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Clinical study of different composite resin systems in Class I cavities (an 18-month randomized clinical trial)

Estudo clínico de diferentes sistemas de resina composta em cavidades de Classe I (um ensaio clínico randomizado de 18 meses)

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ABSTRACT

Objective: this double-blind randomized clinical trial evaluate the clinical performance of Thermo-Viscous Bulk Fill composite, Self-Adhesive Flowable composite, and Filtek Bulk Fill Composites restorations in Class I cavities over a period of 18 months. **Material and Methods:** twenty individuals between the ages of 30 and 45 participated in this research. Each patient should have at least three occlusal Class I carious lesions on their molars. They were dispersed at random, with n=20 teeth representing each tested material. Group I (Futurabond M+ and VisCalor Bulk Fill which heated in a viscolar dispenser at 68 °C for 30s and placed in a 4 mm thickness), Group II (Fusio Liquid Dentin self-adhesive composite which put in a thin layer (1mm increment)), and Group III (Single Bond Universal and Filtek Bulk Fill Posterior composite which applied in 4 mm thickness without heating). Using (USPHS) criteria, all restorations were assessed clinically at baseline, 6 months, 12 months, and 18 months. Using an inverse replica, the marginal seal of the investigated restorations was further evaluated under SEM. Statistical analysis was performed with Chi-square test for all USPH parameters. **Results:** the three tested groups recorded a one hundred percent retention rate after 18 months follow up period. Concerning marginal adaptation, marginal discoloration, anatomical form, surface texture, and color matching, there was a significant difference ($p<0.05$) between the three tested groups after 12 & 18 months. After 12 & 18 months, SEM analysis of the marginal seal revealed a statistically significant difference between the three groups. **Conclusion:** Bulk fill resin composite restorations showed satisfactory acceptable clinical performance after 18 months of clinical service compared to self-adhesive flowable composites, and Viscalor Bulk Fill composite demonstrated excellent results with considerable changes in marginal integrity as a consequence of thermal viscous technology and increased adaptability of restorations toward cavity walls and margins.

KEYWORDS

Bulk fill; Class I; Clinical; Scanning electron microscope; Viscalor.

RESUMO

Objetivo: este ensaio clínico randomizado duplo-cego avaliou o desempenho clínico de restaurações de resina Bulk Fill Termo-Viscosa, resina autoadesiva Flowable e Filtek Bulk Fill Composites em cavidades Classe I durante um período de 18 meses. **Material e Métodos:** 20 indivíduos com idade entre 30 e 45 anos participaram da pesquisa. Cada paciente deveria ter pelo menos três lesões de cárie oclusais de Classe I nos molares. Eles foram divididos aleatoriamente, com n=20 dentes representando cada material testado. Grupo I (Futurabond M+ e VisCalor Bulk Fill aquecido em dispensador viscolar a 68 °C por 30s e colocado em uma espessura de 4 mm), Grupo II (resina composta autoadesiva Fusio Liquid Dentin colocada em uma camada fina (incremento de 1 mm)) e Grupo III (resina composta Single Bond Universal e Filtek Bulk Fill Posterior aplicado em espessura de 4 mm

sem aquecimento). Usando os critérios (USPHS), todas as restaurações foram avaliadas clinicamente no início, 6 meses, 12 meses e 18 meses. Usando uma réplica inversa, o selamento marginal das restaurações investigadas foi avaliado em MEV. A análise estatística foi realizada com o teste qui-quadrado para todos os parâmetros USPH. **Resultados:** os três grupos testados registraram uma taxa de retenção de cem por cento após um período de acompanhamento de 18 meses. Em relação à adaptação marginal, descoloração marginal, forma anatômica, textura da superfície e combinação de cores, houve uma diferença significativa ($p<0,05$) entre os três grupos testados após 12 e 18 meses. Após 12 e 18 meses, a análise SEM do selamento marginal revelou uma diferença estatisticamente significativa entre os três grupos. **Conclusão:** as restaurações de resina composta Bulk Fill apresentaram desempenho clínico aceitável satisfatório após 18 meses de atendimento clínico em comparação com as resinas compostas fluidas autoadesivas, e a resina composta Viscalor Bulk Fill demonstrou excelentes resultados com mudanças consideráveis na integridade marginal, como consequência da tecnologia viscosa térmica e maior adaptabilidade de restaurações nas paredes e margens da cavidade.

PALAVRAS-CHAVE

Bulk fill; Classe I; Clínico; Microscópio eletrônico de varredura; Viscalor.

INTRODUCTION

Composite resins are the material of choice in restorative dentistry due to the growing need for high-quality cosmetic results in daily practice. They are commonly employed in the restoration of posterior teeth due to the growing need for esthetics and the significant progress of newer generations of adhesive methods and composite resin formulations [1].

Despite the recent advancements in restorative materials and procedures, postoperative sensitivity with composite restorations remains a difficulty for clinicians [2]. One of the drawbacks of composite resins is the polymerization shrinkage that leads to contraction stresses that can cause tension at the tooth-restoration interface, and if the stresses exceed the bond strength, microleakage occurs [3].

Self-adhesive flowable composites (SAFC) were introduced to the market to minimize procedure steps a few years ago. Vertise Flow and Fusio Liquid Dentine are now commercially available [4]. SAFC combines the characteristics of adhesive and restorative material technologies in a single product, giving new possibilities to restorative procedures, since it is a direct restorative composite resin material that contains both an adhesive resin and a flowable composite resin [5].

