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MICROLEAKAGE EVALUATION OF PRE-HEATED VERSUS HIGH VISCOSITY BULK FILL AND INJECTABLE RESIN COMPOSITES

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ABSTRACT

Aim: The study compared micro leakage of pre-heated resin composites to those of high viscosity bulk fill and injectable composites.

Materials and Methods: Forty-eight freshly extracted premolar teeth were collected, standardized class V cavities were prepared and then divided randomly into 3 equal groups: a thermoviscous one (VisCalor Bulk), a high viscosity resin-based composite (X-tra fil), and G-ænial universal injectable composite. Different insertion techniques were applied for the three composite resins. VisCalor Dispenser was used to pre-heat the VisCalor resin composite specimens at 65˚C, and Xtra-fil composite was applied in a bulk of 4mm. In contrast, Gaenial composite was injected directly inside the cavity. Then, each specimen was submerged for a full day in a 2% methylene blue dye solution. A stereomicroscope was utilized to examine the penetration of methylene blue to evaluate the microleakage of the restorations through the use of image analysis software. Obtained results were investigated using SPSS with significance level set at $p \leq 0.05$.

Results: The mean micro leakage was significantly higher for VisCalor bulk fill at 694.3 than X-tra fil at 152.7 (P=0.0145) and significantly higher than G-ænial at 219.5 (P=0.0305). The difference in mean micro leakage between X-tra fil and G-ænial was not statistically significant (P=0.9103).

Conclusion: Micro leakage was detected in all evaluated composite groups. Pre-heating VisCalor bulk fill resin composite up to 65˚C seems to increase marginal gap formation compared to the studied unheated resin composites. Unheated composite materials represented by X-tra fil and G-ænial proved superior sealing ability and lesser micro leakage than VisCalor bulk fill.

KEYWORDS: Thermoviscous, Preheated, Microleakage, Bulk fill, Injectable

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INTRODUCTION

Patients' high demand for esthetic restorations and the evolving tooth preservation concept in operative dentistry dictate increased use of resin composite restorations in modern dentistry[1]. Despite the continuous improvements in resin composite restoration since its introduction by Bowen, we are facing drawbacks such as polymerization shrinkage and high viscosity. These drawbacks make them difficult to manipulate and result in an increasing marginal gap between tooth and restoration[2, 3].

The transfer of germs, ions, and molecules between the tooth surface and filling material contact is known as micro leakage, and it can lead to increased sensitivity, secondary caries, discoloration, and restorative failure. The incremental layering technique was confirmed to decrease the volumetric shrinkage of composite and its subsequent micro leakage, but it has adverse effects such as the prolonged time of application, voids incorporation, and possible contamination between subsequent composite layers[3]. Therefore, bulk-fill composites were introduced with different insertion techniques in an attempt to solve some of the problems associated with the incremental packing technique. Nowadays, they gained widespread clinical application due to the improvement in curing properties, reduced polymerization shrinkage stresses, and cuspal deflection, besides simplifying application technique and increased curing depth[4]. However, polymerization shrinkage and its resultant micro leakage are still some of the main drawbacks when using bulk-fill composite restoration.

Pre-heating resin composite before inserting it into the cavity is one of the most recent innovations. Pre-heating high-viscosity bulk-fill composites enhances their flow ability, makes application easier, lowers their viscosity, and improves marginal sealing without sacrificing the benefits of their high mechanical properties[1, 5, and 6]. The benefits of bulk fill and pre-heating have recently been combined with the introduction of VisCalor bulk, a thermoviscous bulk fill composite with a novel heating device called VisCalor dispenser[7]. The manufacturer claims that this technology, once warmed by near-infrared technology, becomes flow able and enables for instant application within the capsule inside the gun, thus keeping its high temperature that rapidly cools after insertion, allowing for immediate sculpting of a packable resin composite and thus solving problems that were associated when using conventional heating devices which show a rapid decrease of composite temperature after removing it from heating device and before its adaptation inside the cavity[8].

Additionally, the G-aenial Universal injectable is a universal low-viscosity restorative composite that was recently introduced. The manufacturer claims that it displays exceptional strength and resistance besides increased wettability and adaptation to cavity walls and margins for long-lasting aesthetic restorations. This composite has a unique technology that relies upon two parameters: the uniform filler dispersion and the efficient filler salinization that improves the composite's strength while maintaining its low viscosity (G-ænial Universal injectable technical manual).

