Research Square

Preprints are preliminary reports that have not undergone peer review.
They should not be considered conclusive, used to inform clinical practice,
or referenced by the media as validated information.

Clinical evaluation of marginal integrity of tempered and non-tempered bulk fill Vs incrementally packed nanohybrid resin composite restorations: one year randomized clinical trial

Yomna Hossam Elbarbary
October 6 University
Yasmin Atef Ahmed
October 6 University
Marwa Mohamed Temirek
mma25@fayoum.edu.eg

October 6 University

Research Article

Keywords:

Posted Date: April 19th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-9247693/v1

License: This work is licensed under a Creative Commons Attribution 4.0 International License.
Read Full License

Additional Declarations: No competing interests reported.

Abstract

Background

Polymerization shrinkage and marginal degradation remain major challenges in resin composite restorations. Bulk-fill and thermo-viscous composites have been introduced to simplify placement while maintaining marginal integrity.

Aim

The study's objective was to assess the marginal integrity of tempered and non-tempered bulk fill versus incrementally packed nanohybrid resin composite restorations through a one- year clinical follow up conducted at three evaluation intervals.

Methods

A total of sixty adult participants were included after providing informed consent. The study involved posterior teeth with occlusal carious lesions and no clinical signs of irreversible pulpitis. Standardized Class I cavity preparations were performed, followed by restoration using resin-based composite materials. Participants were randomly divided into three groups of equal numbers. **In the first group**, restorations were completed using a preheated bulk-fill composite (VisCalor Bulk, VOCO, Germany). **The second group** received a bulk-fill composite applied at room temperature (X-tra fil, VOCO, Germany). **The control group** was restored using a nanohybrid composite placed incrementally (Grandio, VOCO, Germany). Clinical evaluation was carried out after three, six, and twelve months using modified USPHS criteria. The statistical analysis employed Fisher's exact test. The significance level was found to be ($p \leq 0.05$).

Results

All tested materials demonstrated clinically acceptable marginal integrity throughout the evaluation period. At every evaluation period, there were no statistically significant differences found between the three groups ($p > 0.05$).

Conclusions

Tempered, non-tempered bulk fill, and traditional nanohybrid resin composites showed similar marginal integrity in class I restorations after a year of clinical service, within the constraints of this clinical trial.

Trial registration:

The current study's protocol was registered with identification number PACTR202509620425462 at https://pactr.samrc.ac.za/. (Approval date: 1-8-2024).

INTRODUCTION

Recent advances in restorative dentistry have significantly improved composite resins through enhanced physicomechanical properties and manufacturing technologies, establishing them as reliable materials for direct restorations [1]. Despite these benefits, polymerization shrinkage is still a significant disadvantage because it causes stresses that jeopardize the marginal seal of restorations [2]. Because microgaps greater than 0.5–1.0 μm might allow fluid and bacteria to penetrate, resulting in discoloration, postoperative sensitivity, and eventually restorative failure, gaps at the resin-tooth contact are crucial markers of restoration failure [3]. To reduce polymerization shrinkage stresses, the incremental layering technique was developed, though it remains technique-sensitive and requires specialized instruments and clinical expertise. This limitation spurred the invention of bulk-fill resin-based composites, which may be applied in 4–5 mm increments, lowering operative time and method sensitivity [4]. Bulk-fill composites have different placement processes, which affect their physical and mechanical properties. Internal voids at the tooth-restoration contact are unavoidable and affect both the material and the insertion procedure [5]. Preheating uncured composites has been proven to lower viscosity, improve cavity wetting, increase marginal adaptability, and reduce microleakage. Elevated temperatures improve monomer conversion and handling qualities [6]. The thermo-viscous bulk-fill composite (VisCalor bulk) is a new discovery that combines high viscosity at room temperature with flowable behavior when heated to 68°C using a customized dispenser. This permits the material to retain its shaping capabilities while enhancing insertion flow. [7]. Clinical evaluation remains essential, as in vitro tests cannot fully replicate the oral environment, including dentinal fluid flow, surface tension, and masticatory stresses, which can affect restoration longevity. Although bulk-fill composites are commonly used, there is still not enough clinical evidence about how thermo-viscous preheating affects their marginal integrity compared to other techniques. In addition, few studies have focused on Class I restorations, even though their high C-factor and susceptibility to shrinkage stresses, which makes this area worth further investigation. So, the goal of this study was to assess the marginal integrity of tempered and non-tempered bulk-fill composites vs incrementally placed nanohybrid composites. The null hypothesis was that tempered bulk-fill (VisCalor bulk) and non-tempered bulk-fill (X-tra Fil) resin composites would have similar marginal integrity to incrementally applied nanohybrid resin composites (Grandio).

Materials and Methods

The restorative materials employed in this study are listed in Table 1.

Table (1): Manufacturers, lot number, composition, and specifications of the material.