Currently, incremental layering method is regarded as the gold standard for the placement of light-curing composite materials [6]. In order to shorten the duration of the method without compromising the durability of the materials, so-called “bulk-fill” composites were brought to the market with the commercial advantage of lowering polymerization shrinkage and eliminating the incremental technique. Due to their low polymerization stress and excellent light-curing reactivity, these materials are suitable for insertion in a 4 mm bulk placement [7].

However, the high viscosity and stickiness of composites make them difficult to handle and manipulate, resulting in inadequate marginal adaptation to preparation walls [8]. A new alternative invention involves preheating of conventional composites in a chair-side warming device prior to polymerization [9].

Pre-heating of high viscosity bulk-fill composites might provide a transitory viscosity decrease equivalent to that of a flowable composite without compromising the better mechanical properties associated with highly filled resin composites [10].

The thermo-viscous bulk-fill composite VisCalor bulk fill takes a recent technique. This is a composite material with a high viscosity at room and body temperature that is transformed into a flowable consistency by heating to 68 °C in a particular dispenser with a heating function (Thermo-Viscous-Technology). In a single restorative composite material, it combines the flowability of a low-viscosity composite during insertion with the sculpting ability of a high-viscosity composite [6].

This study aims to assess the clinical performance of Thermo-Viscous, Self-Adhesive Flowable, and nano hybrid bulk-fill composite restorations. The null hypothesis was that the investigated materials would demonstrate identical clinical performance in simple Class I cavities.

MATERIAL AND METHODS

Trial design

This study was conducted as a double-blind randomized clinical study.

Trial setting

This study was carried out at the clinic of Department of Restorative Dentistry, Faculty of Dentistry, Tanta University.

Sample size

The total sample size in this study was 60 cases divided into 3 groups at the significance level of 95% using a computer program G power version 3. The cases were distributed on 20 patients. Each patient have three moderate posterior occlusal carious lesions. This was performed according to the equation:

$$SS = \frac{Z^2 \times P \times (1-P)}{C^2} \quad (1)$$

Where:
Z = Z value (1.96 for 95% confidence level)
p = percentage picking a choice, expressed as decimal
c = confidence interval, expressed as decimal.

Ethical considerations

All procedures and nature of the study were explained to the patients and their written informed consents was obtained according to the guidelines on human research performed by the Ethics Committee at Faculty of Dentistry, Tanta University which approved the performance of the partical part of this research after fulfilling the necessary requirements of committee with code #R-RD-5-20-2.

- **Patient Selection** - Twenty individuals between the ages of 30 and 45 participated in this research. Each patient should have at least three occlusal Class I carious lesions on their molars (Figure 1). Patients were chosen from the clinic of the Department of Restorative Dentistry, Faculty of Dentistry, Tanta University, based on inclusion and exclusion criteria. Before procedures of treatment, all patients were given oral hygiene instructions, and when necessary, they were sent to the periodontology department for scaling and polishing [11].

Inclusion criteria

- Good oral hygiene.
- Patient should have normal occlusion.
- Accessible isolation with rubber dam.
- Good periodontal health.
- Availability for follow up recalls.

Exclusion criteria

- Patients with bad oral hygiene.
- Abnormal occlusion.
- Patients with compromised medical history.
- Sever or chronic periodontitis.
- Non-vital or endodontically treated teeth.
- Pregnancy.

Randomization and allocation concealment

These randomization sketches were performed utilizing tools available on the website www.sealedenvelope.com. A researcher not involved in the research plan performed the

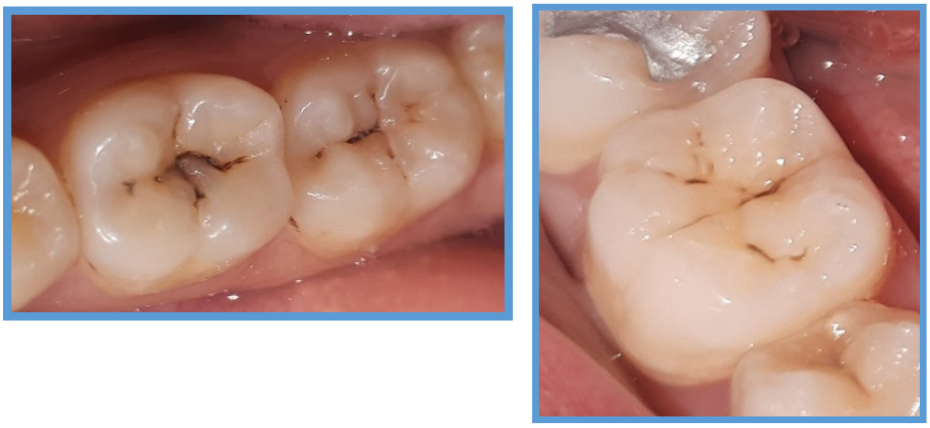


Figure 1 - Preoperative image of patient having three molars with simple Class I carious lesions.

randomization process. Each participant was randomized 30 min before starting the procedures with help of researcher. The randomization sketch of the patient was sent to operator just before starting the dental procedures to avoid bias.

Blinding

The evaluators who were not included in the restorative procedures, were blinded to investigated groups. The patient was also consider blinded to tested groups, but the operator wasn't blinded to these groups as result of the significant difference between the tested materials, this is what describe the double-blind study.