Many studies reported assessment of micro leakage. However, there is limited data concerning the effects of pre-heating bulk-fill resin composites on gap formation and micro leakage between the restorative material and cavity margins[9]. Therefore; the study aimed to compare the micro leakage of pre-heated versus those of high viscosity bulk fill and injectable resin composites.

MATERIALS AND METHODS

Sample Size Calculation

Continuously responding variable helped to make sample size calculations derived from matched pairs in a prior research by Guvenc et al[10]. The investigation aimed to assess the impact of different composites on micro leakage, employing a dependent t-test or an equivalent non-parametric test to compare two distinct composites. Micro leakage exhibited a range from 1.46±0.78 to 2.33±0.67. G Power statistical analytic software (version 3.1.9.6) was employed for sample size determination. Statistically; 16 samples were determined for each group to be adequate to spot a greater effect size (d = 1.196562), achieving an actual power (1-β error) of 0.95 (95%) and a significance level (α error) of 0.05 (5%) for a two-sided hypothesis test **Fig. (1)**.

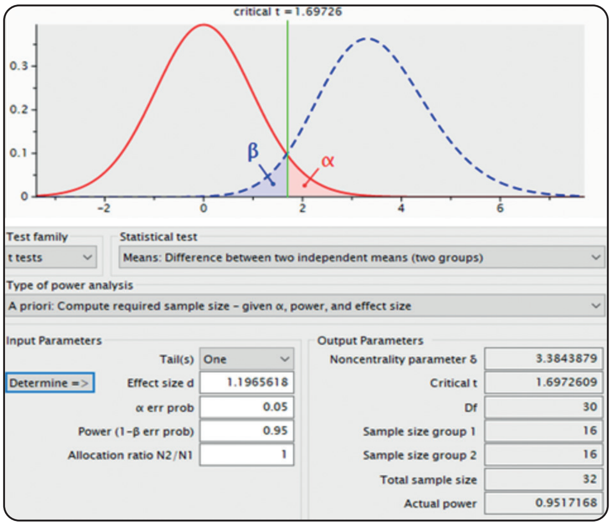

Fig. (1) Power Graph revealing the Power of the Study corresponding to the Estimated Sample Size using G Power Analysis.

Three types of bulk fill resin composites were evaluated in the study: a thermoviscous pre-heated composite (VisCalor Bulk), a high viscosity resin-based composite (X-tra fil), and a universal injectable composite (G-ænial Universal injectable). The related resin composites' details were given in **Table 1**.

Ethical Approval

The research protocol was thoroughly viewed and approved by Badr University in Cairo BUC Institutional Ethical Committee with approval number BUC-IACUC-230827-31.

Teeth selection, grouping, and cavity preparation

A total of 48 sound, intact, freshly extracted (for orthodontic treatment) human, maxillary premolars were collected and used according to the ethical approval from Badr University in Cairo Ethical Committee. The type of resin composite was then used to randomly separate the teeth into three equal groups. Group A (n=16): teeth were restored with VisCalor (VOCO, Cuxhaven, Germany). Group B (n=16): Teeth were restored with X-tra fil (VOCO, Cuxhaven, Germany). Group C (n=16): Teeth were restored with G-ænial Universal injectable composite (GC, Tokyo, Japan).

TABLE (1) Material, manufacturers, and composition of bulk-fill resin-based composites.

Material	Manufacturer	Shade	Resin System	Filler	Filler Loading
VisCalor Bulk	Voco, Cuxhaven, Germany	A2	Bis-GMA, Aliphatic dimethacrylates	Inorganic nanohybrid filler (not defined by the manufacturer)	83 wt%
X-tra fil	Voco, Cuxhaven, Germany	A2	Bis-GMA, UDMA, TEGDMA	Barium-boron-aluminosilicate glass	86 wt%
G-ænial Universal injectable	GC Corporation, Tokyo, Japan	A2	UDMA Bis-MEPP TEGDMA	SiO2, Barium glass	69 wt%
Futurabond U	Voco, Cuxhaven, Germany		HEMA, Bis-GMA, HEDMA	Acidic adhesive monomer	

Bis-GMA = bisphenol-A diglycidil ether dimethacrylate; HEMA = Hydroxyethyl methacrylate; HEDMA = Hexane diol dimethacrylate or 2-hydroxyethyl dimethacrylat; TEGDMA = Triethylene glycol dimethacrylate; UDMA= urethane Dimethacrylate

