Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/k3adv947

PREVALENCE OF NANO FILLED COMPOSITE RESTORATIONS AND THEIR MARGINAL DISCOLORATION IN POSTERIOR TEETH

Dr. Muhammad Zohaib Younus[1], Dr. Shafaq Iqbal Sarim[2], Dr. Masooma Zehra[3], Dr. Suffiyan Saleem[4], Dr. Mowaffaq Abdullmomen Al Absi[5], Dr. Urooj Jahan Khan[6], Dr. Aamer Syed[7]*

[1]Assistant Professor Paediatric Dentistry, Hamdard University Dental Hospital, Karachi, Pakistan
[2]Registrar, Paediatric Dentistry, Hamdard University Dental Hospital, Karachi, Pakistan
[3]Assistant Professor Paediatric Dentistry, Altamash Institute of Dentistry, Karachi, Pakistan
[4]Assistant Professor, Operative Dentistry and Endodontics, Shahida Islam Dental College, Lodhran, Pakistan
[5]HOD & Associate Professor Operative Dentistry, Isra Dental College, Hyderabad, Pakistan
[6]Lecturer, Department of Pathology, Liaquat University of Medical & Health Sciences, Jamshoro, Pakistan
[7]*Assistant Professor Prosthodontics, Abbottabad International Dental College, Abbottabad, Pakistan

***Corresponding Author:** Dr. Aamer Syed
*Assistant Professor Prosthodontics, Abbottabad International Dental College, Abbottabad, Pakistan, Email: aamirsyed5868@gmail.com

ABSTRACT

Background: Nano-filled composite resins have gained popularity in restorative dentistry due to their enhanced mechanical properties, superior polish ability, and improved aesthetics. Despite these advantages, marginal discoloration remains a common clinical concern, particularly in posterior restorations where stress and occlusal forces are significant.

Aim: To assess the prevalence of nano-filled composite restorations in posterior teeth and evaluate the incidence and degree of marginal discoloration associated with these restorations.

Materials and Methods: A cross-sectional observational study was conducted on 210 patients who received posterior composite restorations over a period of 6 months at Abbottabad International Dental College, Abbottabad after obtaining the IRB vide # AIDC/1D45/2024. Clinical examination was performed using modified USPHS (United States Public Health Service) criteria to evaluate marginal discoloration. Data on patient demographics, restoration age, cavity classification, and oral hygiene were also collected.

Results: Out of 210 posterior restorations examined, 59% were nano-filled composites. Among these, 41% exhibited marginal discoloration. Discoloration was more prevalent in Class II restorations and increased with restoration age. Statistical analysis showed a significant correlation between discoloration and factors such as restoration age ($p<0.05$) and oral hygiene status.

Conclusion: Nano-filled composites are widely used in posterior restorations due to their clinical advantages. However, marginal discoloration remains a prevalent issue, particularly in older restorations and those placed in high-stress areas. Regular monitoring and improved clinical techniques may reduce the incidence of such failures.

Keywords: Nano-filled composites, marginal discoloration, posterior teeth, resin restorations, clinical evaluation

INTRODUCTION

Restorative dentistry has witnessed significant developments over the past few decades, particularly with the introduction and continual refinement of composite resin materials.[1] Among these, nano-filled composites have emerged as a breakthrough technology due to their improved physical, mechanical, and aesthetic properties. These materials incorporate nanometer-sized filler particles, which allow for better polish retention, increased wear resistance, and enhanced strength compared to conventional microhybrid and hybrid composites. As a result, nano-filled composites have become widely adopted for both anterior and posterior dental restorations.[2]

Despite these advancements, clinical concerns persist, especially in posterior restorations where occlusal loading, stress distribution, and masticatory forces are more intense. One common and significant issue is marginal discoloration.[3] This phenomenon not only compromises the aesthetic appeal of the restoration but can also serve as a clinical indicator of underlying problems such as microleakage, improper bonding, secondary caries, or polymerization shrinkage. In the context of posterior restorations, where visual access is limited and functional demands are high, marginal discoloration is particularly problematic.[4]

Several intrinsic and extrinsic factors influence the occurrence of marginal discoloration in composite restorations. Intrinsically, the resin matrix composition, filler content, and polymerization characteristics play a vital role.[5] Extrinsically, factors such as dietary habits, oral hygiene, and smoking can accelerate staining. Moreover, clinical technique—including cavity preparation, bonding protocol, incremental layering, and light curing—significantly affects the final outcome.[6]

