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Original Article

Evaluation of Modeling Resin Insertion Versus Incremental Composite Placement Technique in Class I Posterior Restorations: An 18-month Randomized Clinical Trial

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Abstract

Aim: This study aimed to evaluate and compare the clinical performance of modeling resin insertion technique versus incremental composite placement technique in Class I posterior composite restorations over an 18-month follow-up period.
Subjects and methods: Fifty participants requiring Class I composite restorations were randomly assigned into two equal groups (n=25). Group 1 received restorations using modeling resin (Tetric® N-Ceram Nano-hybrid incremental composite, Ivoclar, Switzerland) with Modeling Resin (Bisco, USA), while Group 2 received restorations (Tetric® N-Ceram Nano-hybrid incremental composite, Ivoclar, Switzerland) without modeling resin. Restorations were evaluated at baseline, 3, 6, 12, and 18 months using modified USPHS criteria
Results: No statistically significant differences were found between both groups for any criteria across all time intervals ($p > 0.05$). At 18 months, the survival rate did not differ significantly between groups ($p = 0.18978$). Modeling resin group showed 68% alpha scores while conventional group showed 84%, all within clinically acceptable limits ($p = 0.2513$).
Conclusion: The clinical performance of Modeling resin and conventional incremental application techniques was similar and found to be clinically acceptable after 18 months of clinical use.
Clinical Significance: Modeling resin can be effectively used to mold resin composite restorations, offering acceptable clinical performance in posterior class I cavity restorations.
Keywords: Modeling resin, Incremental layering technique, Posterior composite restorations, Randomized clinical trial.

Introduction

Resin composite (RBC) materials are greatly favored in esthetic dentistry due to their great bonding ability, ease of repair, and close resemblance to nature **(Yadav & Kumar, 2019).** Their esthetic and mechanical qualities meet the growing need for restorations that are aesthetically pleasing. Composite use is however hindered by polymerization shrinkage, which can compromise marginal integrity and durability **(Mohamed et al., 2021).** Besides, the material's high viscosity and tackiness discourage proper cavity adaptation, which makes it vulnerable to voids and failure especially in Class I high C-factor cavities **(Dionysopoulos et al., 2014).** Incremental layering methods are conventionally employed to control the constraints of polymerization

shrinkage and poor cavity adaptation **(Sengupta et al., 2023).**

Apart from improving handling, Manufacturers have developed special materials known as modeling liquids (MLs), which are primarily hydrophobic methacrylate-based resins like UDMA, Bis-GMA, and TEGDMA, that help reduce finishing time and improve surface appearance without influencing the structure of the composite **(Perdigão et al., 2021; Bayraktar et al., 2021).** However, there are concerns about their potential deleterious effect on the physical and surface characteristics of the final restoration **(Sedrez-Porto et al., 2017).** There remains no evidence available regarding the influence of different modeling agent formulations on surface properties such as microhardness, roughness, and color stability.

To bridge this knowledge gap, the present study aimed to clinically evaluate and compare the performance of the modeling resin insertion technique versus the conventional incremental placement technique in Class I posterior restorations over an 18-month period, using the modified United States Public Health Service (USPHS) criteria for assessment. The null hypothesis stated that no difference would be observed between the two techniques after 18 months of follow-up.

Materials and Methods

A. Materials

The materials & Lot number, specifications, chemical composition and manufacturer are shown in **(Table 1).**

B. Methods

Trial registration and ethical approval

The protocol is registered on clinical trials (www.clinicaltrials.gov) with I.D.: NCT05801458. Ethical approval was conducted by the Research Ethics Committee (REC), Faculty of Dentistry, Cairo University on 26/06/2023 with identification number: 7623.

Study setting and trial design

The study was conducted at the clinic of the Conservative Dentistry Department, Faculty of Dentistry, Cairo University. A randomized controlled clinical trial design was employed, consisting of two parallel groups with a 1:1 allocation ratio within an equivalence framework.

Recruitment

Participants were recruited using a convenient consecutive sampling method until the required sample size was reached, after which they were randomly assigned into two groups (n = 25) according to the tested interventions. After being informed about the study, eligible participants provided written consent in Arabic.

Eligibility criteria

Participants, aged 25 to 45, were required to have good oral hygiene, no active dental issues, normal occlusion, and the ability to attend follow-ups. Exclusions included individuals with a high caries index, uncontrolled parafunctional habits, orthodontic appliances, or pregnancy.

Sample size calculation

According to **Attia et al. (2021)**, the response within each study group followed a normal distribution. Power analysis was conducted using the marginal discoloration scores of the restored surfaces at the 18-month follow-up as the primary outcome measure. An effect size of $w_1 = 0.8$ and $w_2 = 0.96$ was assumed. With a significance level (α) set at 5% and a statistical power of 80%, the least needed sample size was calculated to be 41 participants. To compensate for a possible 20% dropout rate, the sample size was increased to 50 participants (25 per group).

Allocation of participants

Sequence generation and allocation concealment

The random allocation sequence was generated using a simple randomization method. A computer-generated list of random numbers (https://www.random.org/) ranging from 1 to 50 was prepared and divided into two columns representing the intervention and comparator groups. Allocation concealment was ensured through the use of sealed, opaque envelopes, from which the operator selected. Both participants and outcome assessors were blinded to the materials applied. A CONSORT flow diagram illustrating the progression of participants throughout the trial is presented in **Figure 1.**

Clinical Restorative Procedures

Patient Selection and Diagnostic chart filling

Diagnostic assessment chart for each patient was recorded.

Field Preparation

Prophylactic polishing was performed to clean the tooth surfaces and eliminate any remaining dental plaque, after which multiple isolation was achieved using a rubber dam.