Standardized class V cavities that measured 3mm mesio-distally, 2mm occluso-gingival, and 2 mm bucco-lingual were prepared on the buccal surfaces of the selected teeth. The gingival margin of the preparation was about 1 mm apical to the cemento-enamel junction. The cavities were standardized using a millimeter ruler, a K-file, and a colored marker pen to accurately determine the dimensions. The preparations were performed using inverted cone and fissure carbide burs size 1 (Komet, Germany) mounted to a high-speed air turbine handpiece under abundant water coolant. The prepared cavity depths and dimensions were confirmed using a graduated periodontal probe. After preparation, the teeth were thoroughly cleaned with water and dried gently.

Bonding Procedures

A universal hydrophilic containing HEMA (hydroxyl ethyl methacrylate) acidic adhesive; Futurabond U (Voco, Cuxhaven, Germany) was manipulated as instructed by the manufacturer. A selective acid etching technique was performed; where the enamel margins were carved for 30 seconds, then, rinsed with water for about 20 seconds. A light air stream was used to just remove the extra water. The adhesive resin was equally applied to all cavity surfaces, then, brushed in for 20 seconds using the Single Tim applicator. Gentle air thinning was implemented for 5 seconds to fade away the adhesive solvent. Subsequently, light-curing was carried out for 20 seconds using a light-emitting diode curing device (LED; Woodpecker, China) at 1000 mW/cm^2 light intensity.

Application of the restorative materials

As directed by the manufacturer, VisCalor Bulk was used for the ***first group; A:*** The VisCalor compule was heated inside VisCalor Dispenser that was adjusted to Program 1. The composite was heated to about 65 °C in about 0.5 minute, and the working time was 2.5 minutes. Then, VisCalor resin was directly injected into the prepared cavity, starting from the deepest point. Then, the top of the cavity was filled with material, leaving the tip of the caps below the surface. A light-emitting diode curing equipment was then used to polymerize the resin for about 20 seconds.

The second group; B: The bulk fill X-tra fil composite cap was inserted into the opening of the dispenser gun. Then, the composite was directly inserted to the prepared cavity in a bulk of about 4 milimeters with an even and slow pressure on the levers of the dispenser together. It was then light-cured following the manufacturer instructions for about 20 seconds.

The third group; C: The G-aenial Universal injectable composite was injected directly into the cavity in an incremental packing of 2 mm in accordance with the manufacturer's directions, and then light-curing was performed for 20 seconds utilizing the same light curing unit. Afterwards, aluminum oxide flexible discs (3M ESPE, USA) in the order of coarse, medium, and fine types were used to polish and finish the resin restorations. Finishing stone (Shofu-Japan) was used for that process. The samples were thereafter separately kept for a full day in distilled water.

Micro leakage Assessment

In order to guarantee adequate sealing against dye penetration, teeth were then coated twice with a dark nail paint, with leaving the area of about 1 mm from the restoration. For a full day, each tooth was submerged in a 2% methylene blue solution. After that, the teeth were taken out and properly cleaned of any remaining dye under running water. With the use of a diamond sectioning disc submerged in water coolant, the teeth were cut longitudinally in bucco-lingual direction into the middle of the restoration. The restorations were inspected at a 25x magnification using a Leica stereomicroscope (Leica Microsystem Ltd, Germany) to measure the level of dye absorption throughout the tooth-restoration interface. Afterword, an image analysis software (Leica Application Suite V3 1.0) was used to quantitatively evaluate in millimetres the amount of dye penetration.

RESULTS

GraphPad Prism 18 and the IBM SPSS software package version 24.0 (Armonk, NY: IBM Corp) were used to perform the statistical analysis of the presented data. For each group, descriptive statistics were collected, such as means and standard deviations. The Kolmogorov-Smirnov and Shapiro-Wilk tests were used to determine normality before group comparisons using One-Way Analysis of Variance (One Way ANOVA). On the other hand, Tukey's post hoc test was used for several comparisons. The results of these tests indicated a normal distribution for the parametric data under consideration.

