith, R.,Yadav, T. G., Pitalia, D., Babaji, P., Apoorva, K., & Sharma, A. (2020). Comparative evaluation of mechanical and microleakage properties of Cention-N, composite, and glass ionomer cement restorative materials. J Contemp Dent Pract, 21(6), 691-695.
37. Ferracane, J. L. (2005). Developing a more complete understanding of stresses produced in dental composites during polymerization. Dental materials, 21(1), 36-42.
38. Overton, J., Littlestar, M., & Starr, C. (2006). Class V restorations. Summitt JB, Robbins JW, Hilton TJ, SchwartzRC. Fundamentals of Operative Dentistry. Chicago: Quintessence Publishing Co, 420-436.
39. Khier, S., & Hassan, K. (2011). Efficacy of composite restorative techniques in marginal sealing of extended class v cavities. International Scholarly Research Notices, 2011.
40. Nikolaenko, S. A., Lohbauer, U., Roggendorf, M., Petschelt, A.,Dasch, W., & Frankenberger, R. (2004). Influence of c-factor and layering technique on microtensile bond strength to dentin. Dental materials, 20(6), 579-585.
41. Obici, A. C., Sinhoreti, M. A. C., Correr-Sobrinho, L., Góes, M. F. d., & Consani, S. (2005). Evaluation of mechanical properties of Z250 composite resin light-cured by different methods. Journal of Applied Oral Science, 13, 393-398.
42. Cunha, L. G., Alonso, R. C. B., Souza-Junior, E. J. C. d. ,Neves, A. C. E. C., Correr-Sobrinho, L., & Sinhoreti, M. A. C. (2008). Influence of the curing method on the post-polymerization shrinkage stress of a composite resin. Journal of Applied Oral Science, 16, 266-270.
43. Costa, S., Martins, L., Franscisconi, P., Bagnato, V. S., Saad, J. R. C., Rastelli, A. N. d. S., &Andrade, M. (2009). Influence of different light sources and photo-activation methods on degree of conversion and polymerization shrinkage of a nanocomposite resin. Laser physics, 19, 2210-2218.
44. Nicholson, J., & Czarnecka, B. (2016). 3 - Composite resins. In J. Nicholson & B. Czarnecka (Eds.), Materials for the Direct Restoration of Teeth (pp. 37-67). Woodhead Publishing.
45. Shenoi, P. R., Kokane, V. B., Thawale, H. V., Kubde, R. R., Gunwal, M. K., & Shahu, S. P. (2021). Comparing marginal microleakage in classV cavities restored with flowable composite and Cention-N using confocal microscope-an in-vitro study. Indian Journal of Dental Research, 32(3), 348-353.