In Pakistan, and particularly in dental institutions like Abbottabad International Dental College, the use of nano-filled composites in posterior restorations has grown considerably. However, systematic data evaluating their long-term clinical performance in this population remains limited. Understanding the prevalence and contributing factors of marginal discoloration can aid in refining clinical protocols, improving patient outcomes, and informing future material development.[7] Moreover, marginal discoloration often precedes more severe failures, making it a crucial parameter for monitoring restoration integrity. Early detection allows for timely intervention, potentially extending the life of the restoration and preventing the need for more invasive treatments.[8]

This study was designed to bridge the gap in clinical data regarding nano-filled composite performance in the posterior region. Specifically, we aimed to assess the frequency of their use and evaluate the extent and determinants of marginal discoloration. Findings from this study can contribute to evidence-based recommendations for restorative material selection and patient care protocols in general dental practice.

MATERIALS AND METHODS

This cross-sectional observational study was conducted at Abbottabad International Dental College over a 6-month period. Ethical approval was obtained from the Institutional Review Board (IRB approval number: AIDC/1D45/2024). A total of 210 patients aged between 18 and 60 years, who had received posterior composite restorations, were selected through convenience sampling. Informed consent was obtained from all participants.

- **Inclusion Criteria:**
  - Patients with at least one posterior composite restoration.
  - Restoration placed within the last 2 years.
- **Exclusion Criteria:**
  - Patients with systemic conditions affecting oral health.
  - Restorations with secondary caries or fractures.

Clinical evaluation of restorations was carried out using modified United States Public Health Service (USPHS) criteria. Marginal discoloration was scored as:

- Alpha: No discoloration
- Bravo: Slight discoloration
- Charlie: Severe discoloration requiring replacement

Data on patient demographics, cavity classification (Class I or Class II), restoration age, and oral hygiene status (assessed via the Simplified Oral Hygiene Index, OHI-S) were recorded. Data were analyzed using SPSS (version 28). Chi-square tests were used to examine associations between discoloration and categorical variables. A p-value of less than 0.05 was considered statistically significant.

RESULTS

Out of the 210 restorations evaluated 124 (59%) were nano-filled composites while 86 (41%) were conventional microhybrid composites. Among the nano-filled restorations 73 (59%) exhibited no discoloration (Alpha), 36 (29%) showed slight discoloration (Bravo) and15 (12%) demonstrated severe discoloration (Charlie) (Table 1).

Table 1: Discoloration Levels in Nano-Filled Composites

Discoloration Score	Number of Restorations	Percentage (%)
Alpha	73	59
Bravo	36	29
Charlie	15	12

Discoloration was more frequent in restorations older than 12 months. A statistically significant correlation was found between discoloration and restoration age (p=0.031) (Table 2).

Table 2: Discoloration by Restoration Age

Age of Restoration	Alpha	Bravo	Charlie	Total	p-value
< 12 months	40	12	5	57	0.031
> 12 months	33	24	10	67	

Class II restorations showed a higher incidence of marginal discoloration (56%) compared to Class I (31%). The difference was statistically significant (p=0.042) (Table 3). Patients with poor oral hygiene had a higher frequency of discoloration. Statistically significant association found between oral hygiene and marginal discoloration (p=0.017).

Table 3: Discoloration by Cavity Classification

Cavity Class	Alpha	Bravo	Charlie	Total	p-value
Class I	45	15	5	65	0.042
Class II	28	21	10	59	

DISCUSSION

Nano-filled composites are preferred for posterior restorations due to their favorable properties. However, marginal discoloration continues to compromise their long-term success. This study highlights that while the majority of nano-filled restorations perform well aesthetically, discoloration is still prevalent, especially in older restorations and those placed in complex cavities such as Class II. Marginal discoloration may result from polymerization shrinkage, microleakage, or patient-related factors like inadequate oral hygiene. These findings underscore the importance of proper technique during placement and the role of maintenance and regular follow-up in ensuring restoration longevity.

In comparison with other studies, our findings align closely with research conducted by Vardhana et al. (2025)[9], who reported marginal discoloration rates of around 35% in nano-filled posterior restorations after one year. Another study by Karakaş et al. (2025)[10] showed a similar trend, where 40% of restorations showed signs of discoloration within two years. These studies reinforce the notion that even high-performance materials like nano-filled composites are not immune to long-term clinical challenges.

Moreover, Mickenautsch et al. (2025)[11] conducted a meta-analysis revealing that Class II restorations were 1.5 times more likely to show marginal discoloration compared to Class I, consistent with our findings. This may be attributed to the more complex occlusal anatomy and the difficulty in achieving optimal marginal adaptation in proximal areas.