Tables (2) and (3) presented descriptive statistics and multiple comparisons of micro leakage scores for three composite filling materials – VisCalor bulk fill, X-tra fil, and G-ænial composites. **Table (2)** displayed the descriptive statistics, including minimum and maximum, measures of central tendency (mean, median), measures of variability (standard deviation, standard error of mean, percentiles), and 95% confidence intervals. These statistics profile the distribution of micro leakage scores for each material.

TABLE (2) Descriptive statistics of microleakage of VisCalor bulk-fil composite, X-tra fil composite, and G-ænial composite

	VisCalor bulk fill composite.	X-tra fill composite	G-ænial composite
Min	214.9	66.76	135.9
25% Percentile	268.9	76.97	160.6
Median	776.4	92.16	233.4
75% Percentile	1079	258.7	271.4
Max	1243	292.6	287.5
M	694.3	152.7	219.5
SD	425.5	100.1	59.68
SEM	190.3	44.79	26.69
Lower 95% CI	166.0	28.37	145.4
Upper 95% CI	1223	277.1	293.6

Min; Minimum, Max; Maximum, M; Mean, SD; Standard Deviation, SEM; Standard Error of Mean, CI; Confidence Interval

The mean micro leakage was highest for VisCalor bulk fill composite (M=694.3), followed by G-ænial (M=219.5) that was followed by X-tra fil (M=152.7). The micro leakage medians displayed a similar pattern for the assessed resins where the VisCalor value was the highest (776.4), followed by that of the G-ænial (233.4), then, that of the X-tra fil (92.16). As there were observed discrimination between mean and median for VisCalor and G-ænial; indicating positively skewed distributions with more scores clustered towards lower values but a few extremely high scores stretching out the upper end. For X-tra fil, the mean and median were closer, showing a relatively more symmetrical distribution.

TABLE (3) Multiple Comparisons of micro leakage of VisCalor bulk fill composite, X-tra fil composite, and G-ænial composite.

	MD	95.00% CI of diff.	Significant?	P-value
VisCalor bulk fil composite vs. X-tra fil composite	541.6	-123.6 to 309.7	Yes	<0.0001
VisCalor bulk fil composite vs. G-ænial composite	634.6	-123.6 to 309.7	Yes	<0.0001
X-tra fil composite vs. G-ænial composite	93.02	-123.6 to 309.7	No	0.5555

MD; Mean Difference, CI; Confidence Interval, P; Probability Level

The minimum and maximum scores demonstrated the range: VisCalor had the highest minimum (214.9) and maximum (1243), indicating the most incredible spread of micro leakage values. The standard deviations quantified the variability: VisCalor (±SD=425.5) showed substantially more inconsistency versus X-tra fil ((±SD=100.1) and G-ænial (±SD=59.68). The confidence intervals also reflected that variability in the mean estimates.

According to the obtained descriptive statistics; VisCalor bulk fill composite showed significantly higher micro leakage on average combined with much greater variability and spread in the scores versus the more consistent and lower leakage profiles of X-tra fil and G-ænial. The obtained results profoundly supported certain clinical implications regarding material selection. Observed VisCalor's limited sealing capacity predisposed restorations recurring decay, pulpal inflammation, and premature failure that were sequelae of micro leakage. The manufacturer's claims of superiority for the bulk-fill composite were unsupported. In contrast, X-tra fil and G-ænial demonstrated excellent marginal sealing with average micro leakage values of less than 220; leakage resistance on par with traditional composites.

Comparing between X-tra fil and G-ænial, the former might have a slight edge with lower average leakage and tighter clustering of scores. However, the lack of a statistically significant difference meant that either would clinically perform very similarly. Beyond micro leakage, properties like wear resistance, polish ability, esthetics, and dentin bonding might guide the choice. The obtained results [**Table (3)**] presented Tukey's post-hoc test that compared micro leakage in three resin composites: VisCalor bulk fill, X-tra fil, and G-ænia. Tukey's test was used after ANOVA to precisely determine the pairs of group means that were statistically different. After accounting for multiple tests, those tests whether the differences in mean micro leakage between materials were statistically significant. However; VisCalor bulk fill composite evidently reported significantly high micro leakage values compared to those of X-tra fil (mean diff = 541.6) and G-ænial (mean diff = 634.6) ($p<0.0001$), there was no significant difference between X-tra fil and G-ænial micro leakage values.