Materials

The materials used in this study are three types of composites (Self-Adhesive Flowable composite, Thermo-Viscous composite and Filtek Bulk Fill Composites with their two recommended types of adhesives (Futura bond M+ and Single Bond Universal adhesives respectively). The chemical composition, manufacturer and web site of each material are provided in (Table I).

Restorative procedures

To minimize salivary contamination and to ease the restorative treatments, the field was isolated by a rubber dam. The cavity of occlusal Class I was prepared in accordance with the extension of caries. Cavity preparation was restricted to the removal of carious lesions up to 4 mm in depth (Figure 2). Using a graded periodontal probe, the cavity's depth was measured [12].

All cavities were prepared using straight carbide fissure burs number 57 (Dentsply, United Kingdom) held in a high-speed handpiece with a water-cooling system. In cases of deep caries, a thin coating of calcium hydroxide (Dycal chemically cured Calcium Hydroxide, Dentsply Sirona, United Kingdom) was applied, followed by a layer of glass ionomer cement base (Ionoseal Resin modified Glass Ionomer Cement Base, Voco, Germany).

Three groups were evaluated based on the materials utilized for restoration (Figure 3). These materials were randomly divided in each patient having 3 different carious molars either upper or lower teeth. Restorations were randomly distributed intra-orally to eliminate variables such as tooth type and position as shown in (Table II). In accordance with the manufacturer's instructions, the cavities were restored with the appropriate adhesive system and composites.

- *Group (I): cavities were restored with VisCalor Bulk Fill using the corresponding adhesive system Futurabond M+*
- *Group (II): cavities were restored with Fusio Liquid Dentin self-adhesive composite*

Table I - Chemical composition, manufacturer and web site of tested materials in this study

Material	Composition	Manufacturer	Web Site
VisCalor Bulk Fill (Thermoviscous, Nano hybrid bulk-fill composite compules) shade A2	Matrix: BIS-GMA (10-25%), aliphatic dimethacrylate(2.5-5%) Inorganic Filler: nano-scale filler(83% by wt)	VOCO GmbH Cuxhaven, Germany	www.voco.com
Futurabond M+ (one-step self-etch adhesive, PH=2)	BIS-GMA, 2-Hydroxy ethyl methacrylate (HEMA), ethanol, adhesive momomer, catalyst and Urethanedimethacrylate (UDMA)		
Fusio liquid Dentin (Self-Adhesive Flowable Composite) shade A2	Matrix: 4MET, HEMA, UDMA, TEGDMA, Fillers: Nano-sized amorphous silica and barium glass (65% by wt)	Pentron Clinical, Orange, CA, USA	www. Pentron. com
Filtek Bulk Fill Posterior Restorative (Nanohybrid bulk-fill composite) shade A2	AUDMA, UDMA, fillers are a combination of non-agglomerated /non-aggregated 20 nm silica filler, a non-agglomerated/non-aggregated 4 to 11 nm zirconia filler, an aggregated zirconia/silica cluster filler and a ytterbium trifluoride filler (76.5% by wt)	3M ESPE, St. paul, MN, USA	www.3M ESPE.com
Single Bond Universal (one-step self-etch adhesive, PH=2.7)	10-MDP phosphate monomer, Di methacrylate Resin filler, BISGMA, Vitrebond copolymer, HEMA, saline, water		

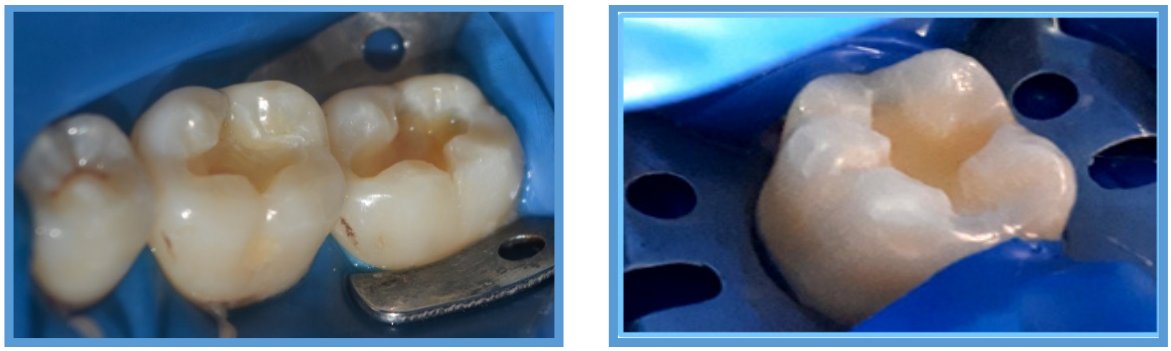


Figure 2 - An image of patient showing Class I cavity preparation of three molars.

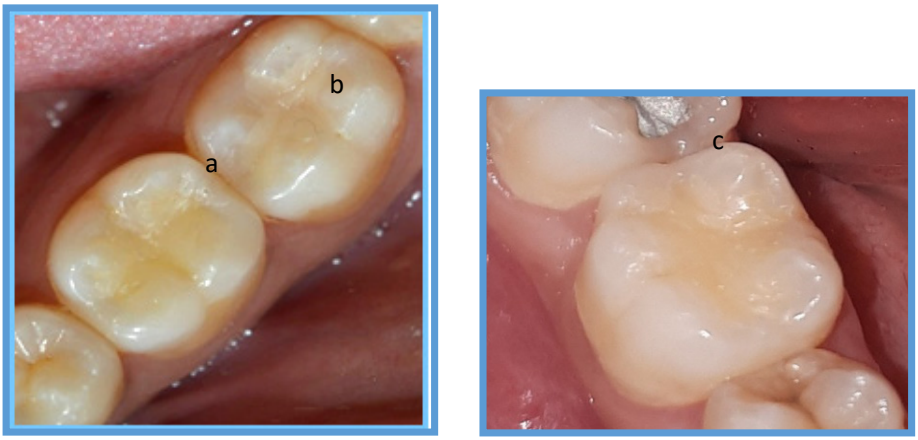


Figure 3 - An image showing final restoration of group I with preheated Viscalor Bulk Fill composite (a), group II with self-adhesive composite Fusio Liquid Dentin (b) and group III with Filtek Bulk Fill composite resin (c).