Cavity Preparation Steps

Cavity preparation adhered to minimally invasive dentistry principles, focusing on ICDAS 3 and 4 lesions. Standardized dimensions were maintained, with a depth of 0.5 mm below the DEJ and a width of one-third the intercuspal distance. Adhesive cavity designs with rounded internal angles were used to minimize stress. Caries removal involved carbide burs under water cooling, followed by manual excavation and margin refinement with fine-grit diamond burs.

Restorative Procedure Steps

Adhesion protocol

An etch-and-rinse adhesive protocol was employed following the manufacturer's instructions. Enamel was etched with 37.5% phosphoric acid for 30 seconds and dentin for 15 seconds, followed by thorough rinsing and gentle drying. A single layer of Tetric® N-Bond Universal adhesive was applied to the prepared surface, agitated for 20 seconds, air-thinned for 5 seconds, and then light-cured for 20 seconds using a LED unit at an intensity of 650 mW/cm².

Intervention: Modeling Resin Insertion Technique & Comparator: Conventional Incremental Placement Technique

Both groups received restorations using Tetric® N-Ceram nano-hybrid composite applied incrementally, with each oblique layer not exceeding 2 mm in thickness. The procedure was identical for both groups except for the use of modeling resin in the intervention group. In that group, a drop of modeling resin was placed in a mixing well, and a modeling brush was dipped into the resin, blotted to remove excess, and used to shape each composite increment before curing. This process was repeated for each layer, with every increment light-cured for 20 seconds using a LED curing unit. The number of increments varied depending on the size of the cavity.

Finishing and polishing steps

Following completion of the restoration, the rubber dam was removed, and occlusion was assessed using articulating paper. Any premature contacts were adjusted using fine-grit round diamond burs. Final polishing was performed using low-speed KENDA dental polishers (Coltene, Altstätten, Switzerland), utilizing rubber abrasive points and discs to achieve a smooth and glossy surface finish.

Outcome Assessment

Restorations were evaluated using the modified USPHS criteria by two trained, calibrated, and blinded assessors at baseline and after 3, 6, 12, and 18 months, according to the outcome chart provided. Any discrepancies in scoring were resolved through discussion until consensus was achieved **(Table 2, Figures 2 & 3).**

Primary Outcome

Marginal discoloration of restorations assessed using the modified USPHS criteria **Table (2), Demirci et al. (2018) and Karaman et al. (2017).**

Secondary Outcomes

Other clinical parameters were also assessed using the modified USPHS criteria, including marginal integrity, color match, surface roughness, anatomic form, retention of the restoration, secondary caries, and postoperative sensitivity. The assessment methods and scoring for these parameters are presented in **Table (2)**.

Statistical Analysis

Data analysis was performed using MedCalc version 22. Categorical variables were expressed as frequencies and percentages. The Chi-squared test was used for intergroup comparisons, with significance set at $P \leq 0.05$. Intragroup comparisons were assessed using Cochran's Q test with Bonferroni correction ($P \leq 0.005$). Relative risk (RR) was calculated to determine clinical significance. Kaplan–Meier survival analysis and the Log-rank test were used to compare group outcomes, with a 95% confidence interval and 80% statistical power applied to all two-tailed tests.

Results

Demographic data

All 50 participants accomplished the 18-month follow-up, achieving a 100% retention rate. No statistically significant differences were found between the groups regarding sex, age, or gender distribution ($P = 0.3948$) **Table (3)**, nor in teeth distribution ($P = 0.5597$) **Table (4).**

Clinical evaluation

Over the 18-month follow-up, both the modeling resin and conventional techniques showed clinically acceptable outcomes with no statistically significant differences in wear/anatomic form, retention, recurrent caries, or postoperative sensitivity. Marginal discoloration significantly increased over time within the modeling resin group ($P < 0.001$), with a 1.6 times higher risk compared to the conventional group. Marginal integrity was comparable between groups, though a slightly higher risk of compromise was observed in the modeling resin group. Surface texture remained stable across both groups ($P = 1.0000$), and color match showed a significant change over time in the modeling resin group, with a 33% higher risk of mismatch **Table (5)**.

Survival Analysis

At the end of the follow-up, 8 restorations in the modeling resin group and 4 in the conventional group were rated with a B score. Kaplan–Meier analysis was employed to create survival curves and Log-rank test for comparison. The survival difference between the two methods was not significant ($P = 0.18978$). The group treated with modeling resin at 18 months showed an 68% alpha score and the control group, an 84% alpha score, with no statistical difference between them ($P = 0.2513$). Despite these differences, all restorations were considered clinically successful. **Figure (4)**

Table (1): Materials' description, composition, lot number and manufacturer.

Material	Description	Composition	Lot number	Manufacturer
Tetric N-Ceram	Universal nano-hybrid incremental composite	Dimethacrylates, Ba-Al glass (glass ceramics), ytterbium trifluoride, mixed oxide and copolymer, CQ.	#Z03H17	Ivoclar Vivadent, Liechtenstein, Switzerland
Modeling Resin	Low viscosity micro-filled composite	UDMA, TEGDMA, Bis-GMA, Amorphous silica, CQ.	#2200001773	BISCO, Inc. Schaumburg, USA
Tetric N-Etch Gel	37% Phosphoric acid etch	Phosphoric acid, H_2O, Polyethylene glycol	#Z04HGF	Ivoclar Vivadent, Liechtenstein, Switzerland
Tetric N-Bond Universal	Universal Adhesive	Methacrylates HEMA, highly dispersed SiO_2, initiators and stabilizers, activator solvent initiators.	#Z0415H	Ivoclar Vivadent, Liechtenstein, Switzerland

CQ: Camphorquinone, UDMA: Urethane Dimethacrylate, TEGDMA: Triethylene Glycol Dimethacrylate, BIS-GMA: Bisphenol A Diglycidyl methacrylate, HEMA: 2-H ydroxyethyle Methacrylate, SiO_2: Silicon dioxide.