The mean micro leakage difference between VisCalor bulk fill and X-tra fil composites was 541.6. Since the 95% confidence interval (CI) of the difference (111.8 to 971.4) was not containing zero, the mean micro leakage of VisCalor bulk fill was significantly higher than X-tra fil ($P=0.0145$). Similarly, the mean micro leakage of VisCalor bulk fill was 474.8; higher than that of G-ænial composite. Furthermore, the 95% CI of the difference (45.01 to 904.6) excluded zero; indicating that the mean micro leakage of VisCalor bulk fill was significantly higher than that of G-ænial ($P=0.0305$). In contrast, the mean micro leakage difference between X-tra fil and G-ænial composites was 66.78. Since the 95% CI (-496.6 to 363.0) contained zero, the variance in the value of mean micro leakage between X-tra fil and G-ænial was not statistically significant ($P=0.9103$).

The post hoc analysis confirmed that VisCalor bulk fill micro leakage was significantly higher than X-tra fil and G-ænial composites. That analysis proved that the sealing ability and the micro leakage resistance of VisCalor bulk fill composite were inferior compared to those of the other two evaluated resin materials (X-tra fil and G-ænial). However, no significant difference in micro leakage was detected between X-tra fil and G-ænial composites, that was evidenced by the negative mean difference of -66.78 and non-significant P value. Those data suggested that X-tra fil and G-ænial performed comparably in terms of micro leakage, with no clear advantage of one over the other.

In summary, Tukey's post-hoc test provided statistical evidence that VisCalor bulk fill composite exhibited significantly lower sealing ability and higher micro leakage than X-tra fil and G-ænial composites. However; X-tra fil and G-ænial composites showed similar micro leakage with no significant difference between them. The analysis validated the conclusions from the descriptive statistics that VisCalor bulk fill performed the least in minimizing micro leakage among the three composites tested, **Fig 2**. Furthermore, **Fig 3-5** stereomicroscope image of VisCalor composite, X-tra fil composite, and G-ænial composite showed depth of methylene blue dye penetration in class V cavities at tooth-restoration interface using image analysis software.

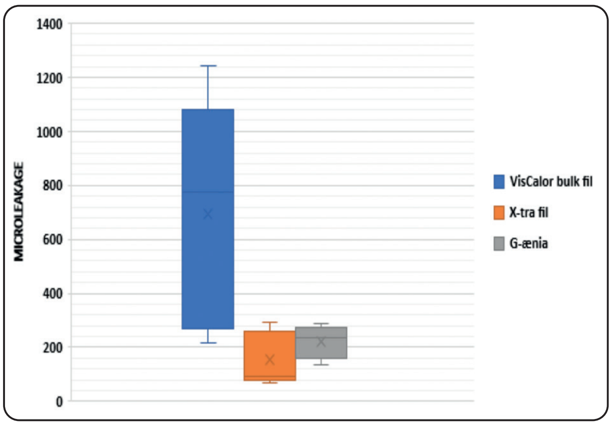

Fig. (2) Box and Whisker chart illustrating the VisCalor bulk fill composite microleakage, X-tra fil composite, and G-ænial composite.

DISCUSSION

The study was intended to gauge and compare the micro leakage of the pre-heated resin composite