Table II - Intra- oral random distribution of restorations

Type of restoration	Lower teeth	Upper teeth	Total number
Group (I) VisCalor Bulk Fill	18 molar	2 molar	20 molar
Group (II) Fusio Liquid Dentin	13 molar	7 molar	20 molar
Group (III) Filtek Bulk Fill	16 molar	4 molar	20 molar

- *Group (III): cavities were restored with Filtek Bulk Fill Posterior composite using the corresponding adhesive system Single Bond Universal (Control group)*

Group (I): the following Prior to the application of VisCalor Bulk fill composite, Futurabond M+ adhesive (one-step self-etch adhesive) was applied by micro-brush and light cured using LED curing light device for 10s in accordance with the manufacturer's instructions. VisCalor Bulk fill was heated in a viscolar dispenser at 68 °C for 30s and placed in a 4 mm thickness as a single piece; then the unpolymerized and still plastic composite was adapted with a Teflon-coated condenser and light-cured using LED curing light device with an intensity >850mW/cm2 max reach 1200 mW/cm2 for 20s following manufacturer's instructions

Group (II): Fusio Liquid Dentin self-adhesive composite resin was put in a thin layer (1mm increment) and agitated with a needle tip for 20s, followed by 10s of light curing. Then, when required, additional layers were applied in increments of 2mm and light-cured for 10s per the manufacturer's recommendations.

Group (III): Prior the application of Filtek Bulk Fill restorative material, the suggested Single Bond Universal adhesive (one-step self-etch adhesive) was applied by micro-brush and light cured for 10s per manufacturer's recommendations. This restorative material was placed in a 4 mm thickness, fitted with a Teflon-coated condenser, and light-cured for 10s per the manufacturer's instructions.

Restorations were finished using a composite finishing kit (Enhance Finishing & Polishing System, Dentsply) and then polished using aluminium oxide extra thin polishing disks (Sof-Lex XT, 3M Espe, Germany) according to the manufacturer's instructions [11,13].

Clinical evaluation

Each restoration was clinically assessed at baseline, 6 months, 12 months, and 18 months by two calibrated investigators not including the dentist who restored the lesions, utilizing an intraoral camera, flat-surfaced mouth mirrors, and a dental explorer in accordance with modified United States Public Health Service (USPHS) criteria [14]. Included in these parameters are retention rate, marginal adaption, postoperative sensitivity, marginal discoloration, secondary caries, anatomical form, surface texture, and color matching. If disagreement was occurred between the examiners, a third equally calibrated expert was asked for evaluation.

SEM evaluation

In addition, for evaluation of marginal integrity, impressions of the restored teeth were made using a silicone impression material (Aquasil Ultra XLV, Dentsply, United Kingdom), and an inverse replica of the restored teeth was prepared along evaluation periods and gold sputtered to be examined under scanning electron microscopy (SEM) with magnification x200 to study the restoration-tooth interface [15]. The resultant micrographs were be scanned on monitor screen, then they were transferred onto Orion 6.60.6 software program and these images were appeared on the computer to determine marginal integrity.

Statistical analysis

The collected data along the evaluation periods were tabulated and statistically analyzed using Statistical Package for Social Sciences (SPSS) version 25 computer program. The three tested groups statistically evaluated by Chi-Square test, was used to examine the statistical relationship between clinical evaluation periods and scores in the same group, also used to shows the significant difference between groups in the same duration for primary outcome (retention) and secondary outcomes (marginal adaptation, marginal discoloration, surface roughness, color match, anatomical form and postoperative sensitivity)

RESULTS

A total of 60 cases (were distributed on 20 patients) were selected and recalled all over 18 months of follow-up. Regarding the retention rate of the composite restorations that were evaluated. After 18 months of follow-up, the Chi-Square test indicated that all tested groups had a hundred percent (100%) retention rate.

Regarding marginal adaptation, marginal discoloration, anatomic form, surface texture and color matching, the Chi-Square test revealed a statistically significant difference between the three examined groups after 12 and 18 months of follow-up ($p<0.05$). Chi-square test demonstrated a statistically significant difference between follow-up periods in group II, as group II Fusio Liquid Dentin self-adhesive composite scored the greatest rate of deterioration of these clinical criteria (Table III), (Figures 4, 5, 6, 7).

In the current investigation, marginal adaptation of group II (Fusio Liquid Dentin) recorded 50 percent Alfa scores and 50 percent Bravo scores throughout the duration of the study, as group II Fusio Liquid Dentin self-adhesive composite scored the greatest rate of marginal breakdown. These clinical results were comparable to those observed by SEM examination of the inverse replica, which revealed a significant difference between the three groups after 12 & 18 months ($p= 0.033, 0.016$) as group II Fusio Liquid Dentin self-adhesive composite had the highest rate of marginal seal deterioration (Figures 8, 9). In addition, there was a statistically significant difference ($p = 0.014$) in the clinical follow-up times in group II.