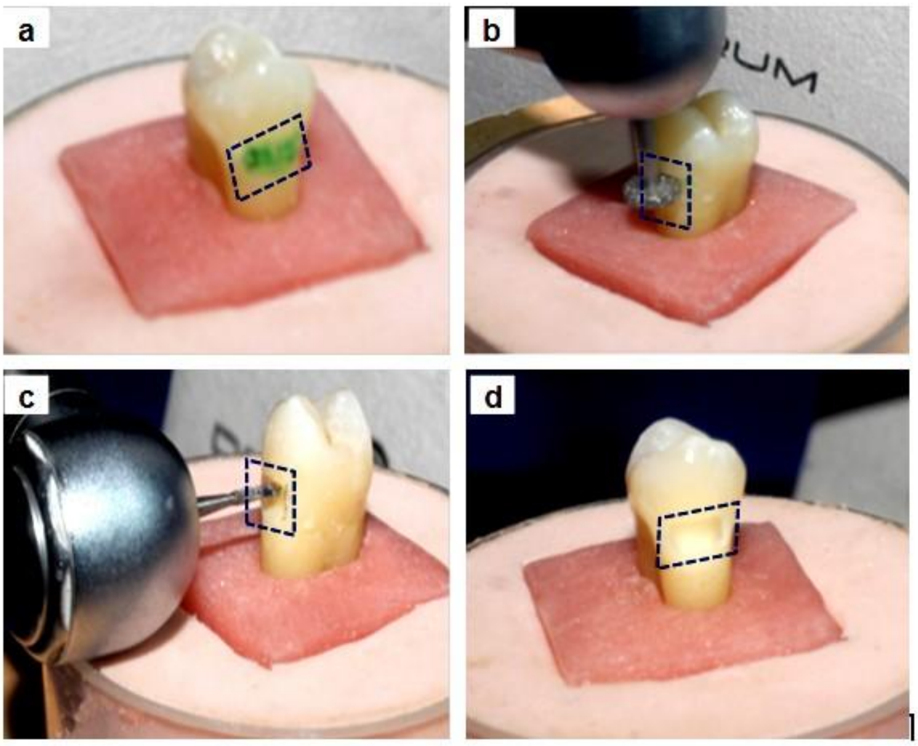

Figure 1. Cavity preparation steps: (a)Marking the outline of cavity (b) Initial cavity by a diamond wheel bur (c) Standardizing the cavity depth by a tungsten carbide fissure bur (d) Final prepared cavity.

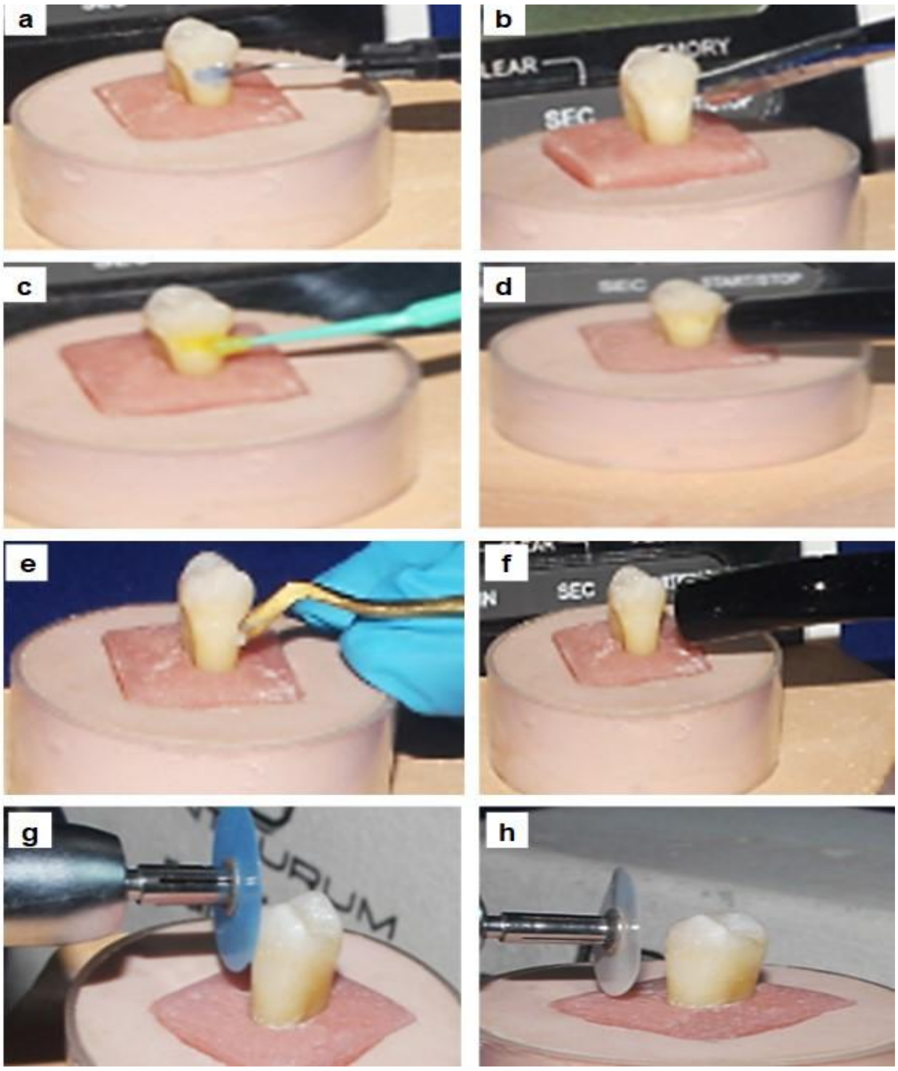

Figure 2. Restorative procedure: (a) Acid Etching. (b) Rinsing. (c) Adhesive application. (d) Curing. (e) Composite filling application. (f) Curing. (g) Finishing. (h) Polishing.