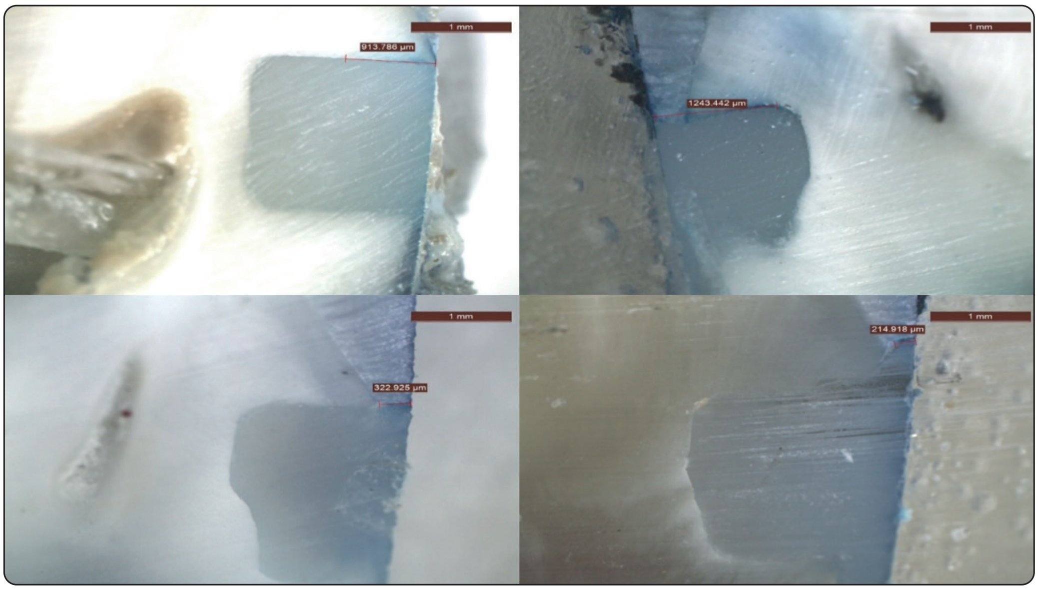

Fig (3) Stereomicroscope image of VisCalor composite showing depth of Methylene Blue dye penetration in class V cavities at tooth restoration interface using image analysis software.

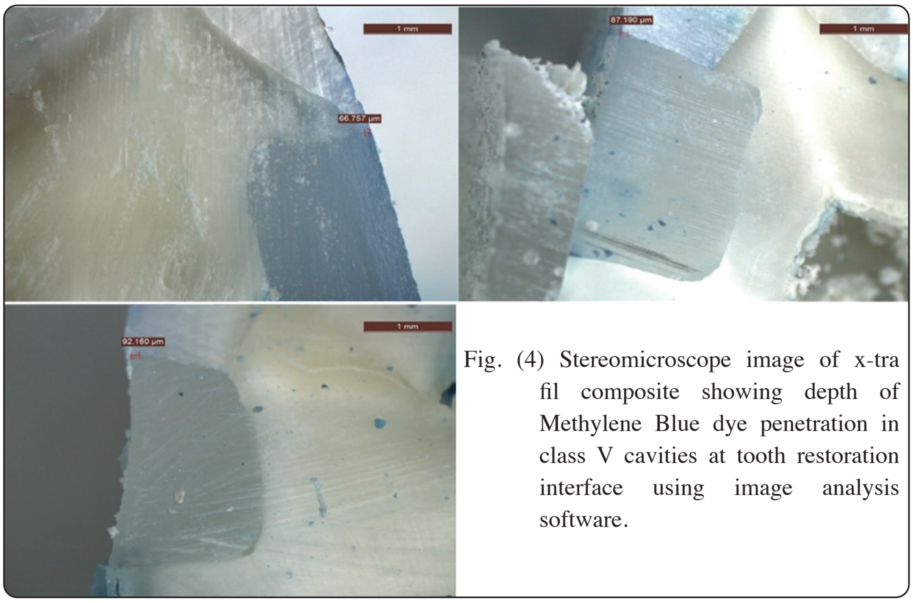

Fig. (4) Stereomicroscope image of x-tra fil composite showing depth of Methylene Blue dye penetration in class V cavities at tooth restoration interface using image analysis software.

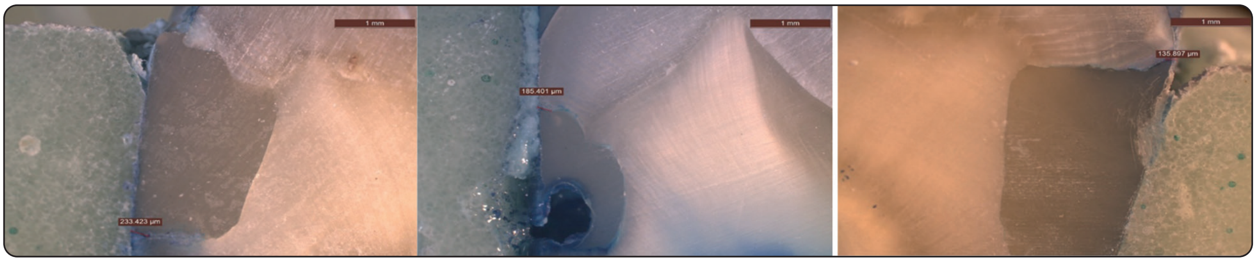

Fig. (5) Stereomicroscope image of G-ænial Universal injectable composite showing depth of Methylene Blue dye penetration in class V cavities at tooth restoration interface using image analysis software.

restorations to that of unheated ones in class V cavities. Assessment was carried out by means of a dye penetration technique and a stereo microscope aided with an image analysis software. Study results proved that all investigated resin composite materials were presenting variable degrees of micro leakage. Each resin composite material had its specific insertion technique, demonstrating how selection of resin composite and its manipulation procedure would affect the marginal integrity at the tooth-restoration interface. Therefore, the null hypothesis was rejected.

