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Clinical assessment of thermo-viscous versus conventional bulk-fill resin composites in proximal compound posterior restorations: A randomized controlled clinical trial

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***Abstract*---**Objective The purpose of this prospective randomized clinical study was to compare the clinical performance of thermo-viscous bulk-fill resin composite versus conventional bulk-fill resin composite in proximal compound posterior restorations. Materials and Methods: A total of fifty-four Class II cavities were prepared in forty-seven patients. The patients were divided into two groups according to the type of the bulk-fill used (n=27).Group 1 : thermo-viscous bulk fill (Viscalor,Voco) while Group 2: conventional bulk fill (Xtra-fil ,Voco). Both groups received the same adhesive system; selective enamel etching using the single dosed dual cured universal adhesive (Futura-bond U, Voco). All restorations were clinically evaluated at periods of 1 week (initial recall), after six months, and after one year. Assessment

was done according to the modified United States Public Health Service (USPHS) criteria. Data were statistically analyzed using Friedman to compare between the tested periods for each group ($p < 0.05$). Results: There was no significant difference between group 1 and group 2 regarding all tested criteria at different follow up periods; where $P > 0.05$. Conclusions: Thermo-Viscous Bulk fill composite (Viscalor bulk fill) and conventional packable bulk fill composite resin (X-tra-fil) exhibited comparable acceptable clinical performance after one year of clinical evaluation.

***Keywords*---**pre-heating, bulk-fill resin composite, thermo-viscous resin composite, proximal compound cavities**.**

Introduction

For several years, the growing needs for the use of direct, light-activated resin composite have increased significantly in restorative dentistry. They are considered to be one of the most essential treatment options in restorative dentistry which has been motivated by several factors such as patient desire for more esthetic restoration, an increased desire for minimally invasive restorations and more reliable dental adhesive systems. [1] Since 1960s, their first introduction in the market, the resin composites had been improved in different areas, as aesthetics, wear, and handling properties. Despite the non-stoppable improvement and evolution of the resin composite there are still main problems that compromise the resin composite durability as the polymerization shrinkage and marginal microleakage**.** Polymerization shrinkage of the resin composite considered being the challenge itself and also due to the arise of the shrinkage stresses, which results in gap formation in the bonded interface which led to accumulation of the voids and afterwards the marginal deterioration. [2]

To overthrow those problems, many trials have been made to enhance the properties of the resin composite as improvement of the mechanical properties of these materials, including changes of the fillers their amount, size and type and the use of non-methacrylate-based monomers. The technique of application as well as the change in the clinical procedures has been proposed to increase the longevity of the restoration as it compensates for the stress associated with polymerization shrinkage as it gives better marginal adaptation between the resin composite and the cavity walls. The high viscosity and stickiness of contemporary resin composites make the insertion, as well as adaptation, of the material to preparation walls difficult and unpredictable. [3]

The conventional (incrementation) technique of application can be very complicated and time consuming especially when it is used to restore too deep and large cavities in the posterior teeth. So, many clinicians hoped for an alternate to that technique which considered being technique sensitive. The introduction of the bulk-fill resin composites in the market have been arose in response to the demand of more efficient, short clinical time restoration. [4] Bulk-fill materials are placed in the cavities as 4-5mm increment each of them thickness. For increasing of the curing depth of the bulk-fill materials,

enhancement of the translucency of the resin composite and photo-initiator system optimization also lead to shorter curing time. [5] Despite the presence of bulk fill materials which shorten clinical time, the idea of lowering the viscosity of the resin composite by their different means can aid for better adaptation help in good adaption to the wall of the cavity. [6]

Pre-heating of uncured resin composites is one of the methods that are used improve the handling characteristics during restoration. Increasing the temperature of resin composites usually reduces their viscosity, leading to improved marginal integrity and decreased microleakage by reason of enhanced wetting of cavity walls. Preheating enhances the radical and monomer mobility leading to alteration in many mechanical and physical properties. [7] Recent literatures assumed that lowering the viscosity of the resin composite by raising their temperature leads to increase in their flowability and showed lots of benefits as marginal adaptation improvement, enhancement in handling properties, better mechanical properties, and increase of degree of conversion of monomers. [8]

A new approach, based on thermo-viscous technology, was recently introduced in the dental market. VisCalor® bulk (VOCO, Cuxhaven) is considered to be at the room and the body temperature as a high-viscosity composite material, which is then converted to a flowable consistency by their heating in a composite heater or their special dispenser to a temperature of 65° C. The testing of the materials clinically is important to determine their durability and performance. Therefore, the purpose of the current study was to investigate if there is difference in the clinical performance between thermo-viscous and conventional bulk-fill resin composite compound posterior restorations.