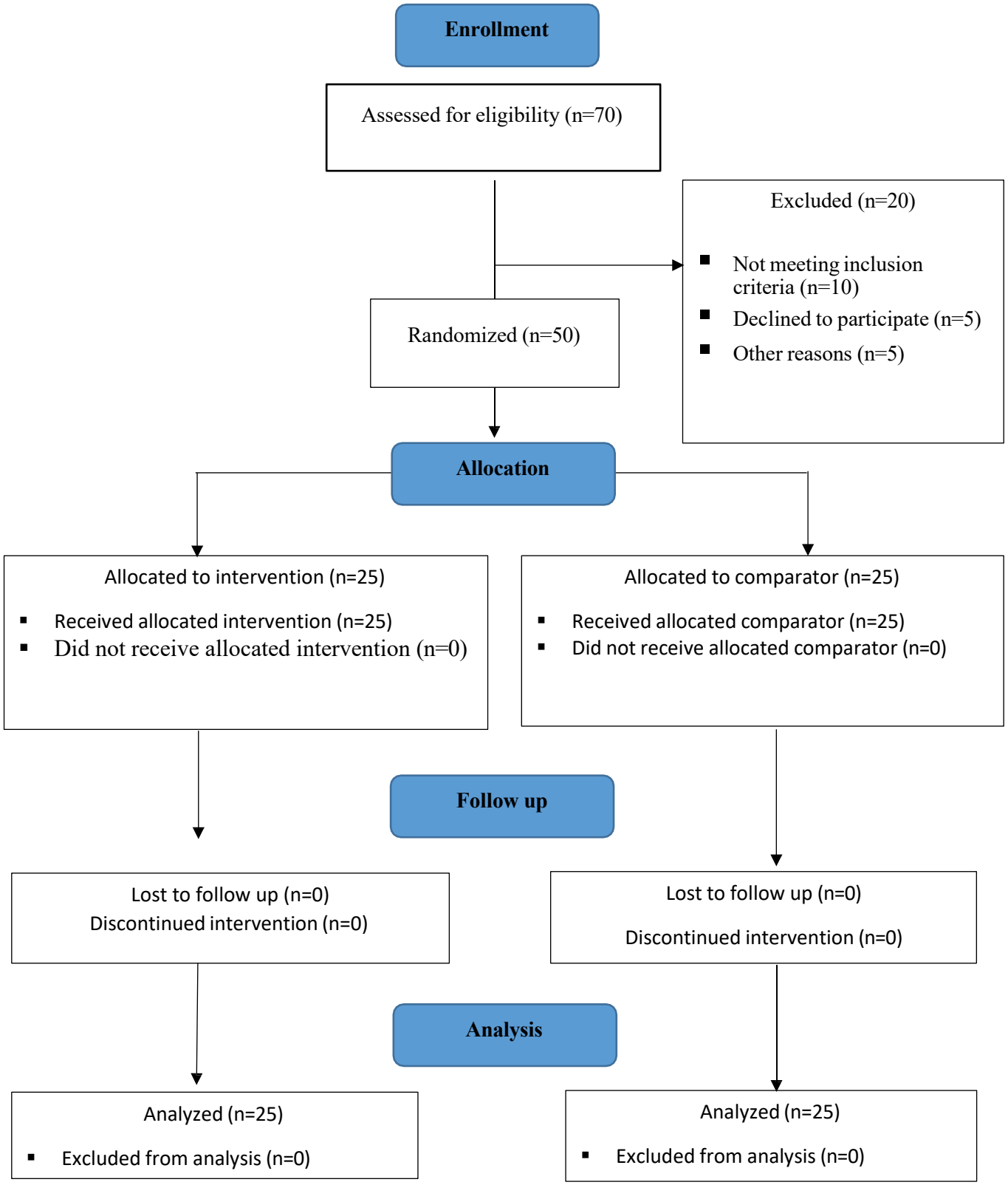


Figure (1): CONSORT Flow chart showing the process of case selection: enrollment, allocation& follow-up of patients in this study.