Recently, bulk-fill resin composites have been introduced to the dental market with high expectations, making them superior to the conventional incremental techniques. Bulk fill is a highly viscous composite restoration that fills the cavity in a single layer with a depth of 4mm to 5mm, and it has a less technique-sensitive procedure[11]. Bulk fill has many advantages over low viscosity composite; as it allows for the use of stress-relieving monomers and fillers that permit modulation of the polymerization reaction. Moreover, it contains reactive photo-initiators and modified high molecular weight base monomers that aim to minimize polymerization shrinkage stresses. Furthermore, the bulk technique reported superior mechanical properties, allowed greater conversion at increasing depths, and minimized voids and subsequent contamination between composite layers, leading to a more durable and clinical performance of restoration[12, 13].

Accordingly, as conventional incremental composites, bulk fill resin composites were pretty different in terms of matrix and filler composition between different categories, whether pre-heated or unheated bulk fill composites[14]. Evidently, the viscosity of resin composite affects its adaptability to cavity walls and margins as well as marginal gap formation between the tooth surface and the inserted restorative material. Consequently, these marginal gaps under aging conditions might adversely affect the physical and mechanical properties of the resin-based composite material. In addition, they might act as strain enhancers, leading to medical failure of the composite restoration[14, 15].

Those study findings were in agreement with the theory that postulate that thermal energy forces the monomers further apart, permitting them to slide more readily, therefore; increasing the degree of polymerization, decreasing the polymerization shrinkage and stresses and improving mechanical properties of set restoration[16, 17]. Increasing the flow ability of composite would enhance the variation of uncured (residual monomer) resin composite material to cavity walls and margins and, hence, decrease microleakage[1, 18].

Recent literature interprets the advantages of pre-heating composite and increasing its flow ability due to the thermal energy that increases the molecular motion of monomer chains in the composite resulting in a higher degree of monomer conversion that leads to better-handling properties, improved marginal adaptation, and overall better mechanical adaptation. Therefore, resin composite pre-heating seemed to have an impact on the daily operative procedures, serviceability and longevity of final restoration which made it a popular technique clinically[1, 6, 16, 19, 20, 21, 22].

A new thermos-viscous bulk fill resin composite was introduced to the market: VisCalor bulk with its specific heating device. The VisCalor dispenser is specially designed for pre-heating and has improved manipulation properties. This system combines the advantage of bulk fills and the viscosity of the flow able composite. The manufacturer claimed that the dispenser's decreased viscosity of the material to easily flow and intimately adapt to cavity margins and undercuts. Thereby, VisCalor system was produced to improve the rheological properties of the resin, decrease air bubble formation and minimizing marginal gaps. That system used infrared technology to warm-up composite compules within seconds and allowed immediate application into the cavity without removing the capsule from the heating device. Once placed into the cavity, they rapidly cool, allowing for immediate sculpting as for a packable composite. The mode 1 of device allows pre-heating at 65°C for about 0.5 min. and 2.5 min. as working time[8, 23, 24].

Intact, non-carious, human teeth were used to prepare a class V cavity design; aiming to appropriately assess micro leakage. They decrease technique sensitivity, are simple to prepare and restore, and have minimal configuration elements. Class V cavities are thought to be difficult to clinically restore because of the morphological features in the cervical area. In addition, successful true adhesion of restorative resin material to dentin or cementum in the cervical area is difficult to achieve, which might result in micro leakage and its aftereffects, including hypersensitivity, secondary caries, and restoration failure[25, 26, and 27]. Each resin composite restoration, should be used with the recommended bonding system as instructed by the manufacturer; in order to improve the adhesive bond strength, its durability and serviceability as well as to hinder the micro leakage outcomes.

However, several in vitro techniques were elaborated for assessment of micro leakage, the most common used is the dye penetration method. It has numerous advantages, including no radiation or reactive chemicals being used, and is highly feasible due to the variety of available dye solutions.

In addition; the dye has a contrasting color without chemical interactions with the specimens[25, 28]. Methylene blue is used as it has a relatively small molecular size (0.5-0.7mm), that helps in its further penetration and affects test reliability[29, 30].