Materials and Methods

The restorative materials used in this study are described in Table (1).

Table (1): Materials' specifications, compositions, manufacturers and lot numbers

Material	Specification	Composition	Manufacturer	Lot number
Vococid	Etching gel	Ortho-phosphoric acid (34.9%).	Voco, Cuxhaven, Germany *www.voco.com*	162708
Futurabond U	Universal Adhesive	HEMA, Bis-GMA,2-HEDMA,1.6-hexanediyibismethacrylate, acidic adhesive monomer, urethane dimethacrylate, catalyst, silica nanoparticles, ethanol	Voco, Cuxhaven, Germany *www.voco.com*	1938705
X-tra fil	Bulk-fill posterior resin composite	*Matrix*: dimethacrylate (Bis-GMA, TEGDMA, UDMA) *Filler*:	Voco, Cuxhaven, Germany *www.voco.com*	1929571

		Inorganic filler (Barium aluminum silicate, fumed silica, pigments) Filler content by weight :86%		
VisCalor® bulk:	Thermo-viscous preheated bulk-fill resin composite	*Matrix*: Bis-GMA, aliphatic dimethacrylate *Filler*: Inorganic filler Filler Content by weight : 83%	Voco, Cuxhaven, Germany *www.voco.com*	1946635

(1) Bis-GMA: Bisphenol A diglycidylmthacrylate.
(2) UDMA: Urethane dimethacrylate.
(3) TEGDMA: Triethyleneglycoldimethacrylate.
(4) Bis-EMA: Bisphenol A polyethylene glycol dietherdimethacrylate.
(5) PEGDMA: Polyethyleneglycoldimethacrylate.

Ethical approval

The trial was designed following the SPIRIT 2013 Statement. The trial was registered in *ClinicalTrials.gov*. The identification number for the registry was NCT04152460 (Date of approval: 04-11-2019). The ethical issues of this trial was reviewed and approved by the Research Ethics Committee (REC) – Faculty of Dentistry, Cairo University (Approval no. 19749 / Date of approval: 28-7-2019).

Sample size calculation

According to the results of the previous study **[5]** in which the probability of score A for marginal integrity for conventional bulk-fill resin composite (comparator) was (0.764), probability of score B was (0.235) with effect size w=0.529 (n=28). If the estimated probability of marginal integrity for pre-heated thermo-viscous bulk-fill resin composite was (0.85) for score A, (0.15) for score B with effect size w= 0.7 (n=17). By adopting an alpha (α) level of 0.05 (5%), power=80%. The predicted sample size (n) was a total of (45). Sample size was increased by (20%) to account for possible dropouts during follow-up intervals to be total of (54) cases i.e. (27) for each group. Sample size calculation was performed using G*Power 3.1.9.2.

Participants recruitment

During the period from 1st of May 2020 to 15th of July 2020, adult patients attending the conservative dentistry clinic, Faculty of Dentistry – Cairo University who required posterior tooth-colored restorations were asked to participate in this trial. Medical and dental histories were carefully assessed. Thorough examination including extra- and intra-oral examinations of the volunteers were performed and recorded in diagnostic chart to identify volunteers fulfilling the eligibility criteria of the trial. Patients aging ≥18 years with a high level of oral hygiene and having at least 12 posterior teeth in occlusion were chosen for this study. Moderate to deep compound class II cavities in well-formed and fully-erupted

posterior teeth were included. Participants with general/systemic illness, heavy bruxism habits or receiving orthodontic treatment were excluded from the study.

Assessment of pulp sensibility

The pulp sensibility was checked by a cold test (Endo-Frost -50 °C, Coltène/Whaledent GmbH+ Co. KG; Langenau, Germany). After 10 seconds of cold application on the center of buccal surface of the examined tooth, participants were expected to answer positively to this test providing a short and transient pain response but if the pain lingers more than 10 seconds it should be considered as a sign of irreversible pulpitis.

Radiographic examination

A digital peri-apical radiograph was taken before starting of the restorative procedures to check the approximation degree of the caries to the pulp, lamina dura intactness and the presence of any peri-apical radiolucency to exclude the case.

Cavity preparation

The operation field was isolated by the application of latex rubber dam sheet (medium consistency) (Sanctuary Dental Dam, Perk; Malaysia). The adhesive cavity preparation design was employed according to the principles of minimally invasive dentistry: cavity preparation was only limited to the caries removal; no cusps involved in the prepared cavity; the gingival margins should include sound enamel; internal line and point angles should be rounded; no beveling to the prepared walls and margins.