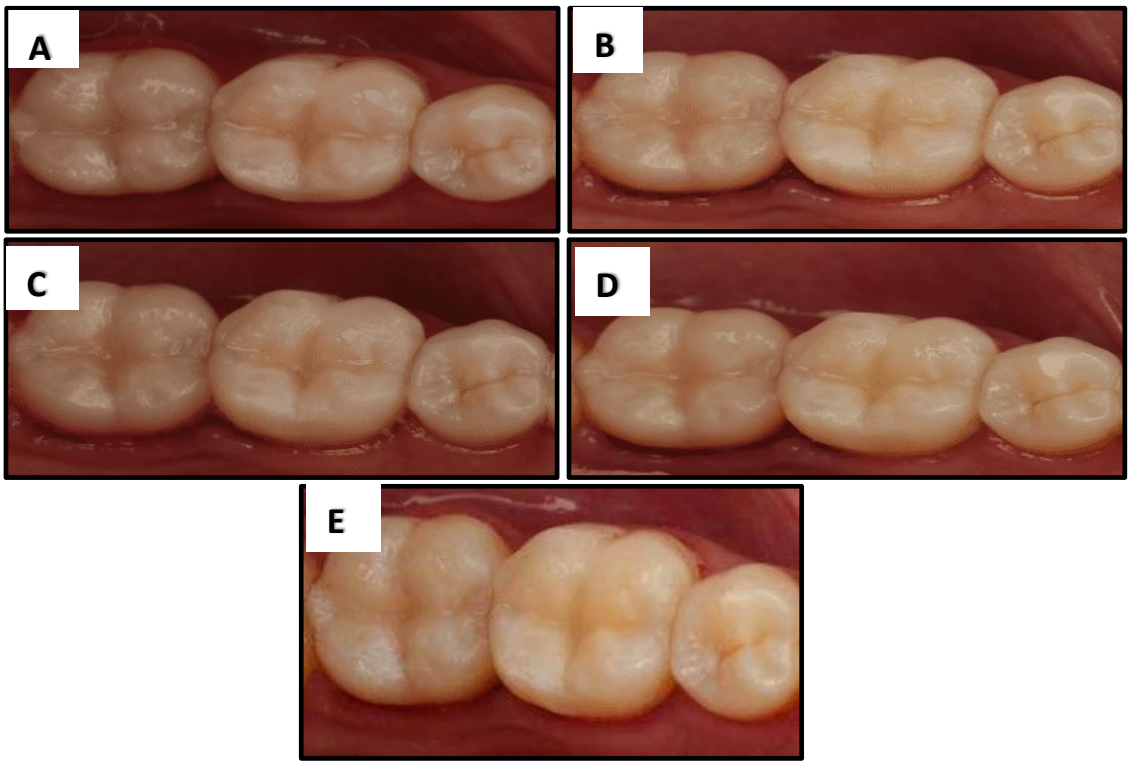


Figure (2) A: Postoperative photos showcasing the restorations of the Lower 1st and 2nd molars using modeling resin insertion technique, B: 3 month follow up period, C: 6 month follow up period, D: 12 month follow up period, E: 18 month follow up period

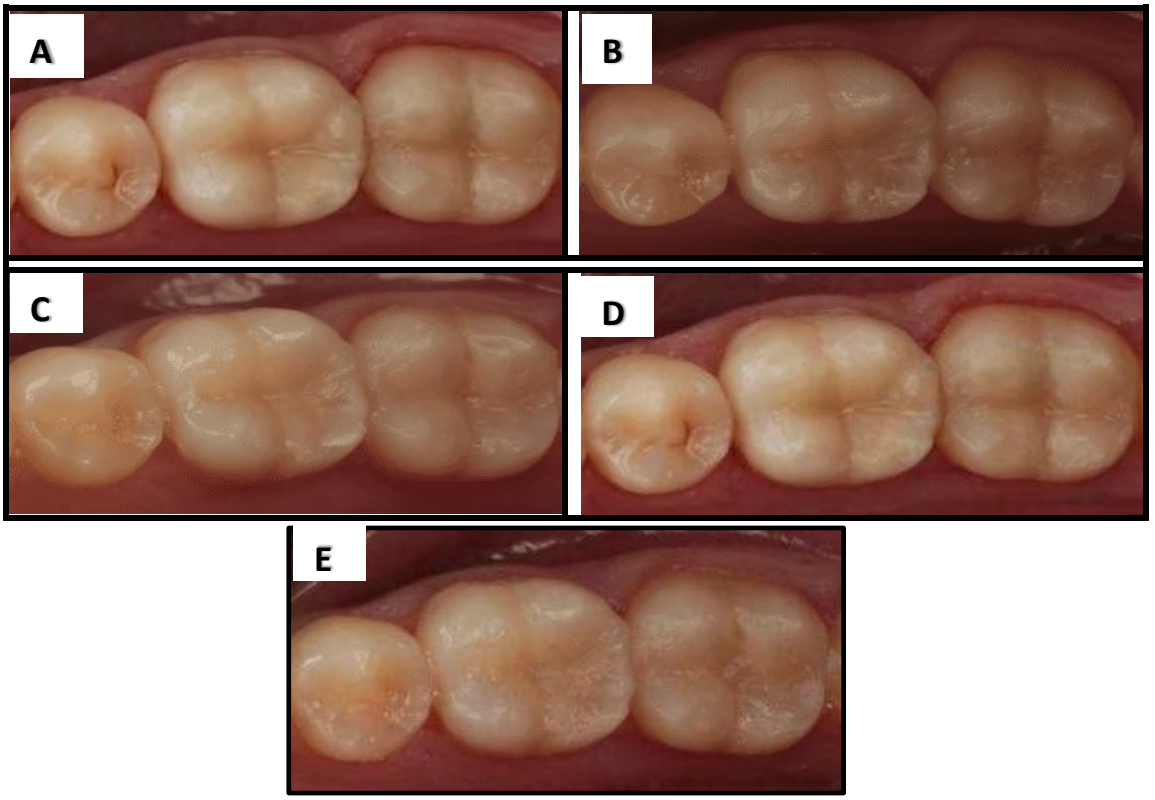


Figure (3) A: Postoperative photos showcasing the restorations of the Lower 1st and 2nd molars without using modeling resin insertion technique, B: 3 month follow up period, C: 6 month follow up period, D: 12 month follow up period, E: 18 month follow up period

Table (2): Modified USPHS criteria, score, characteristics, measuring unit and method of diagnosis for assessment of dental restorations, Demirci et al. (2018) and Karaman et al. (2017).

Outcome	Score	Characteristics
Marginal Discoloration	A	No discoloration between tooth structure and restoration.
	B	Non penetrating marginal discoloration, can be polished away.
	C	Discoloration has penetrated margin in pulpal direction.
Marginal Integrity	A	Closely adapted, no detectable margin.
	B	Detectable marginal discrepancy, clinically acceptable.
	C	Marginal crevice, clinically un-acceptable.
Surface Texture	A	Surface of restoration is smooth.
	B	Surface of restoration slightly rough, can be refinished.
	C	Surface deeply pitted, cannot be refinished.
	D	Surface is fractured or flaking.
Color Match	A	No mismatch in color.
	B	Mismatch in color, within a normal range of tooth color.
	C	Mismatch in color, outside the normal range of tooth color.
Anatomic Form	A	Continuity of restoration, with apparent anatomic form.
	B	Discontinuity of restoration, insufficient to show dentin or body.
	C	Loss of sufficient material to show dentin or body.
Recurrent Caries	A	No evidence of caries at the restoration margin.
	B	Evidence of caries at the restoration margin.
Postoperative Hypersensitivity	A	Not present.
	B	Sensitive but diminishing in intensity.
	C	Constant sensitivity, not diminishing in intensity.
	D	Immediate replacement necessary.