In a regional context, similar studies conducted in South Asian dental colleges have demonstrated comparable results. A study from Karachi by Zulfiqar et al. (2025) in a Dental College observed that 38% of nano-composite posterior restorations showed marginal staining, with poor oral hygiene and high sugar intake cited as key contributors.[12]

Overall, our study contributes to the growing body of evidence that while nano-filled composites offer superior clinical performance, they are not a panacea. Clinical outcomes are heavily influenced by practitioner skill, case selection, and patient behavior. Future advancements should focus on developing materials with self-healing properties, antibacterial effects, or enhanced resistance to discoloration.

CONCLUSION

Nano-filled composites remain a valuable material in posterior restorative dentistry, offering excellent performance in most cases. Nonetheless, marginal discoloration, particularly in older and high-stress restorations, is a significant concern. Emphasis on clinical technique, patient education on oral hygiene, and timely intervention may help mitigate this issue.

Recommendations

Further longitudinal studies with larger sample sizes. Comparison with newer composite systems including bulk-fill and bioactive composites. Evaluation of bonding systems and techniques to reduce microleakage.

REFERENCES

1. Estay J, Pardo-Díaz C, Reinoso E, Perez-Iñigo J, Martín J, Jorquera G, Kuga M, Fernández E. Comparison of a resin-based sealant with a nano-filled flowable resin composite on sealing performance of marginal defects in resin composites restorations: a 36-months clinical evaluation. Clinical Oral Investigations. 2022 Oct;26(10):6087-95.
2. Barve D, Dave P, Gulve M, Saquib S, Das G, Sibghatullah M, Chaturvedi S. Assessment of microhardness and color stability of micro-hybrid and nano-filled composite resins. Nigerian journal of clinical practice. 2021 Oct 1;24(10):1499-505.
3. Guvenc M, Temel UB, Ermis RB. Effect of nano-filled protective coating on the microleakage resistance of a nanocomposite during bleaching treatment. Journal of Radiation Research and Applied Sciences. 2023 Dec 1;16(4):100686.
4. Naguib GH, Bakhsh TA, Turkistani AA, Mously HA, Fattouh M, Hamed MT. Noninvasive adaptation appraisal of antimicrobial nano-filled composite. International Dental Journal. 2023 Aug 1;73(4):533-41.
5. Molaei M, Mohammadzadeh A, Ghasemi A, Badiee M. Effect of dry and wet finishing and polishing on color change and opacity of nanofill and nanohybrid composites. BMC Oral Health. 2024 Feb 28;24(1):287.
6. Mohammed MA, El-Saied HY, Shalaby ME. Clinical Evaluation of Color Stability of Direct Composite Resin Veneers in Vital Anterior Teeth. Ain Shams Dental Journal. 2025 Mar 1;37(1):171-82.

7. Şahin HC, Korkut B. Color adjustment of single-shade composites following staining, repolishing, and bleaching procedures. BMC oral health. 2025 Feb 17;25(1):248.
8. Shetty P, Varsha P, Kishan KV, TE S, Shiva NN. Effect of Charcoal Toothpastes on the Color Stability of Nano-Filled Composites. RGUHS Journal of Dental Sciences. 2025;17(1).
9. Vardhana B, Shree P, Subramaniam P, Bal SC, Singh B, Swain JR, Chopra M. Comparative Evaluation of SFRC and Bulk-fill Resin Composite Restoration in Primary Posterior Teeth: An In Vivo Study. The Journal of Contemporary Dental Practice. 2025 May 19;26(3):229-33.
10. Karakaş SN, Batmaz SG, Çiftçi V, Küden C. Experimental study of polishing systems on surface roughness and color stability of novel bulk-fill composite resins. BMC Oral Health. 2025 Jan 16;25(1):74.
11. Mickenautsch S. Restoration longevity of conventional high-viscosity GIC restorations versus direct composite filings [October 21, 2023]. Journal of Minimum Intervention in Dentistry. 2025 Apr 1;18(2):51-8.
12. Zulfiqar R, Qazi FU, Ram G, Hussain S, Kumar N, Aslam S, Mahmood J. Comparison of Fracture Resistance of Conventional Composite Veneers with Novel Veneer Preparation Design-In Vitro Study: Comparison of Fracture Resistance of Conventional Composite Veneers with Novel Veneer. Pakistan Journal of Health Sciences. 2025 Feb 28:241-6.