Group I recorded an Alfa rating during all evaluation periods, with the exception of surface roughness and color matching (5 percent bravo score after 18 months follow up). During the clinical assessment period, none of the tested restorations exhibit secondary caries; all tested materials achieved a perfect Alfa score.

In terms of post-operative hypersensitivity, in the present investigation, sensitivity was identified in only 5% and 10% of patients restored with Viscalor and Filtek Bulk Fill composite restorations (groups I and III respectively) at baseline, and it dissipated within a few days. At the baseline, the Chi-Square test indicated no significant difference between the three examined groups ($p = 0.349$). In group II, which utilized the self-adhesive composite Fusio Liquid Dentin, no post-operative sensitivity was identified throughout any of the assessment periods.

Table III - Number and percentage of restorations that scored Alfa at baseline (BL), 6, 12 and 18 months for each parameter

	Viscalor Bulk Fill				Fusio Liquid Dentin				Filtek Bulk Fill			
	BL	6M	12M	18M	BL	6M	12M	18M	BL	6M	12M	18M
Retention	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)
Marginal adaptation	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	19 (95%)	14 (70%)	10 (50%)	20 (100%)	20 (100%)	19 (95%)	16 (80%)
Hyper sensitivity	19 (95%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)
Marginal discoloration	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	18 (90%)	14 (70%)	11 (55%)	20 (100%)	20 (100%)	19 (95%)	17 (85%)
secondary caries	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)
Anatomic form	20 (100%)	20 (100%)	20 (100%)	20 (100%)	20 (100%)	18 (90%)	15 (75%)	12 (60%)	20 (100%)	20 (100%)	20 (100%)	19 (95%)
surface texture	20 (100%)	20 (100%)	20 (100%)	19 (95%)	20 (100%)	17 (85%)	13 (650%)	11 (55%)	20 (100%)	20 (100%)	19 (95%)	17 (85%)
color match	20 (100%)	20 (100%)	20 (100%)	19 (95%)	20 (100%)	17 (85%)	13 (650%)	11 (55%)	20 (100%)	20 (100%)	19 (95%)	17 (85%)

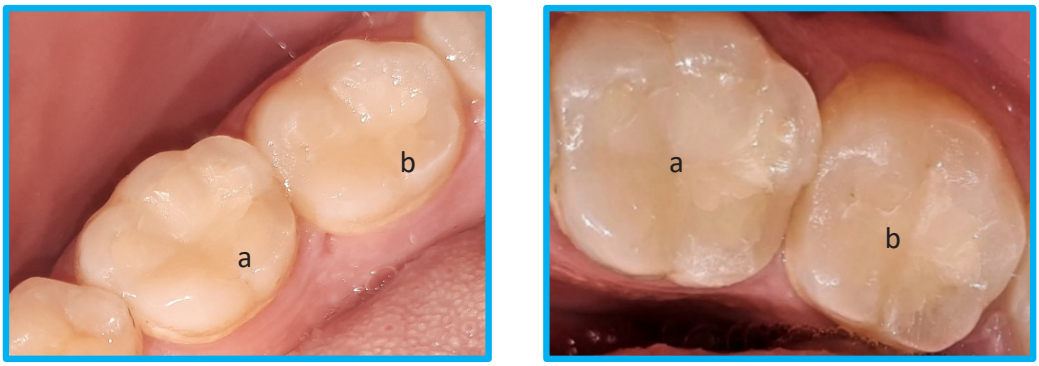


Figure 4 - Clinical photo represents Alfa score of marginal adaptation of *Viscalor Bulk Fill* (a) *and Filtek Bulk*(*b) at base line* (a) & Bravo score of marginal adaptation *Filtek Bulk Fill only* (b) after 18 months follow up period.

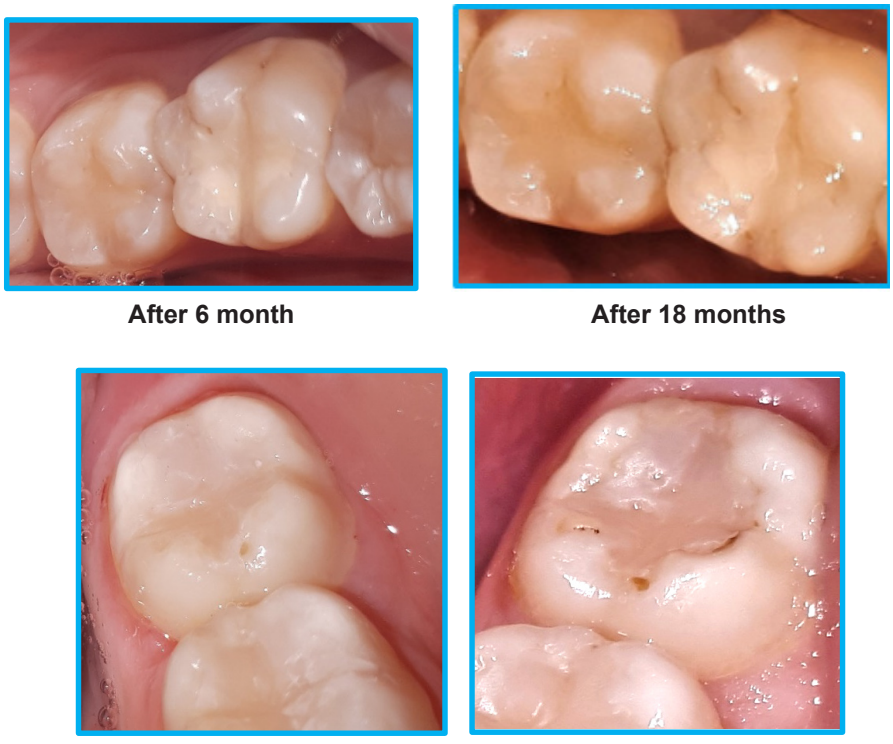


Figure 5 – (A) Clinical photo represents Bravo score of marginal adaptation and discolration of *Fusio Liquid Dentin.* (B) Clinical photo represents Bravo score of of marginal adaptation and marginal discoloration *Fusio Liquid Dentin.*