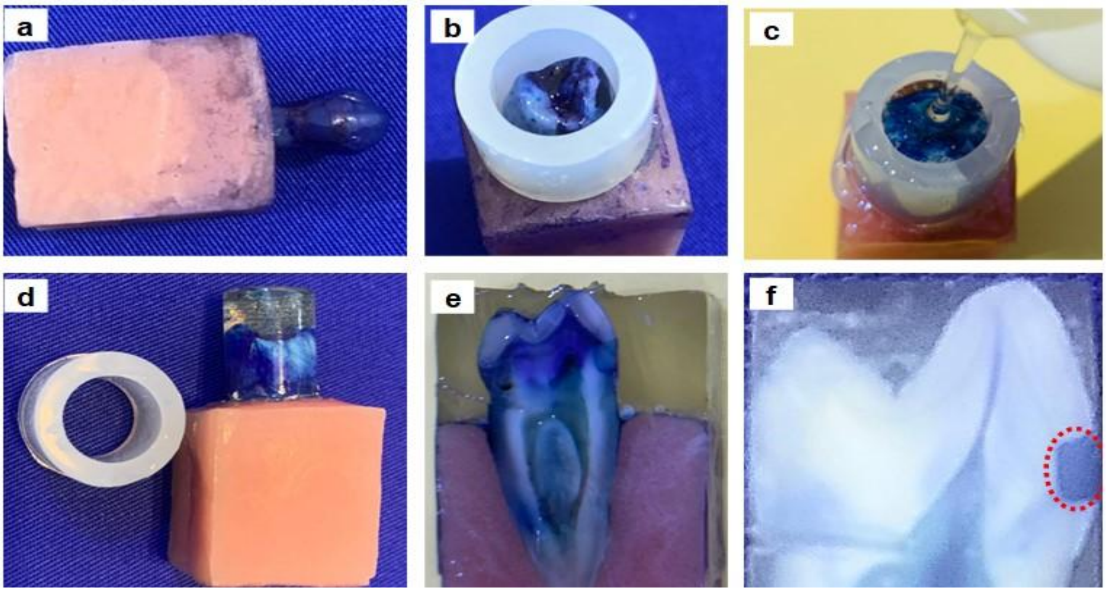

Figure 3. Preparation for micro-leakage measurement: (a) Methylene blue dye after 48 hours (b) blocking with acrylic resin (c)Acrylic resin pouring (d) Demolding of the sample (e) Sectioned sample (f) Cl v within sectioned sample.