Table (3): Gender distribution among groups

	Gender		Row total (RT)
Group	Male	Female	
Modeling resin	9	16	25 (50.0%)
Conventional Incremental	12	13	25 (50.0%)
Column total (CT)	21	29	50
	(42.0%)	(58.0%)	
P value		P = 0.3648	

Table (4): Teeth distribution among groups

Group	Teeth distribution		Row total (RT)
	Maxillary molar	Mandibular molar	
Modeling resin	10	15	25 (50.0%)
Conventional Incremental	8	17	25 (50.0%)
Column total (CT)	18 (36%)	32 (64%)	50
P value	P = 0.5597		

Table (5) Frequency and percentage for all evaluation criteria scores for the intergroup comparison between groups within each follow-up and intragroup comparison within each group between different follow-up periods

		Modeling Resin Insertion Technique			Conventional Incremental Placement		
Criteria	**Follow-up**	**A**	**B**	**C**	**A**	**B**	**C**
Marginal discoloration	Baseline	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	3 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	6 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	12 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	18 months	20 (80%)	5 (20%)	0 (0%)	22 (88%)	3 (12%)	0 (0%)
Marginal integrity	Baseline	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	3 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	6 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	12 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	18 months	23 (92%)	2 (8%)	0 (0%)	24 (96%)	1 (4%)	0 (0%)
Wear/ Anatomic form	Baseline	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	3 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	6 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	12 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	18 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
Surface texture	Baseline	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	3 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	6 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	12 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	18 months	22 (88%)	3 (12%)	0 (0%)	22 (88%)	3 (12%)	0 (0%)
Color match	Baseline	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	3 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	6 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	12 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	18 months	21 (84%)	4 (16%)	0 (0%)	22 (88%)	3 (12%)	0 (0%)
Retention	Baseline	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)

	3 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	6 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	12 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	18 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
Recurrent caries	Baseline	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	3 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	6 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	12 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	18 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
Postoperative Hypersensitivity	Baseline	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	3 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	6 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	12 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)
	18 months	25 (100%)	0 (0%)	0 (0%)	25 (100%)	0 (0%)	0 (0%)

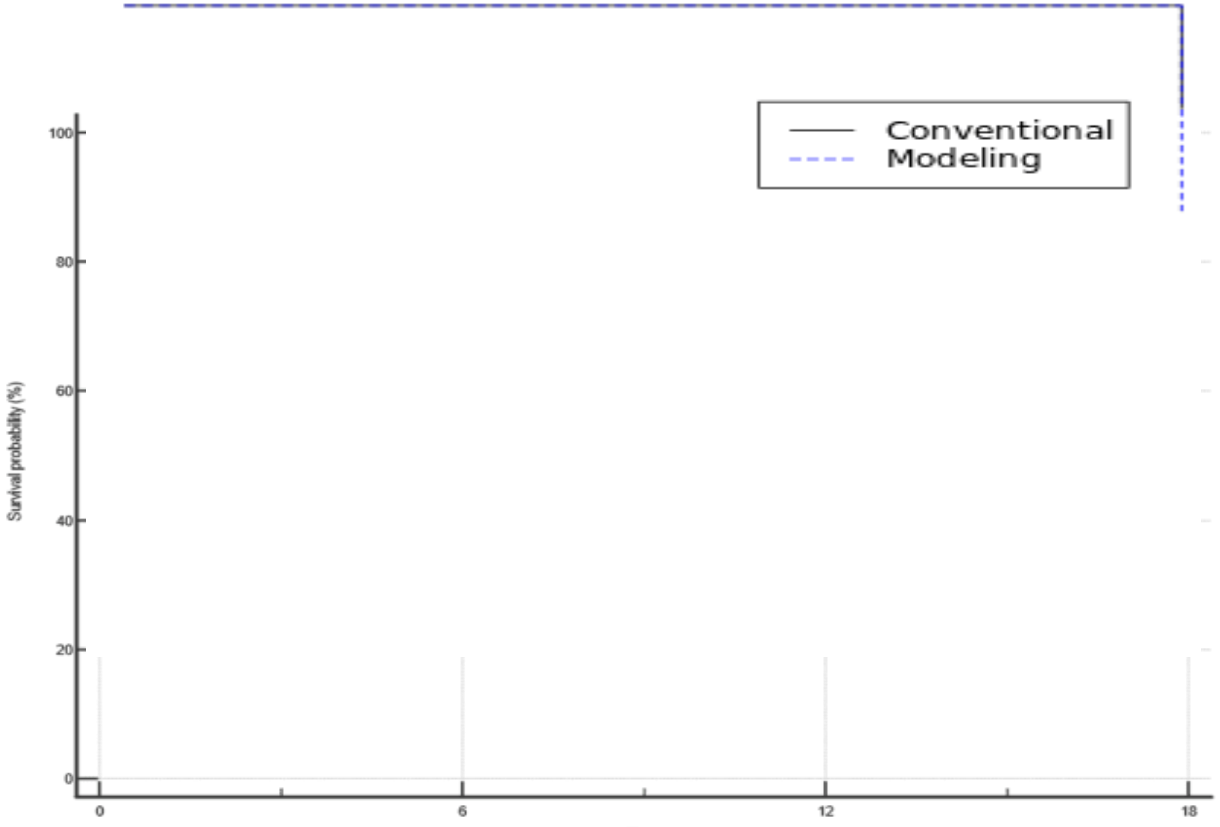


Figure (4): Survival analysis of Modeling resin and Conventional for occlusal restorations after 18 months.