Material	Specification	Composition	Manfac turer	Lot no.
Vococid	Etching gel	Ortho-phosphoric acid (34.9%).	Voco, Cuxhaven,Germany	**2509261**
Futura bond U	Universal Adhesive	HEMA, Bis-GMA,2-HEDMA,1.6-hexanediyi bismethacrylate, Urethane dimethacrylate, ethanol, nanoparticles of silica catalyst, and acidic adhesive monomer	www.voco.com	**2312644**
VisCalor® bulk	Thermally viscous preheated bulk-fill resin composite	**Matrix**: Aliphatic dimethacrylate with Bis-GMA **Filler**: Filler that is inorganic By weight, the filler content is 83%.		**2316299**
X-tra fil	Bulk-fill posterior resin composite	**Matrix:** Dimethacrylate (Bis-GMA, TEGDMA, and UDMA) **Filler**: Inorganic filler content by weight: 86%		**2312620**
Grandio	Conventional nanohybrid light-curing resin composite used with incremental layering technique	**Matrix**: TEGDMA, UDMA, and Bis-GMA **Inorganic filler**: By weight, the filler content is about 89%.		**2314268**

Study design and ethical approval

The current investigation was structured as randomized, controlled, double-blind, parallel-arm clinical trial with a 1:1:1 allocation ratio. The Research Ethics Committee, Faculty of Dentistry, October 6 University approved the protocol in accordance with the SPIRIT 2013 Statement guidelines (Approval No. RECO6U/15-2024; June 1, 2024). The trial was registered with the Pan African Clinical Trial Registry (PACTR202509620425462; August 1, 2024). All study procedures were conducted at the Conservative Dentistry Clinic, Faculty of Dentistry, October 6 University, Egypt. The trial was self-funded.

Sample size calculation

The sample size was computed using data from [8]. A minimum of 16 restorations per group were required using a chi-square test with an effect size of 0.63, 80% power, and 5% significance. The sample size was expanded to 20 participants per group in order to account for a possible 20% dropout rate, for a total of 60 restorations. The calculation was done with G*Power program (version 3.1.9.4).

Participants recruitment

After a thorough review of their medical and dental histories, adult patients in need of posterior resin composite restorations at the Conservative Dentistry Clinic, Faculty of Dentistry, October 6 University, Egypt, underwent a clinical examination to determine their eligibility. Just 60 of the 105 patients satisfied the requirements for inclusion. Adults between the ages of 18 and 40 who had no fewer than 12 posterior teeth in occlusion, practiced good oral hygiene, and were available for follow-up appointments were eligible to participate. The teeth selected for restoration were permanent molars exhibiting moderate to deep primary Class I carious lesions, were fully erupted, in normal occlusion, and vital with a positive response to cold testing. Patients with systemic diseases, those who were pregnant or lactating, individuals with severe bruxism, known allergies to restorative materials, or undergoing orthodontic treatment were excluded. Additionally, teeth having secondary caries, non-vital status, or irreversible pulpitis were not part of the study. Before enrolment, every participant gave written informed consent.

Randomization and blinding

Participants had been allocated to one of three groups (20 individuals each) using a computer-generated randomization technique on the website (www.random.org). Allocation concealment was ensured by employing sequentially assigned numbers in opaque, sealed envelopes that were only opened during treatment. The study used a double-blind design, meaning that both those participating and the outcome assessors were unaware of the group assignments. However, the operator could not be blinded because to changes in material handling, particularly the need for a heating mechanism for the thermo-viscous composite.

Cavity preparation and restorative procedures

Rubber dam isolation was used for all procedures. Local anesthesia (4% articaine with 1:100,000 epinephrine) was given. Carbide burs under water cooling were used to create Class I cavities. Minimally invasive techniques were used to remove caries. There were no bevels, and internal line angles were rounded. A glass ionomer base was placed on the pulpal floor when the cavity depth got close to 5 mm. After applying 34.9% phosphoric acid to selectively etch the enamel for 20 seconds, the surface was thoroughly rinsed and gently dried with air. A universal adhesive (Futurabond U, VOCO) was then applied to both enamel and dentin per the manufacturer’s recommendations, followed by gentle air thinning to

ensure uniform distribution. The adhesive was subsequently polymerized for 10 seconds using an LED curing unit (Elipar™ S10) operating at an intensity of 1200 mW/cm².

Group allocation

Participants were categorized into three groups based on the type of restorative material used:

Group 1: Tempered bulk-fill composite (VisCalor® Bulk). Prior to placement, the material was heated to 65°C using the dedicated VisCalor dispenser. It was then injected directly into the cavity via a compule with a slim, flexible cannula, facilitating access to narrow and deep areas. Each layer was light-cured for ten seconds after the composite was applied in increments of no more than four millimetres.

Group 2: Non-tempered bulk-fill composite (X-tra fil). Gold-plated hand tools were used to apply the material in thickness increments of up to 4 mm. After that, each increment was light-cured for ten seconds.

Group 3: The control group consisted of a conventional nanohybrid composite (Grandio) that was placed using a classic incremental layering process, with each layer having a maximum thickness of 2 mm. Gold-plated instruments were used for placement, and each increment was light-cured for twenty seconds.

Following completion of the restorations, fine-grit diamond burs and appropriate polishing systems were used under water coolant to finish and polish the surfaces. Articulating paper was used to adjust occlusion.

Our study adheres to CONSORT guidelines and include a completed CONSORT checklist Fig. 1

Outcome assessment

Using modified USPHS criteria for marginal integrity, restorations were assessed at three, six, and twelve months.

Table 2
Modified USPHS criteria[8]

Criteria	Score	Description
Marginal integrity	0	Continuous adaptation between restoration and tooth surface; no explorer engagement.
	1	Explorer engages at the interface, but visible gap.
	2	Gap with visible enamel at the tooth-restoration contact.
	3	Gap with exposed dentin at the tooth-restoration contact.

Two independent, calibrated examiners assessed the restorations. When there was disagreement, discussion was used to come to a decision. Data were gathered, recorded, and subjected to statistical analysis.

Statistical analysis

Percentages and frequencies were used to display the data. The chi-square test was used to compare groups. The Friedman test and the Dunn-Bonferroni post hoc test were used to compare groups across various follow-up periods. A significance criterion of $p < 0.05$ was established. SPSS software (version 26, IBM Corp., Armonk, NY, USA) was used for statistical analysis.