Therefore; the study aimed to evaluate different insertion techniques, a pre-heated bulk fill resin composite and an unheated one on micro leakage of class V cavities using dye penetration technique under a stereomicroscope. All assessed composite materials reported different forms of micro leakage. The study results in terms of micro leakage might be attributed to the composition of the different resin composite materials[31].

The present study revealed a statistically significant difference in micro leakage values among the three investigated groups, with greater amount of leakage observed in the VisCalor bulk group. Those results were in agreement with Yang et al[7], who found an increase in micro leakage, when the composite was pre-heated to 60˚C. Accordingly, Daronch et al[5], who attributed that micro leakage to the possibility of the drop in temperature between the heating process, filling and curing of resin composite within the cavity, saying that when curing composite it might probably reach a lower temperature where the enhanced mechanical properties gained by high temperature might be diminished.

Another study revealed that increased volumetric shrinkage when resin composites were pre-heated to temperatures ranging from 54 to 68˚C. In addition, Wagner et al[1] found that delaying curing of the pre-heated composite after its placement inside the cavity might increase micro leakage as the drop in composite temperature might give chance to the viscoelastic nature of restoration to pull away from cavity walls and margins faster and due to higher temperature, that was reached, elastic deformation might be faster.

The study findings were incongruent with those of Akah[2], who found superior adaptation of VisCalor bulk fill composite to cavity walls and margins and attributed those findings to the heat energy that separated composite monomers apart, therefore; facilitating their sliding more readily and hence increase material adaptation, besides the cooling rate of VisCalor bulk which is 2.5 minutes considered long enough for stress relief and better adaptation to cavity walls. The study findings were contradicted by Fròes-Salgado et al[6], who found that pre-heating of composite revealed better marginal adaptation compared to that at room temperature justified that to the fact that pre-heating of composite resin reduced its viscosity and thereby increased its adaptation to cavity walls and margins and decreased th total gap area as when the temperature rises, the flow ability of resin increased which results in enhanced adaptability to cavity walls.

All studied resin composite groups showed different micro leakage values. The possible reasons for lesser micro leakage values of G-ænial composite compared to those of VisCalor bulk fill composite might be due to its composition of ultra-fine barium particles (150nm), that were firmly bonded into resin matrix with ***Full Coverage Silane Coating*** (***FSC***) that was considered the latest innovation technology to ensure ***optimal filler Salinization*** (G-ænial universal injectable technical manual, GC, Version 1, 2018).

Obtained study results were in agreement with those of Ranka et al[32] and Martínez-Sabio et al[33], who found the less micro leakage measurement of G-ænial injectable composite as compared to further kinds, and they credited that to the uniform filler (69% wt% inorganic filler) dispersion together with the efficient ***Silanization*** increased wettability of the fillers and improved the linkage to the resin monomers that would result in a reduced amount of polymerization contraction and increase variation of the G-ænial composite material to cavity walls and margins resulting in good marginal integrity[34, 35].

Evidently; G-ænial composite has enhanced its ***thixotropic property***; i.e. it has low viscosity with increased wettability that offer a better adaptation to cavity walls, floors, and margins without dipping, and consequently, it has an excellent promising marginal sealing ability with a resultant estimated decreased microleakage[36].

The X tra-fil bulk fill composite (UDMA and TEGDMA organic matrix diluents, 86% wt% inorganic filler, nano-hybrid composite) showed the lowest micro leakage values in the study. Those findings were in agreement with Abbasi et al[37], who attributed it to the combination of a new multi-hybrid filler technology with a novel initiator system formed filler material basis minimizing polymerization shrinkage and enhanced curing depth with a resultant decrease in the micro leakage. In conjunction, Elhendawi et al[38] and Temirek[39] attributed those findings to the high filler content and different types of fillers incorporated that resulted in better performance with a resultant increase in the marginal sealing ability of the material.

CONCLUSIONS

Within the limitations of this in vitro study, the retrieved conclusions might be:

1. None of the studied resin composite materials seem able to absolutely eliminate micro leakage in class V cavities.
2. Although the studied thermoviscous bulk fill composite technology offers the advantage of easy manipulation, time saving and least technique sensitivity of all direct resin composites due to its rheological properties, it might be unpromising because of the micro leakage.

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