Discussion

In today's world of readily available information, patients' expectations regarding restorative dental treatments have grown **(Blatz et al., 2019).** Simultaneously, dentists are increasingly looking for materials that combine superior properties with user-friendliness to minimize chair time and enhance efficiency. This demand has driven the dental industry to innovate new materials that balance patient needs with practitioner convenience (**Palin et al., 2018).**

Achievement of both form and function is based on natural replication of the tooth structure. This relies on a solid knowledge of dental anatomy, skill in composite modeling ability, and awareness of composite characteristics such as color, shade, and consistency, **(Paolone et al., 2023).** The composite placement technique requires the material to be placed in thin successive increments in order for it to be contoured into the natural tooth form. One usual limitation with this technique, however, is that the composite will bond to application instruments, which may result in the layers creating gaps or voids with one another, which may weaken the overall strength of the restoration **(Mohamed et al., 2021).** To reverse this, modeling resins have been developed to improve handling by reducing surface tension and enhancing wettability during anatomical shaping.

Modeling resins (MRs), typically composed of methacrylate-based monomers such as UDMA, Bis-GMA, and TEGDMA, are used to moisten instruments or brushes between layers or on the final surface of a composite restoration. This process smooths the restoration, enhances esthetics, and reduces finishing and polishing time **(Araújo et al., 2018).** In addition, these resins decrease porosity during layering, thereby improving mechanical strength and color stability **(Dinçtürk et al., 2023).** Unlike bonding agents, modeling resins are HEMA-free and solvent-free, making them less likely to compromise the integrity of the composite structure.

To date, most studies on modeling resins have been in-vitro. While such studies provide data on material properties, they cannot reproduce the actual clinical setting in which occlusal forces, thermal variations, saliva, and bacterial activity are factors. Clinical trials have to be used to evaluate the actual behavior of materials under actual conditions **(Elkady et al., 2024).** Thus, this randomized clinical study was conducted to assess how the modeling resin insertion technique clinically effects composite restorations.

The restorations in this study were assessed using the modified USPHS criteria at baseline, and at 3, 6, 12, and 18 months. Although longer evaluations are ideal for assessing material longevity, the 18-month timeframe still provides valuable performance insights **(Perdigão et al., 2014).** The criteria scored as Alpha, Bravo, or Charlie was chosen for their relevance and consistency in clinical assessments (**Elkady et al., 2024).** All restorations were performed under standardized conditions by the same operator, enhancing reliability. Fifty patients were randomly assigned into two groups of 25, and all completed the follow-up, yielding a 100% retention rate. Both techniques yielded satisfactory results. This can be partly attributed to the conservative cavity designs, proper sealing, disease control, and patient oral hygiene (**Al-Sheikh et al., 2019).** Statistically, there were no significant differences related to gender, age, or tooth location, and most restorations received Alpha scores, with no group outperforming the other at any time point. Thus, the null hypothesis was accepted.

Marginal discoloration was the primary variable evaluated, being one of the first signs of composite deterioration (**Loguercio et al., 2010).** Both techniques showed excellent results, although at 18 months, five restorations in the MR group and three in the conventional

group were rated Bravo. A key observation was the slightly higher rate of discoloration in the modeling resin group, potentially due to the hydrophilic nature of methacrylate copolymers, which can absorb moisture from both salivary fluids and underlying dentin. While this may compromise marginal adaptation and contribute to staining, in this study it did not result in gap formation or secondary caries. The discoloration observed was superficial and likely removable with additional polishing.

No statistically significant difference in marginal integrity was observed between the two groups throughout the study period. However, at the 18-month follow-up, two restorations in the modeling resin group and one in the conventional incremental group received a "Bravo" rating. This minor discrepancy may be due to the higher flowability of the modeling resin, which could have caused marginal overhangs during placement. Although these overhangs appeared smooth, continuous, and clinically acceptable at the time, the modeling resin likely facilitated slight overflow of the composite beyond the cavity margins. The subsequent fracturing of these thin composite extensions on the enamel surface near the cavity edges likely contributed to the observed marginal defects.

Throughout the follow-up period, no statistically significant differences in anatomical contour were observed between or within the two groups. The favorable outcome was likely due to the high mechanical strength of the used composite, which exhibits a filler loading (80 wt.%) responsible for its resistance to wear. The modeling resin includes diurethane dimethacrylate (UDMA), a monomer that has the ability to form strong hydrogen bonds and enhance polymerization efficiency and degree of conversion **(Pratap et al., 2019).** Such properties can potentially explain the lack of negative effect on anatomical contour stability from modeling resin use. In line with this, **Kutuk et al., (2020)** found no significant difference in micro-hardness between restorations both with and without modeling liquid. Similarly, **Münchow et al., (2021)** suggested that modeling liquids may enhance tensile strength by preventing voids in layering. The opposite, however, were the results determined by **Bayraktar et al., (2021), Paula et al., (2016), and Tuncer et al., (2013),** whose results included reduced micro-hardness after the application of modeling liquids. They attributed this to the formation of a resin-rich surface layer, one which, although intended to be removed after polishing, may have wetting agents penetrate deeper into the resin, thereby affecting its hardness.

Regarding surface texture, no statistically significant differences were observed. At the 18-month follow-up, three restorations for each group were rated as "Bravo" and hence evidenced no overall effect of the use of modeling resin on surface quality. The minimal surface changes noted were more likely due to the inherent nature of the resin composite than to the modeling resin. This was supported by **Tuncer et al. (2013),** who reported no significant differences in surface roughness between modeling liquid-treated and untreated resin composites. **Pereira et al. (2021)** also concluded that surface roughness was not affected by modeling resin since all specimens presented identical roughness upon simulation of brushing. **Bekdaş et al. (2025)** also stated that modeling liquids may enhance or decrease roughness depending on the initial texture of the composite material, again substantiating that the effect is material-dependent and not necessarily due to the use of modeling resin in a constant fashion.