Results

Participant characteristics

60 patients received 60 Class I restorations, which were divided evenly into three groups (n = 20 per group): conventional nanohybrid composite (Group I), high-viscosity bulk-fill composite (Group II), and thermo-viscous composite (Group III). Every restoration was assessed at three, six, and twelve months. Maxillary molars made up 45% of the treated teeth, whereas mandibular molars made up 55%. The study population, which ranged in age from 22 to 36 years (median age = 26.3 years), consisted of 36 females (60%) and 24 males (40%).

Marginal integrity

Intergroup comparison

Marginal integrity scores at three, six, and twelve months are summarized in Table 3 and Fig. 2. No statistically significant differences were found among the three groups at any time point ($p > 0.05$). At 3 months, all restorations across the groups exhibited ideal marginal integrity (Score 0) (100%). At 6 months, Score 0 was observed in 85% of Group I, 90% of Group II, and 95% of Group III. Slight marginal discrepancies (Score 1) were noted in 10%, 10%, and 5% of Groups I, II, and III, respectively. Score 2 was detected in only one restoration (5%) in Group I. However, the differences among the groups were not statistically significant ($p = 0.63$).

By 12 months, Score 0 was reported in 70% of Group I, 85% of Group II, and 90% of Group III. Score 1 occurred in 20% of Group I and 10% of both Groups II and III. Score 2 was identified in 10% of Group I and 5% of Group II, with no instances of Score 3 in any group. Intergroup differences remained statistically non-significant ($p = 0.47$).

Table 3
Comparison between groups regarding marginal integrity:

		GROUP						P value
		Conventional nanohybrid resin Composite		Non tempered Bulk-Fill resin Composite		Tempered Resin Composite		
		Count	Column N %	Count	Column N %	Count	Column N %	
3 Months	Score0	20	100.0%	20	100.0%	20	100.0%	----
	Score1	0	0.0%	0	0.0%	0	0.0%	
	Score2	0	0.0%	0	0.0%	0	0.0%	
	Score3	0	0.0%	0	0.0%	0	0.0%	
6 Months	Score0	17	85.0%	18	90.0%	19	95.0%	0.63
	Score1	2	10.0%	2	10.0%	1	5.0%	
	Score2	1	5.0%	0	0.0%	0	0.0%	
	Score3	0	0.0%	0	0.0%	0	0.0%	
12 months	Score0	14	70.0%	17	85.0%	18	90.0%	0.47
	Score1	4	20.0%	2	10.0%	2	10.0%	
	Score2	2	10.0%	1	5.0%	0	0.0%	
	Score3	0	0.0%	0	0.0%	0	0.0%	

Intragroup comparison

There were no statistically significant changes over time within any group ($p > 0.05$) in the intragroup comparison across evaluation periods (Table 4, Fig. 3).

The percentage of restorations with Score 0 in Group I dropped from 100% at three months to 85% at six months and 70% at twelve months, but this decline was not statistically significant ($p = 0.13$).With no statistically significant change over time ($p = 0.37$), Score 0 in Group II dropped from 100% at three months to 90% at six months and 85% at twelve months.At 3, 6, and 12 months, respectively, 100%, 95%, and 90% of restorations in Group III had Score 0, with no statistically significant improvement ($p = 0.34$).

Table 4
Comparison between 3 months, 6 months, and 1 year within each group regarding marginal integrity:

		Time						P value
		3 months		6 months		12 months		
		Count	Column N %	Count	Column N %	Count	Column N %	
Conventional nanohybrid resin Composite	Score 0	20	100.0%	17	85.0%	14	70.0%	0.13
	Score 1	0	0.0%	2	10.0%	4	20.0%	
	Score 2	0	0.0%	1	5.0%	2	10.0%	
	Score 3	0	0.0%	0	0.0%	0	0.0%	
Non tempered Bulk-Fill resin Composite	Score 0	20	100.0%	18	90.0%	17	85.0%	0.37
	Score 1	0	0.0%	2	10.0%	2	10.0%	
	Score 2	0	0.0%	0	0.0%	1	5.0%	
	Score 3	0	0.0%	0	0.0%	0	0.0%	
Tempered Resin Composite	Score 0	20	100.0%	19	95.0%	18	90.0%	0.34
	Score 1	0	0.0%	1	5.0%	2	10.0%	
	Score 2	0	0.0%	0	0.0%	0	0.0%	
	Score 3	0	0.0%	0	0.0%	0	0.0%	

Discussion

Resin composite restorations have traditionally been placed using an incremental layering approach, where the material is applied in small increments to improve curing efficiency and minimize shrinkage-related stresses. Although this method is widely accepted, it requires careful execution and additional clinical time, with the possibility of incorporating voids or contaminants between layers. [9].

Consequently, bulk-fill resin composites were introduced to permit placement in thicker increments of up to 4–5 mm. This was achieved through modifications such as increased translucency, advanced

photoinitiator systems, and stress-relieving resin matrices [10]. Bulk-fill composites are available in flowable and packable formulations. Flowable materials exhibit better cavity wall adaptation because of their low viscosity, whereas packable composites provide improved mechanical strength due to their higher filler content.

To combine the advantages of both types, preheating of packable composites has been proposed to temporarily reduce viscosity, thereby enhancing flow and cavity adaptation without negatively affecting mechanical properties [11]. Previous studies have shown that preheating resin composites can improve handling characteristics by decreasing viscosity, increasing wettability, and enhancing marginal adaptation, which may help reduce microleakage at the tooth–restoration interface [3]. Although in vitro studies provide valuable preliminary information about restorative materials, they cannot fully simulate the complex oral environment. Therefore, well-designed randomized clinical trials are essential to evaluate the clinical performance and longevity of restorative materials under clinical conditions.