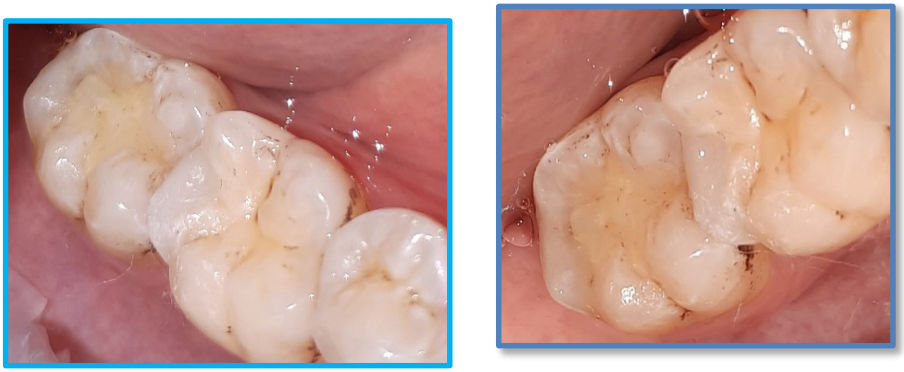


Figure 6 - Clinical photo represents Bravo score of color match of Fusio Liquid Dentin after 6 and 18 months follow up.

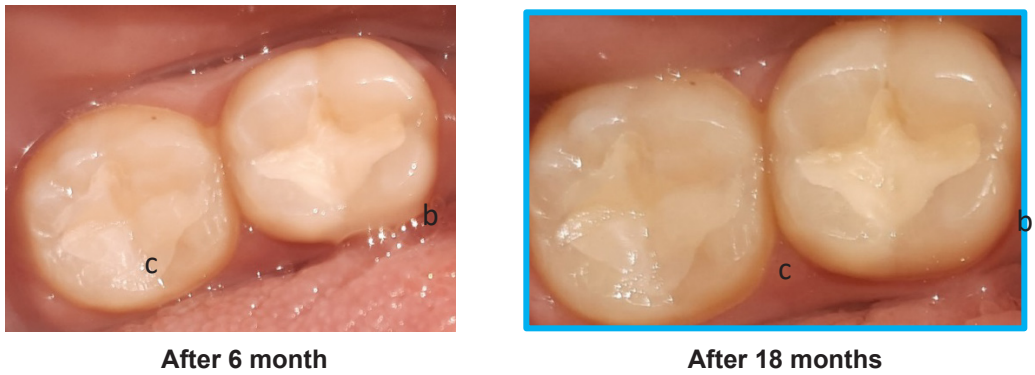


Figure 7 - Clinical photo represents Bravo score of anatomic form of Fusio Liquid Dentin (b), Filtek Bulk Fill (c) after 6 and 18 months follow up.

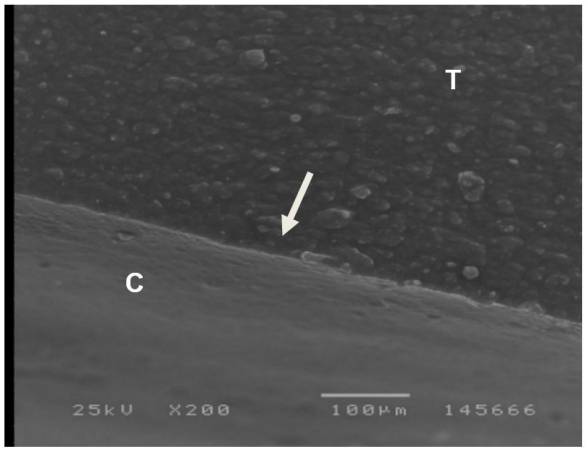
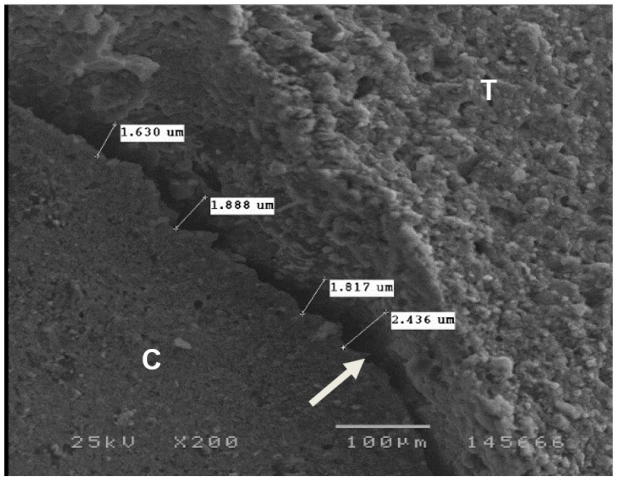


Figure 8 - SEM image of VisCalor Bulk Fill at base line showing sealed marginal interface between composite (C) and tooth (T) without micro-gaps (arrow).