Color match also showed the same pattern, and no differences were statistically significant. The structure of the modeling resin, which is composed of UDMA, Bis-EMA, and amorphous silica, may have provided color stability. This agrees with other studies showing minimal influence of modeling resin on color over time **(Kutuk et al., 2020; Pereira et al., 2021),** although some studies have reported minimal discoloration due to voids between layers **(Tuncer et al., 2013).**

In the context of retention of restoration, both groups had no Bravo or Charlie scores and there were no significant differences between them. The success of a restoration is a function of multiple factors, such as the clinician's experience with the technique and the material properties, adequate isolation during the placement, size and location of the cavity, patient's parafunctional habits, and oral hygiene. The excellent retention figures in this study are most likely attributable to the fact that all procedures were carried out by one experienced operator and on well-selected patients. Furthermore, regular use of the same bonding agent and technique with beneficial isolation conditions likely enhanced restoration success. They are corroborated by other clinical studies, even those with other composite types, types of cavities, and follow-up durations **(Attia et al., 2021; Sadeghi et al., 2010).**

No secondary caries was observed in any group during the 18-month follow-up. This favourable outcome can be attributed to several factors, including the relatively short follow-up period, the excellent oral hygiene of the patients, and the quality of the remaining tooth structure particularly the presence of enamel at the cavosurface margins, which supports a good marginal seal **(Nahsan et al., 2015).** These findings are consistent with those of **Hirata-Tsuchiya et al. (2017)**, who reported that low-shrinkage, high-filler-content materials reduce the risk of secondary caries. However, they contrast with the results of **Van Dijken and Pallesen (2013)**, who found that most failures were due to recurrent caries, especially in patients with a high caries risk. This highlights the importance of participant selection in clinical trials, as caries risk plays a significant role in restoration survival.

Regarding postoperative sensitivity, no cases were reported in either group throughout the follow-up. This is credited to the use of the incremental layering technique, which effectively removed polymerization shrinkage and cuspal deflection causes that are established determinants of sensitivity. The findings confirm with **Badr et al. (2021),** where reduced postoperative sensitivity was also encountered through the layering technique, affirming its clinical benefit.

Although both groups demonstrated comparable clinical performance at 18 months, several limitations should be considered. The relatively short observation period may not adequately represent the long-term durability of the restorative materials. Moreover, the study assessed only a single lubricating agent and one composite formulation, which restricts the generalizability of the findings to materials with different compositions or filler characteristics.

Despite these limitations, the null hypothesis was accepted. The use of modeling resin produced clinically acceptable outcomes after 18 months and proved to be a convenient and effective technique for sculpting resin composite restorations in posterior cavities.

Conclusion:

Within the limitations of the current study, it can be concluded that:

1. Modeling resin proved to be a safe and effective aid in placing posterior composite restorations, enhancing handling without compromising clinical performance.

2. It also maintained the esthetic properties of restorations, showing no adverse effects on color match, surface texture, or gloss throughout the evaluation period.

Recommendations

1. Long-term clinical trials are needed to assess the extended effectiveness of modeling resin beyond the 18-month period.

2. Future studies should also explore the impact of different lubricating agents on resin composite performance, helping identify the most effective and biocompatible options for achieving optimal esthetic and functional outcomes in restorative dentistry.

Conflict of interest

Authors affirm no conflicts of interest.

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Ethics

Ethical approval was conducted by the Research Ethics Committee (REC), Faculty of Dentistry, Cairo University with identification number: 7623.

Data availability

Data will be available upon request.

Clinical trial registration:

The protocol is registered on clinical trials (www.clinicaltrials.gov) with I.D.: NCT05801458

Authors' contribution statement

The study was hypothesized and the methodology designed by AAM, MAH, AEA, and DME. AAM was in charge of conducting the clinical trial. AAM and DME analyzed and interpreted the data and prepared the first draft of the manuscript. MAH and DME provided critical revisions and edits. All authors reviewed and gave their approval for the final manuscript.

References

Alsheikh, Rasha. (2019): Effects of Different Application Techniques on Nanohybrid Composite Restorations Clinical Success. ***The Open Dentistry Journal***. 13. 228-235. 10.2174/1874210601913010228.

Attia, Reham. (2021): 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. ***Egyptian Dental Journal.*** 67. 2673-2693. 10.21608/edj.2021.65934.1537

Araújo, F.S.; Barros, M.C.R.; Santana, M.L.C.; Oliveira, L.S.D.J.; Silva, P.F.D.; Lima, G.D.S.; Faria-E-Silva, A.L (2018): Effects of adhesive used as modeling liquid on the stability of the color and opacity of composites**.** ***J. Esthet. Restor. Dent***. 30, 427–433.

Badr, C., Spagnuolo, G., Amenta, F., Khairallah, C., Mahdi, S. S., Daher, E., ... & Zogheib, C. M. (2021): A two-year comparative evaluation of clinical performance of a nanohybrid composite resin to a flowable composite resin. ***J. Funct. Biomater.*** *12*(3), 51.

Bayraktar, E.T.; Atali, P.Y.; Korkut, B.; Kesimli, E.G.; Tarcin, B.; Turkmen, C. (2021): Effect of Modeling Resins on Microhardness of Resin Composites. **Eur. J. Dent.**15, 481–487.

Blatz, M.B. & Chiche, G. & Bahat, O. & Roblee, R. & Coachman, C. & Heymann, H.O. (2019): Evolution of Aesthetic Dentistry. ***Journal of Dental Research.*** 98. 1294-1304.

Demirci, M., Tuncer, S., Sancakli, H.S., Tekçe, N. and Baydemir, C. (2018): Five-year clinical evaluation of a nanofilled and a nanohybrid composite in class IV cavities. ***Oper Dent***. 43(3), pp. 261-271

Dinctürk A, Kedici Alp C. (2023): The Effect of Modeling Liquid on Color Stability and Surface Roughness of Single-Shade Composites: A SEM Study. ***Oral Health Dental Sci***. 7(4); 1-9.