The success of resin composite restorations depends on several factors, including bonding effectiveness, application and curing techniques, cavity configuration, operator experience, and patient-related variables such as occlusal load and oral environment [12]. Accordingly, the aim of the present study was to clinically evaluate the marginal integrity of tempered and non-tempered bulk-fill composites compared with incrementally placed nanohybrid resin composite restorations after one year.

One of the biggest problems with resin composite restorations is polymerization shrinkage.

When composite contraction is restricted by adhesion to cavity walls, stresses may develop at the tooth–restoration interface, especially in cavities where the configuration factor is high. such as Class I preparations. These stresses can adversely affect marginal integrity and potentially compromise restoration longevity [13]. In the present study, because of their high C-factor, which restricts composite flow during polymerization and raises contraction stresses at the bonding interface, Class I cavities were chosen. These strains could make marginal leakage and postoperative sensitivity more possibly occur. [7].

Grandio was used as the control material because of its consistent marginal adaption and known clinical performance[14]. Because of its advantageous mechanical and physical properties, such as its high filler content, sufficient depth of cure, and decreased polymerization shrinkage, the bulk-fill composite X-tra Fil was chosen as the intervention group [13]. VisCalor Bulk (VOCO, Cuxhaven) is a nano-hybrid bulk-fill composite that shows high viscosity at ambient temperature but becomes more flowable when heated to 65°C. Thermo-viscous technology is a new technique in this industry. The ability to respond to internal line angles and undercut areas is enhanced by this brief decrease in viscosity. The material quickly cools after being inserted into the hollow, regaining its sculptable consistency. It was selected as the second intervention group because of its dual behavior, which combines the mechanical qualities of packable materials with the handling advantages of flowable composites while preserving comparatively low polymerization shrinkage and shrinkage stress [15].

Numerous aspects associated with the patient, operator, and material qualities affect the therapeutic lifetime of restorative materials. With yearly failure rates of roughly 1.8% after five years and 2.4% after ten, long-term clinical trials have shown that posterior composite restorations can exhibit good survival rates.[16]. Clinical assessment of the restorations in this study was performed using the modified USPHS (Ryge) criteria, which remain among the most widely applied systems for assessing restorative materials' clinical efficacy [17]. Restoration failure may occur at different time intervals. Early failures are usually associated with technical or procedural factors and may present as postoperative symptoms such as pain or discomfort, whereas late failures are more commonly related to material deterioration, secondary caries, or restoration fracture [18]. All three restorative groups showed satisfactory marginal integrity over the course of the 12-month examination, and there were no statistically significant differences between them. Over time, there was a little decrease in marginal adaptation, most likely as a result of aging-related processes such thermal stress, hydrolytic degradation, and occlusal loading.

The preheated composite showed the most favorable outcomes, likely reflecting improved flowability and cavity adaptation, while conventional incremental composites exhibited slightly higher minor discrepancies. Bulk-fill composites performed acceptably, benefiting from reduced polymerization stress and greater depth of cure. Overall, these results support the null hypothesis. The absence of significant differences among the evaluated materials may indicate that contemporary composite systems have reached a level of clinical reliability where variations in placement technique or viscosity modification do not substantially influence marginal integrity in Class I restorations during short-term follow-up

The present results are consistent with previous randomized clinical trials and systematic reviews reporting comparable marginal performance between bulk-fill and incremental techniques [19]; [20]; [21]; [22]; [23]. These findings suggest that simplified bulk placement does not adversely affect marginal integrity in Class I restorations during short-term follow-up. Regarding thermo-viscous technology, clinical studies evaluating thermo-viscous or preheated composites did not demonstrate statistically superior marginal performance compared with conventional materials [8]; [24]; [25]; [26]. The present findings agree with these clinical outcomes. Although slightly better marginal scores were observed for the thermo-viscous material, the differences were not statistically significant.

Conversely, a small number of clinical studies have suggested that thermal conditioning may improve the marginal adaptation of certain resin composites. For example, [27], [28], and[29] reported better marginal adaptation when composites were placed after preheating compared with the same materials used at room temperature. Nevertheless, these investigations primarily assessed the effect of thermal manipulation within the same composite system rather than comparing different composite formulations. Consequently, the observed improvements are more likely related to optimization of the handling and adaptation properties of a particular material following preheating, rather than indicating a general superiority of thermally conditioned composites over other contemporary restorative systems.

Preheating has been shown to improve marginal sealing in laboratory studies [4], [30], [31], and [32]. However, these researches were carried out in controlled in vitro settings, which might not accurately

reflect intraoral mechanical and temperature stressors. The lack of functional loading in in vitro investigations, variations in aging techniques, cavity configuration, and evaluation criteria could all be contributing factors to the disparity between laboratory and clinical results. Additionally, the results should not be extrapolated to Class II restorations because the current study was restricted to Class I cavities.

One limitation of the present study relates to the duration of follow-up. While the one-year evaluation period provides relevant clinical findings, it may not fully represent the long-term performance of the restorative approaches. Extending the follow-up in future studies could offer a clearer understanding of how marginal integrity evolves over time. Additionally, as the investigation was limited to Class I cavities, including Class II restorations in future research would allow assessment under more complex cavity configurations and broader clinical conditions.