After 18 months

Figure 9 - SEM image of Fusio liquid *Dentin* after 18 months follow up showing different measurements of micro-gaps at interface between composite (C) and tooth (T) (arrow).

DISCUSSION

The present participants were chosen based on specific inclusion and exclusion criteria, and the majority of them had good dental hygiene and periodontal health. To get tested restorations, these patients must have had at least three simple occlusal carious posterior teeth. To prevent the high pulp horns, huge pulp chambers, and hidden microscopic pulpal exposures that are always linked with young age patients [16], the age range of the selected patients was (30-45) years.

Class I cavity design was chosen for the current investigation because it resembled complex cavity preparation and restoration clinically. The large configuration factor of

these cavities limits composite resin flow during polymerization shrinkage, hence raising contraction stresses at the bonding contact and the likelihood of microleakage [17].

Today, bulk-fill composite resins are the preferred material for direct dental restorations. They exhibit less post-gel shrinkage and more reactivity to light polymerization than the majority of traditional composites due to their improved translucency, which increases light penetration and cure depth [18].

When the composite resin was heated, its viscosity reduced, which improved its adaptability to the walls of the cavity preparation, as well as several physical properties, such as a better degree of conversion and less polymerization shrinkage [19]. Typically, the temperature utilized to enhance these properties ranges between 54°C and 68°C, depending on the available device. There are new resins on the market, such as Viscalor [20], created specifically for preheating with enhanced manipulation capabilities.

Concerning the retention rate, the current results recorded a 100 percent retention rate after 18 months of follow-up in all three tested groups. This can be attributed to the effect of preheating and increasing the flowability of the materials, as well as increasing the bond strength at the tooth/restoration interface and utilizing the specific adhesive system recommended by the manufacturers. The high retention rate of Viscalor Bulk Fill restorations in the current investigation was confirmed by Abdalla [21] and Favoreto et al. [22], which stated that there was no retention loss of Viscalor Bulk Fill restorations during the trial.

In addition, Shaalan et al. [23], AlHumaid et al. [14], and Shaalan & Abou-Auf [24] confirmed the current findings for Fusio Liquid Dentin restorations. In basic occlusal cavity preparations, even in conservative designs, the influence of macro-mechanical ways of retention might have enhanced the overall performance of SAFCs, according to their results.

On the other hand, Çelik et al. [11] disagreed with the current results, who evaluated Fusio Liquid Dentin (SAFC) in non-carious cervical lesions; they reported that success rate of Fusio Liquid Dentin was recorded 33% after six months and concluded that, the poor performance of the material may be attributed to lack of macro-mechanical retention and weak bonding due to hydrolytic instability of the functional monomer (4-MET) and the lower etching ability of self-adhesive composite it-self.

Concerning the clinical evaluation of marginal adaptation, the marginal adaptation of Viscalor Bulk Fill restorations (group I) maintained alfa scores of one hundred percent throughout the clinical research periods. This is consistent with findings of numerous other researchers [21,25] who reported that Viscalor Bulk Fill demonstrates excellent results due to its thermo-viscous technology and excellent physical properties, such as a reduction of polymerization shrinkage accompanied by low shrinkage stresses.

Also, Demirel et al. [26] agree with the current results concerning Viscalor Bulk Fill material based on their in vitro findings revealing that the best internal adaptation was observed in sonically inserted SF2 and preheated Viscalor bulk fill, which were the manufacturers' recommended insertion techniques.

Favoreto et al. [22] who evaluated the clinical performance of a new preheating thermoviscous composite compared to a non-heating composite resin in restorations of non-carious cervical lesions over a period of 6-month, disagree with current outcomes concerning Viscalor Bulk Fill. It reported that 24% Viscalor Bulk Fill group showed small defects related to the marginal adaptation. This attributing to several methodological differences (including cavity type, adhesive type used and lower retention rate of adhesive restorations in NCCLs) between both studies explaining these differences.

Due to the material's viscoelastic properties, Alomairy et al. [27] explained and confirmed the present outcomes of Filtek Bulk Fill restoration. The tensions created during the setting and polymerization process, which may be compensated by the flow of the material and have no effect on the restoration's quality.

Throughout the current investigation, marginal adaptation of group II received 50 percent Alfa scores and 50 percent Bravo scores. This was consistent with the findings of Sabbagh et al. [4] who reported that Alfa scores were obtained after 1 and 2 years (58.8% and 50%) respectively. This is due to the inclusion of an adhesive component in the formulation of self-adhesive composites, which may have

deleterious impacts on the composite's physical characteristics. Due to the addition of hydrophilic monomers, the self-adhesive composite exhibited the least dimensional stability [28].

An example of improper sealing of SAFCS could be attributed to the fact that the acidity of the monomers in the self-adhesive materials is not low enough to promote extensive resin penetration through smear-covered surfaces or into aprismatic enamel and that the viscosity of flowable materials is not low enough to achieve good adaptation to the cavity wall [29]. Only after typical etch-and-rinse treatments with strong phosphoric acid is their bond strength improved [30].

Alomairy et al. [27] confirmed the existing results of Filtek Bulk Fill restoration in connection to Postoperative hypersensitivity. They hypothesized that the use of a calcium hydroxide-based liner over deep restorations topped with a glass ionomer cement foundation might reduce postoperative sensitivity.