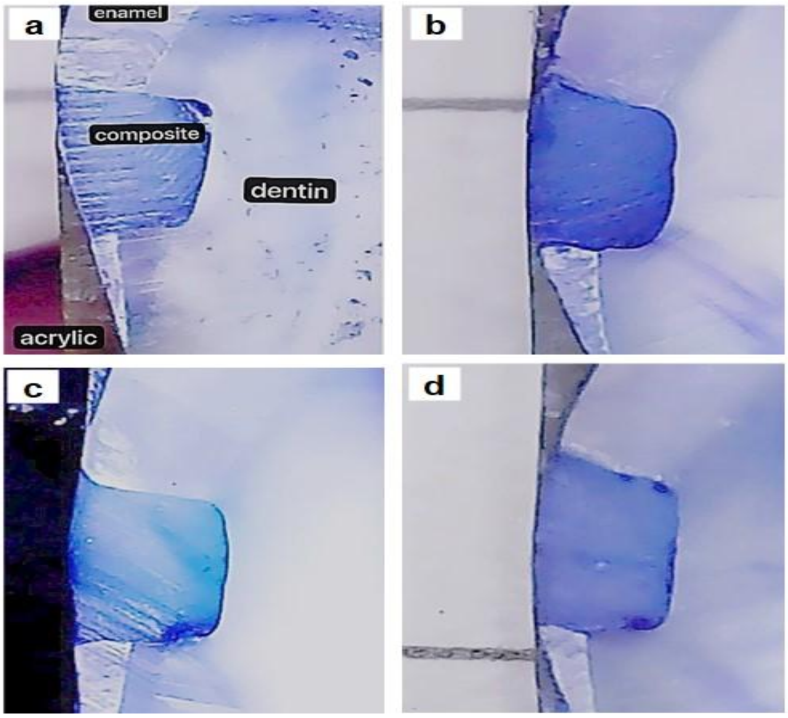

Figure 4. a. Vertical section of class V demonstrating resin composite and ImageJ software were used to measure the microleakage, b. ZENIT, c. EsCom 100, d. Charisma Classic

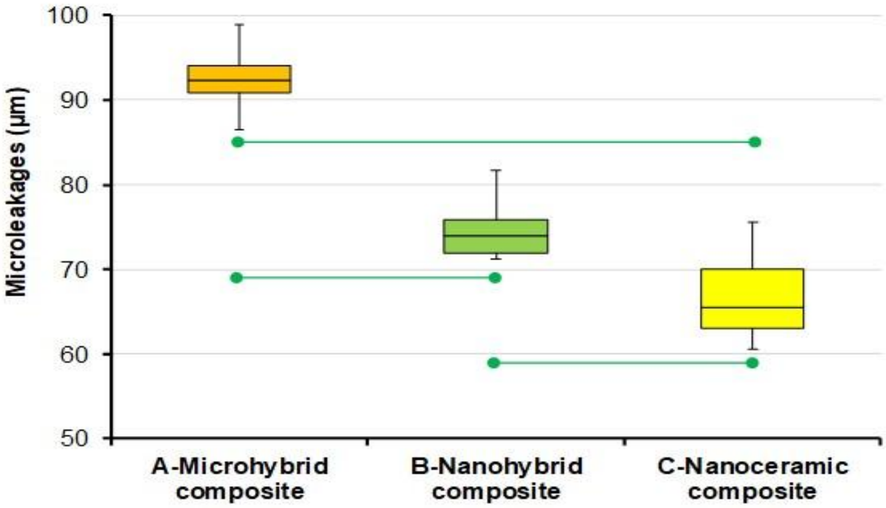

Figure 5. Microleakage count in gingival margins

Table 1. Composition of composite resins used in this study

Product	Type	Composition	Filler loadwt/vol %	Manufacturer
Charisma Classic	Micro hybrid	Bis-GMA, TEGDMA matrix with particle size of 0.005–10 µm, Barium Aluminium Fluoride glass, Pre-polymerized filler.	61 wt/ vol%	Kulzer, Germany
ESCom 100®	Nano hybrid	Bis-GMA, UDMA Barium glass, Silicone dioxide 16–750 nm	70 wt/ vol%	Spident, Korea
ZENIT	Nano Ceramic	Bis-GMA, Bis-EMA, UDMA, BDMA with a glass filler 0.7 µm, Pyrogenic silica 12 nm, Agglomerated nanoparticles.	83 wt%/70 vol%	President Dental, Germany

Note:BIS-GMA: bisphenol A dimethacrylate; Bis-EMA: Bisphenol-A ethoxylated dimethacrylate; UDMA: urethane dimethacrylate; BDMA: butanediol dimethacrylate, TEGDMA:triethylene glycol dimethacrylate.

Table 2. Descriptive statistical results for the tested groups

Groups	Mean	N	Std. Deviation	Minimum	Maximum
A	92.7673	15	3.40694	86.53	99.50
B	74.5653	15	3.34193	71.13	81.67
C	66.4380	15	4.66391	60.49	75.61

Table 3. Tukey HSD results from the microleakage data

(I) VAR01	(J) VAR01	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
A	B	18.20200*	1.40677	0.000	14.7843	21.6197
	C	26.32933*	1.40677	0.000	22.9116	29.7471
B	A	-18.20200-*	1.40677	0.000	-21.6197-	-14.7843-
	C	8.12733*	1.40677	0.000	4.7096	11.5451
C	A	-26.32933-*	1.40677	0.000	-29.7471-	-22.9116-
	B	-8.12733-*	1.40677	0.000	-11.5451-	-4.7096-