Conclusion

We can draw the following conclusions within the constraints of this 12-month randomized clinical trial:

1. In terms of marginal integrity, tempered bulk-fill, non-tempered bulk-fill, and conventional nanohybrid resin composites showed equivalent clinical outcomes in Class I posterior restorations.
2. Without sacrificing marginal adaptation during the first year of clinical service, tempered and non-tempered bulk-fill composites may be dependable substitutes for conventional incremental techniques for treating Class I cavities.

Recommendation:

Longer follow-up research is required to verify that these results hold up over time.

Abbreviations

- Bis-GMA
Bisphenol A diglycidylmthacrylate
- UDMA
Urethane dimethacrylate
- TEGDMA
Triethyleneglycoldimethacrylate
- Bis-EMA
Bisphenol A polyethylene glycol dietherdimethacrylate
- PEGDMA
Polyethyleneglycoldimethacrylate

Declarations

Ethics approval and consent to participate:

The Research Ethics Committee, Faculty of Dentistry, October 6 University approved the protocol in accordance with the SPIRIT 2013 Statement guidelines (Approval No. RECO6U/15-2024; June 1, 2024). The trial was registered with the Pan African Clinical Trial Registry (PACTR202509620425462; August 1, 2024).

Competing interests

The authors declare no competing interests

Consent for publication

Not applicable

Funding

Open access funding is provided by The Science, Technology & Innovation Funding Authority (STDF) in cooperation with The Egyptian Knowledge Bank (EKB). The authors do not have any financial interests in the products used in this article. Also, the authors declare that they have no competing interests regarding authorship and/or publication of this paper. The Science, Technology & Innovation Funding Authority (STDF) provides open-access funding in cooperation with the Egyptian Knowledge Bank (EKB).

Author Contribution

All authors contributed to conception or design, contributed to acquisition, analysis, or interpretation of data. Y.H.E. drafted the manuscript, Y.A.A. and M.M.T. critically revised the manuscript for important intellectual content. M.M.T. gave final approval. All authors agreed to be accountable for all aspects of work ensuring integrity and accuracy.

Acknowledgements:

No acknowledgements are necessary. This work was completed without external support

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

References

1. Yenidünya ÖG, Erdem A, Akgül N, Yazkan B, Özcan M. Influence of Preheating Procedure and Polymerization Modes on Degree of Conversion of Contemporary Resin Composites. Curr Res Dent Sci. 2025;35:65–70. https://DOI.org/10.17567/currresdentsci.1617446.
2. Jehad R. Journal of Clinical Medicine and Surgical Advance The Effect of Bulk-Fill Composites on Microleakage and Marginal Integrity. 2025.
3. attia reham. Two-year clinical performance and marginal integrity evaluation of high C-factor occlusal cavities restored with preheated Bulk-Fill, SonicFill and incremental fill composite resin. Egypt Dent J. 2021;67:2673–93. https://DOI.org/10.21608/edj.2021.65934.1537.
4. Abdelaziz A, abdou A. Effect of preheating of bulk-fill resin dental composite on polymerization shrinkage strain. Egypt Dent J. 2023;69:3273–80. https://DOI.org/10.21608/edj.2023.225789.2660.
5. Akah M. Microleakage of three contemporary bulk fill resin composites; Thermoviscous preheated, sonic fill and flowable bulk fill in class I cavities: In vitro study. Egypt Dent J. 2022;68:985–94. https://DOI.org/10.21608/edj.2021.98946.1812.
6. Temirek MM, Ahmed YA. Wear and Gap formation assessment of thermos-viscous resin composites. Egypt Dent J. 2024;70:3835–46. https://DOI.org/10.21608/edj.2024.300929.3098.
7. Ibrahim HA, Abdalla AI, El-Sayed HY. Clinical study of different composite resin systems in Class I cavities (an 18-month randomized clinical trial). Braz Dent Sci. 2023;26. https://DOI.org/10.4322/bds.2023.e3737.
8. Ahmed YA, Hassanein OE, Abielhassan MH, Mohamed MM. Clinical assessment of thermo-viscous versus conventional bulk-fill resin composites in proximal compound posterior restorations. Int J Health Sci (Qassim). 2022;4107–22. https://DOI.org/10.53730/ijhs.v6ns8.13121.
9. Fahad Alharbi N, Taisir Al-marhoun D, Mohammed Hummadi W, Hamzah Ali Dar Salamah H, Abdulelah Altowerki A. Sultan Al-qattoumah A, Comparative Evaluation Of Bulk-Fill And Incremental Techniques On Microleakage And Marginal Adaptation Of Composite Restorations: A Systematic Review. 32:2025.
10. Sengupta A, Naka O, Mehta SB, Banerji S. The clinical performance of bulk-fill versus the incremental layered application of direct resin composite restorations: a systematic review. Evid Based Dent. 2023;24:143. https://DOI.org/10.1038/s41432-023-00905-4.
11. Ramadan NA, Hasan MMA, Abdalla AI. Marginal adaptation of thermoviscous bulk-fill composite in class II cavities. Tanta Dent J. 2023;20:77–83. https://DOI.org/10.4103/tdj.tdj_50_22.
12. Balkaya H, Arslan S. A Two-year Clinical Comparison of Three Different Restorative Materials in Class II Cavities. Oper Dent. 2020;45:E32–42. https://DOI.org/10.2341/19-078-C.
13. Suneelkumar C, Harshala P, Madhusudhana K, Lavanya A, Subha A, Swapna S. Clinical performance of class I cavities restored with bulk fill composite at a 1-year follow-up using the FDI criteria: a randomized clinical trial. Restor Dent Endod. 2021;46. https://DOI.org/10.5395/rde.2021.46.e24.
14. ahmed rana. F haridy M, H omima gallab. AIN SHAMS DENTAL JOURNAL; 2020.