Regarding Fusio Liquid Dentin restorations, no hypersensitivity was reported throughout the follow-up periods. This was consistent with the findings of Shaalan et al. [23] and Shaalan & Abou-Auf [24] and can be attributed to the fact that the self-adhesive flowable composite material dissolved the smear layer but did not remove it.

Concerning the clinical evaluation of marginal discoloration, the outstanding findings of group I (Viscalor Bulk Fill) supported by Abdalla [21] who recorded 100 percent alfa scores throughout the trial and attributed this to Viscalor Bulk Fill, demonstrate exceptional marginal adaption outcomes.

Favoreto et al. [22] and Elkaffas et al. [31] supported the current results of Viscalor Bulk Fill. Elkaffas et al. [31] reported that only a few favorable results for resin restorations with preheated composites after 3 years of clinical evaluation, with less marginal staining in the preheating composite than non-heating composite resin restorations.

In addition, the current findings on Filtek Bulk Fill were supported by other researches [27,32]. This is because nanofillers allow for great polishability, which minimizes surface roughness and discoloration.

Elbaz et al. [33] attributed their results to the aging of materials and the change in their marginal integrity over time, which resulted in an increase in marginal discoloration.

Secondary caries were not observed in any restorations made using the tested materials during the research period (Alfa score of 100 percent); this might be ascribed to the inclusion of only people with good oral hygiene and/or the short clinical time of assessment. In addition, the present findings on Fusio Liquid Dentin concurred with those of others [12,14,32]. Elbaz et al. [33] demonstrated that Fusio Liquid Dentin undergoes hygroscopic expansion over time; this may have contributed to enhanced marginal adaption by compensating for resin polymerization shrinkage.

Therefore, in the current study regarding the clinical assessment of anatomic form, the excellent results of group I (Viscalor Bulk Fill) are supported by others [21,34] who recorded excellent anatomic form (100 percent alfa scores) throughout the study and stated that Preheating of bulk fill composite results in increased micro-hardness and, therefore, the composite exhibits greater wear resistance.

Currently, Filtek Bulk Fill restorations have achieved favorable outcomes, consistent with the findings of earlier studies [27,31,35]. Alomairy et al. [27] interpreted their findings as a result of the incorporation of a unique nano filler size and technology of bulk-filled materials; exhibiting superior anatomic shape and good wear resistance.

Shaalan & Abou-Auf [24] verified the existing results of Fusio Liquid Dentin restorations, attributing this to the lower filler loading and weaker mechanical characteristics of self-adhesive flowable composites, which diminish the wear resistance of such restorations.

In terms of surface texture, the current results of Viscalor Bulk Fill concur with those of Attia [36] who found no statistically significant difference between warmed and non-heated incremental nano hybrid composite over any follow-up period. These results demonstrated that preheating did not increase surface roughness over the duration of the trial.

Currently, Filtek Bulk Fill restorations have documented favorable surface texture outcomes; our results concur with those of earlier studies [31,35]. This may be the result of the incorporation of nanofiller size and technology into bulk-filled materials; these materials may

exhibit great polishability, hence reducing any surface roughness.

Shaalan & Abou-Auf [24] corroborate the current finding for Fusio Liquid Dentin restorations, attributing this to the surface wear of Fusio Liquid Dentin restorations over time. In contrast, AlHamid et al. [14] and Elbaz et al. [33] found that the addition of nano-sized amorphous silica and glass filler in a self-adhesive flowable composite produces a material with a smoother surface and a superior finish after polishing.

Regarding the clinical assessment of color match, the results of Viscalor Bulk Fill, supported by Abdalla [21] and Elkaffas et al. [31] who reported that these restorations showed superior color stability and clinical performance after 12 and 36 months clinical follow up respectively.

Concerning color match, Fusio Liquid Dentin results were confirmed by Çelik et al. [11] who showed a significant difference in color stability between Fusio Liquid Dentin and traditional composite due to the increased solubility of Fusio Liquid Dentin. According to some experts, the amount of filler inside composites may influence color variations. It is assumed that composites having more than 70 percent by weight of filler are defined by high color stability; nevertheless, Fusio Liquid Dentin, which has 65 percent by weight of filler, demonstrates exceptional color mismatch [37].

CONCLUSION

It was concluded that Bulk fill resin composite restorations showed satisfactory acceptable clinical performance after 18 months of clinical service compared to self-adhesive flowable composites, and Viscalor Bulk Fill composite displayed excellent results with considerable changes in marginal integrity as a result of thermal viscous technology and enhancing cavity wall and margin adaptability. Regarding SEM investigation, the time had a detrimental effect on the marginal seal of self-adhesive flowable composite restorations, which degraded at the conclusion of an 18-month clinical assessment period.

Author's Contributions

AB, CDE, FG: Conceptualization. HI, JKF: Methodology. LMN, OP: Software. CDE, FG: Validation. CDE, FG: Formal Analysis. RTY: Investigation. LMN, OP: Data Curation. AB, CDE, FG: Writing – Original Draft Preparation. HI, JKF: Writing – Review & Editing.CDE, FG: Supervision. CDE, FG, RTY, UIH: Project Administration.

Conflict of Interest

No conflicts of interest declared concerning the publication of this article.

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Regulatory Statement

This study was conducted in accordance with all the provisions of the local human subjects oversight committee guidelines and policies of faculty of dentistry, Tanta university. The approval code for this study is: #R-RD-5-20-2.

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