Dionysopoulos D, Papadopoulos C, Koliniotou-Koumpia E. (2014): The evaluation of various restoration techniques on internal adaptation of composites in class V cavities. ***Int J Biomater***. 148057.

Elkady, M., Abdelhakim, S., & Riad, M. (2024): The clinical performance of dental resin composite repeatedly preheated: A randomized controlled clinical trial. ***J. Dent.***, 144, 104940

Gençer, B.K., Acar, E., and Tarcın, B. (2023) Evaluation of shade matching in the repair of indirect restorative materials with universal shade composites. ***Eur Oral Res***., 57(1), pp.41-48.

Güven Bekdaş, M., Hubbezoglu, I. (2025): Effect of modeling liquid application on color stability and surface roughness of single-shade composites. ***BMC Oral Health***. 25, 120

Hirata-Tsuchiya S, Yoshii S, Ichimaru-Suematsu M. (2017): Two-year clinical comparison of a flowable-type nano-hybrid composite and a paste-type composite in posterior restoration. ***J Investig Clin Dent*** 8(3).

Karaman, E., Yazici, A.R., Ozgunaltay, G. and Ustunkol, I. (2017): Clinical Evaluation of a Silorane- and a Methacrylate-Based Resin Composite in Class II Restorations: 24-Month Results, ***Oper Dent***, 42(4), pp. E102–E110.

Kutuk, Z.B.; Erden, E.; Aksahin, D.L.; Durak, Z.E.; Dulda, A.C. (2020): Influence of modeling agents on the surface properties of an esthetic nano-hybrid composite. ***Restor. Dent. Endod.*** 45, e13.

Lepri, C.P. and Palma-Dibb, R.G. (2012): Surface roughness and color change of a composite: influence of beverages and brushing. ***Dental Materials Journal***, 31(4), pp.689–696.

Loguercio AD, Mânica D, Ferneda F, Zander-Grande C, Amaral R, Stanislawczuk R, de Carvalho RM, Manso A, Reis A. (2010): A randomized clinical evaluation of a one- and two-step self-etch adhesive over 24 months. ***Oper Dent.*** 35(3):265-72.

Mohamed, Hamed. (2021): Comparative Study of Different Cavity Configuration Effect on Marginal Adaptation of Bulk Fill Versus Conventional Resin Composites. ***Al-Azhar Assiut Dental Journal***. 4. 129-139. 10.21608/aadj.2021.208204.

Münchow, E.A.; Sedrez-Porto, J.A.; Piva, E.; Pereira-Cenci, T.; Cenci, M.S. (2016): Use of dental adhesives as modeler liquid of resin composites. **Dent. Mater.** 32, 570–577.

Nahsan F, Wang L, Modena K, Francisconi-dos-Rios L, da Silva L, Calabria M, Casas-Apayco L, Mondelli RF. (2016): A 12-month clinical trial examining the effects of a surface sealant on Class I composite resin restorations. ***Gen Dent***. 64(2):18-20.

Paolone G, Mazzitelli C, Zechini G, Scolavino S, Goracci C, Scotti N, Cantatore G, Gherlone E, Vichi A. (2023): Influence of Modeling Liquids and Universal Adhesives Used as Lubricants on Color Stability and Translucency of Resin-Based Composites. ***Coatings*****.** 13(1):143.

Paula, F.C.; Valentin, R.D.S.; Borges, B.C.D.; Medeiros, M.C.D.S.; Oliveira, R.F.; Silva, A.O. (2016): Effect of Instrument Lubricants on the Surface Degree of Conversion and Crosslinking Density of Nanocomposites. ***J. Esthet. Restor. Dent.*** 28, 85–91.

Perdigão J, Kose C, Mena-Serrano AP. (2014): A new universal simplified adhesive: 18-month clinical evaluation. ***Oper Dent***. 39(2):113–127.

Perdigão, J.; Araujo, E.; Ramos, R.Q.; Gomes, G.; Pizzolotto, L. (2021): Adhesive dentistry: Current concepts and clinical considerations. ***J. Esthet. Restor. Dent.*** 33, 51–68.

Pereira, P.; Silva, B.; Lins, R.; Lima, D.; Aguiar, F. (2021): Effect of wetting agent coverage on the surface properties of resin composite submitted to brushing and staining cycles**. *J. Clin. Exp. Dent.*** e795–e801.

Pippin G, Tantbirojn D, Wolfgang M, Nordin JS, Versluis A. (2024): Effect of Instrument Lubricant on Mechanical Properties of Restorative Composite. ***Oper Dent.*** 49(4):475-483.

Pratap B, Gupta RK, Bhardwaj B, Nag M. (2019): Resin based restorative dental materials: characteristics and future perspectives. ***Jpn Dent Sci Rev.*** 55(1):126-138.

Sedrez-Porto, J.A.; Munchow, E.; Cenci, M.; Pereira-Cenci, T. (2017): Translucency and color stability of resin composite and dental adhesives as modeling liquids—A one-year evaluation. ***Braz. Oral Res.*** 31, e54.

Sengupta A, Naka O, Mehta SB, Banerji S. (2023): The clinical performance of bulk-fill versus the incremental layered application of direct resin composite restorations: a systematic review. ***Evid Based Dent.*** 24(3):143.

Tuncer, S.; Demirci, M.; Tiryaki, M.; Ünlü, N.; Uysal, Ö. (2013): The Effect of a Modeling Resin and Thermocycling on the Surface Hardness, Roughness, and Color of Different Resin Composites**. *J. Esthet. Restor. Dent.*** 25, 404–419.

van Dijken JW, Pallesen U. (2013): A six-year prospective randomized study of a nano-hybrid and a conventional hybrid resin composite in Class II restorations. ***Dent Mater.*** 29(2):191-8.

Yadav, R. and Kumar, M. (2019): Dental restorative composite materials: A review**. *J. Oral Biosci.***, 61(2), pp.78-83.