15. Kandel EMA, Etman WM, Geniad TM. Adaptability of thermo-viscous versus sonicfill-activated bulk fill composite resin restorations. Tanta Dent J. 2023;20:281–7. https://DOI.org/10.4103/tdj.tdj_28_22.
16. Opdam NJM, Van De Sande FH, Bronkhorst E, Cenci MS, Bottenberg P, Pallesen U, et al. Longevity of posterior composite restorations: A systematic review and meta-analysis. J Dent Res. 2014;93:943–9. https://DOI.org/10.1177/0022034514544217.
17. Motamedosanaye V, Akbari H, Ziaaddini S, Mostafazadehbakhtiyary M, Langari AS. Clinical assessment of marginal and bulk fractures and discoloration in posterior composite after 12 to 36 months: A retrospective study. J Clin Exp Dent. 2025;17:848–54. https://DOI.org/10.4317/jced.62724.
18. Demarco FF, Collares K, Correa MB, Cenci MS, de Moraes RR, Opdamz NJ. Should my composite restorations last forever? Why are they failing? Brazilian Oral Research. 2017;31:92–9.https://DOI.org/10.1590/1807-3107BOR-2017.vol31.0056.
19. Veloso SRM, Lemos CAA, de Moraes SLD, do, Egito Vasconcelos BC, Pellizzer EP, de Melo Monteiro GQ. Clinical performance of bulk-fill and conventional resin composite restorations in posterior teeth: a systematic review and meta-analysis. Clin Oral Investig. 2019;23:221–33. https://DOI.org/10.1007/s00784-018-2429-7
20. Sengupta A, Naka O, Mehta SB, Banerji S. The clinical performance of bulk-fill versus the incremental layered application of direct resin composite restorations: a systematic review. Evid Based Dent. 2023;24:143. https://DOI.org/10.1038/s41432-023-00905-4.
21. Arbildo-Vega HI, Lapinska B, Panda S, Lamas-Lara C, Khan AS, Lukomska-Szymanska M. Clinical effectiveness of bulk-fill and conventional resin composite restorations: Systematic review and meta-analysis. Polymers. 2020;12. https://DOI.org/10.3390/polym12081786.
22. Jehad R. Journal of Clinical Medicine and Surgical Advance The Effect of Bulk-Fill Composites on Microleakage and Marginal Integrity. 2025.
23. Zailai A, Alharbi ZA, Dowairi F, Halawi O, Ghulaysan SA, Safhi RE, et al. Clinical Performance and Survival of Bulk-Fill Resin Composites Compared to Conventional Resin Composites in Posterior Permanent Teeth: A Systematic Review and Meta-analysis. Cureus. 2025. https://DOI.org/10.7759/cureus.99792.
24. Elkaffas AA, Eltoukhy RI, Elnegoly SA, Mahmoud SH. 36-Month Randomized Clinical Trial Evaluation of Preheated and Room Temperature Resin Composite. Oper Dent. 2022;47:11–9. https://DOI.org/10.2341/20-301-C.
25. Ibrahim I, Helal H, Ibrahim SH, Riad M. 24 Months clinical prospective of proximal restorations with repeated preheating bulk fill composite up to ten cycles: randomized controlled trial. Sci Rep. 2024;14. https://DOI.org/10.1038/s41598-024-73200-6.
26. Yazici AR, Kutuk ZB, Ergin E, Karahan S, Antonson SA. Six-year clinical evaluation of bulk-fill and nanofill resin composite restorations. Clin Oral Investig. 2022;26:417–26. https://DOI.org/10.1007/s00784-021-04015-2.

27. Mohammed A, Hussein Y, Wedad E. Clinical Evaluation of Pre-heated Versus Un-heated Bulk Fill Composite Resin in Class I Cavities. IOSR Journal of Dental and Medical Sciences (IOSR-JDMS) e-ISSN. 2021;20:59–77. https://DOI.org/10.9790/0853-2005065977
28. Elkady M, Abdelhakim SH, Riad M. Impact of repeated preheating of bulk-fill resin composite on postoperative hypersensitivity; a randomized controlled clinical trial. BMC Oral Health. 2024;24. https://DOI.org/10.1186/s12903-024-04170-4.
29. Taufin N, Priyadarshini BI, Shankarappa P, Ballullaya SV, Devalla S, Gavini S. Eighteen-month clinical performance of preheated nanoceramic resin-based composites in Class I occlusal cavities: A randomized clinical trial. J Conservative Dentistry. 2022;25:47–53. https://DOI.org/10.4103/jcd.jcd_492_21.
30. Darabi F, Tayefeh-Davalloo R, Tavangar SM, Naser-Alavi F, Boorboo-Shirazi M. The effect of composite resin preheating on marginal adaptation of class II restorations. J Clin Exp Dent. 2020;12:e682–7. https://DOI.org/10.4317/JCED.56625.
31. Yang JNC, Raj JD, Sherlin H. Effects of preheated composite on micro leakage-an in-vitro study. J Clin Diagn Res. 2016;10:ZC36–8. https://DOI.org/10.7860/JCDR/2016/18084.7980.
32. Taraboanta I, Stoleriu S, Iovan G, Moldovanu A, Georgescu A, Rusu Negraia M et al. Evaluation of Pre-heating Effects on Marginal Adaptation of Resin-based Materials.

Figures

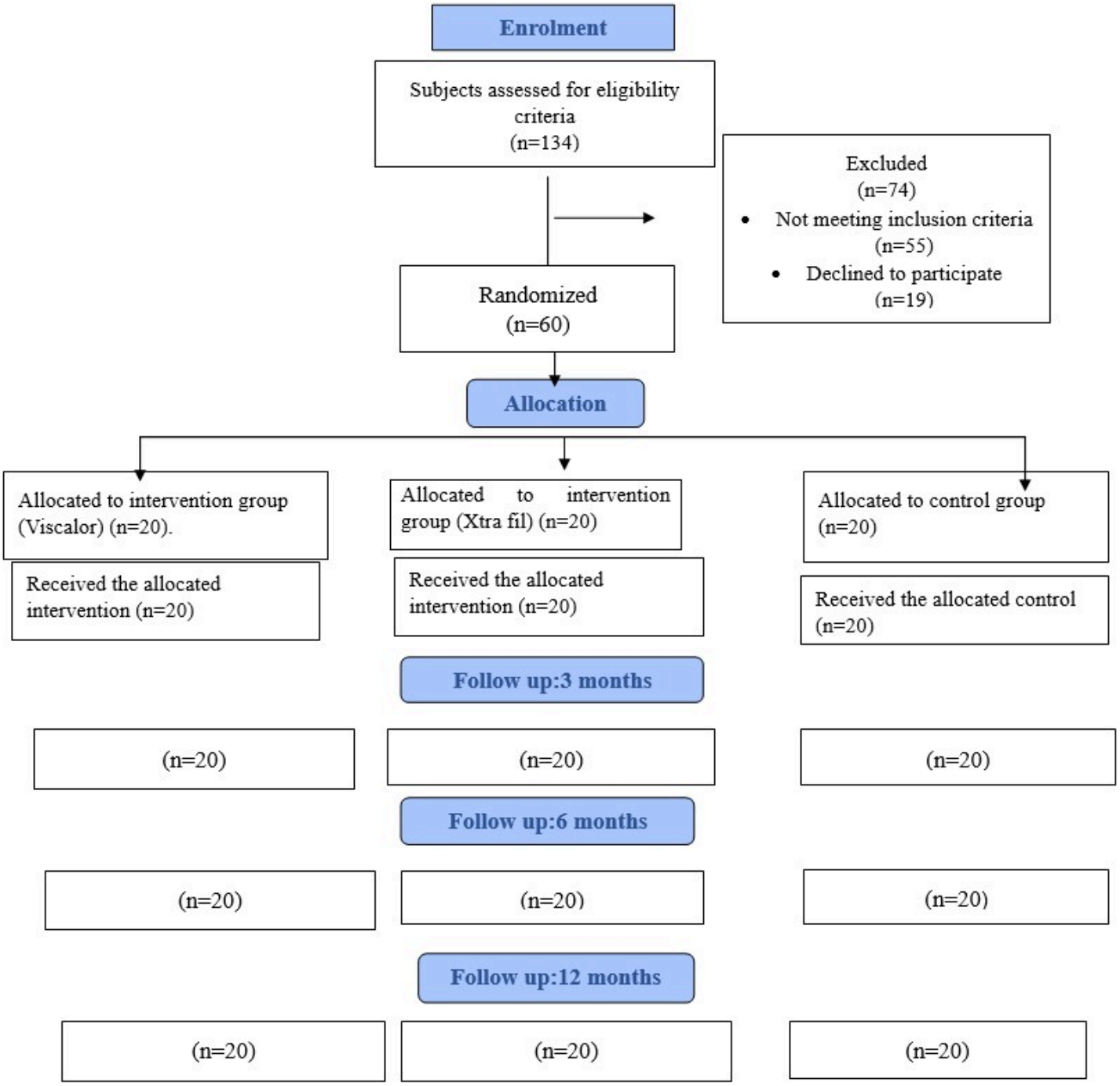


Figure 1

CONSORT flowchart of the clinical trial

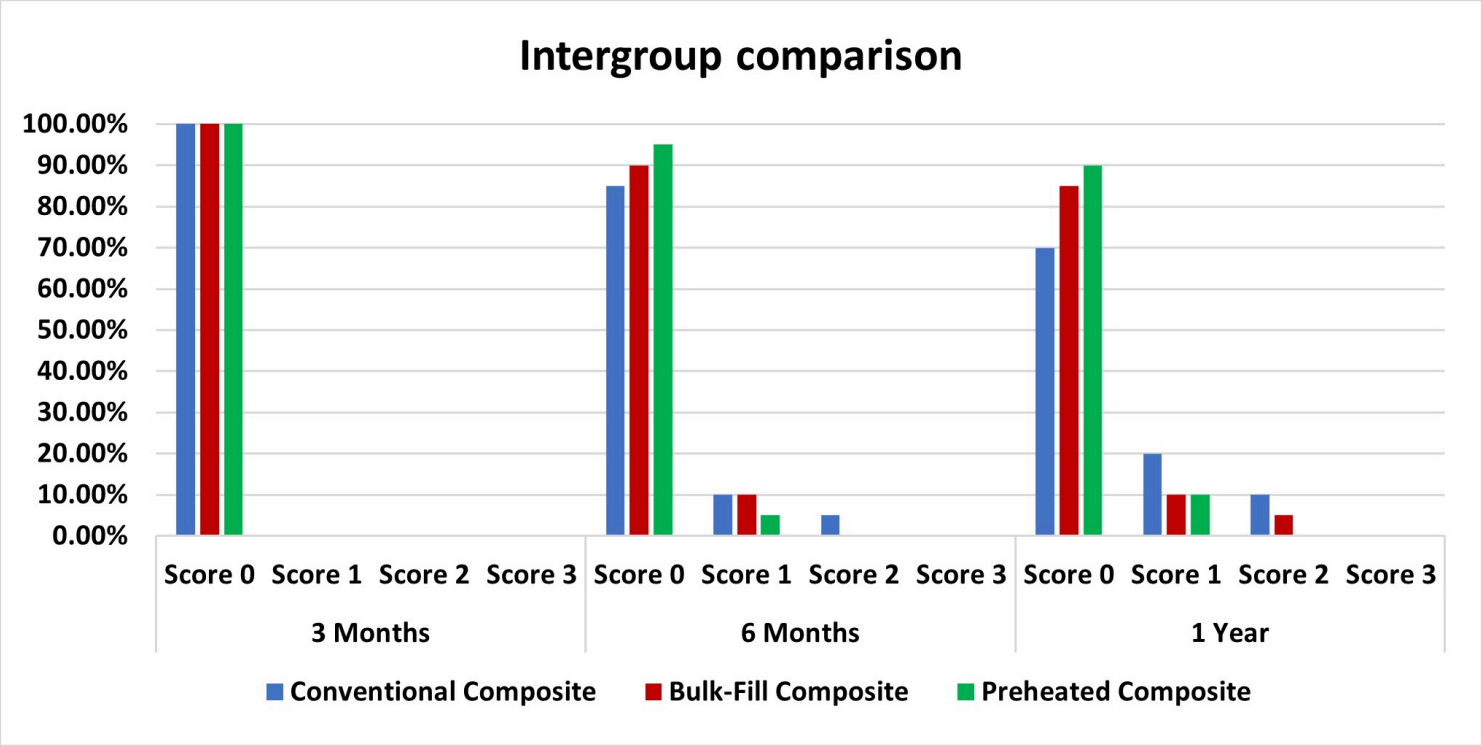


Figure 2

Stacked bar chart represents comparison between groups regarding marginal integrity.

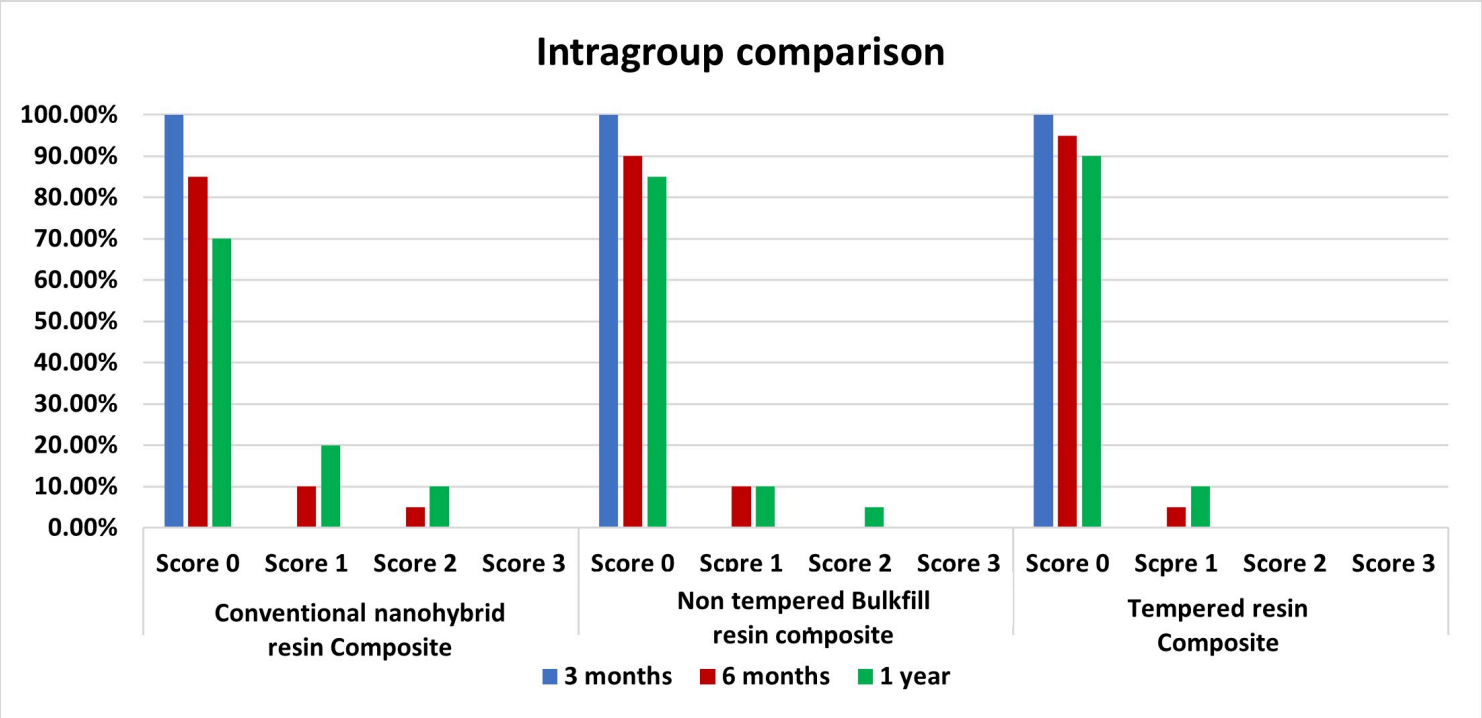


Figure 3

Stacked bar chart represents comparison marginal integrity at 3 months, 6 months and after 1year within each group.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- CONSORT2010ChecklistClinicalevaluationofmarginalintegrityoftemperedandnon.pdf