Restorative procedures

All cavities were restored using sectional matrix system (Composi-Tight® 3D Fusion™ Ring Kit, Garrison, USA) to re-establish physiologically tight contoured interproximal contacts of the teeth. All restorative materials were applied according to the respective manufacturer's instructions as the following, only the enamel surfaces of the cavities were etched using 34.9% phosphoric acid for 15 seconds (Selective Enamel Etching). Then using gentle stream of air for 20 seconds without dehydrating the dentin, the excess water is removed. The adhesive system was applied in rubbing motion using a micro brush for 20 seconds, dried-off for at least 5 seconds, and then cured for 10 seconds.

Thermo-viscous Bulk fill application "Viscalor Bulk Universal"

The thermos-viscous resin composite VisCalor bulk (VOCO, Cuxhaven) was heated using the VisCalor Dispenser (VOCO, Cuxhaven) at 65 °C. For application of the Viscalor Bulk caps the pre-heating was done by using select setting 1 for Viscalor bulk, which has a warm-up time of 30 s. The materials were then kept warm for 2 min 30 seconds (working time). The caps used in this trial were of universal shade 'U' Insert. VisCalor bulks placed into the prepared cavity directly, starting from the lowest point (from bottom to top), till filling the cavity while

keeping the caps tip submerged in the material. The VisCalor bulk compule had a narrow, flexible cannula of facilitates which direct the composite application n hard-to-reach areas and narrow cavity areas. VisCalor bulk was applied in layers each of them 4 mm thick maximum, then using a suitable instrument adaptation then light-curing which directed to the occlusal surface of the restoration for 10 seconds.

Conventional bulk fil application "x-tra fil caps"

The bulk-fill resin composite was available in one semi-transluscent 'universal shade'. The light cure was directed to the occlusal surface (perpendicular to the surface). The light output of the curing unit was checked with a light meter (Curing Radiometer Model 100; Demetron Corp, USA)**.**

Checking of occlusion and contour

For establishing of proper occlusal morphology and contacts all restorations underwent the post-occlusal adjustments using articulating paper (HANEL Articulating Paper, Coltène/Whaledent GmbH + Co. KG; Langenau, Germany) and using the dental floss for ensuring of the quality of interproximal contacts and the adaptation cervically**.**

Finishing and Polishing

Finishing of all restorations was done under copious amount of water coolant using fine-grit diamond burs, while polishing was performed using rubber points (Kenda dental polishers, Liechtenstein). Then the final polishing was done using ultra-fine discs (Sof-Lex, 3 M, and St. Paul, MN, US) and for the proximal surfaces abrasive strips were used.

Clinical evaluation of the restorations

Assessments of the restorations were done at baseline (one week after placement of the restoration), after 6 months and after 12 months using the modified US (USPHS) criteria for the following parameters: marginal integrity, marginal discoloration, secondary caries and postoperative sensitivity. Two independent assessors (who had no preliminary information about the type of interventions evaluated the restorations. In case of disagreement between examiners over assessments, the restorations were jointly re-examined, and a consensus was obtained through discussion between examiners.

Statistical methods

For the results of clinical evaluation of the restorations; data was presented as frequency (n) and percentage %. Chi-square test sued to compare between control and intervention groups. Friedmann test was used for comparison between tested periods for each group followed by multiple comparisons with Dunn Bonferroni. The significance level was set at $p < 0.05$. Statistical analysis was performed with IBM® SPSS® (ver. 26. SPSS Inc., IBM Corporation, Armonk, NY, USA).

Results

In this study, a total of 54 restorations were placed in the cavities of 47 patients and re-evaluated at baseline (after 1 week), 6 and 12 months. 42 patients had one restoration while 3 patients had 2 restorations and 2 patients had 3 restorations. In the first recall after 6 months, 52 restorations in 45 patients were evaluated (only one restoration from each group was lost). After 12 months, another evaluation was performed and one more restoration from the control group was lost. Of the 54 restorations that were placed, 44.4% were maxillary teeth, 55.6% were mandibular teeth, while 20.4% were premolar teeth and 79.6% were molar teeth. The volunteers in this study were 29 females (61.7%, restorations = 35) and 18 males (38.3%, restorations = 19) ranging in age from 22 to 36years (median age was 26.3 years).

Results of marginal integrity

Marginal Integrity assessment was the primary outcome; the examination of marginal integrity was carried out visually using dental mirror and tactile using a probe, the assessment done at baseline, 6 months and after 1 year. The inter-group comparison between both groups have shown no statistically significant difference within different follow up period (p-value = 1.00, p-value= 1.00and p-value = 0.145) respectively. At baseline the scores showed (0) for all restorations (100%); while at 6 months, 26 restorations of both groups showed score (0) representing 100%; after 12 months, 1 restoration (3.8%) showed score 1 for the intervention group (Viscalor Bulk), while 4 restorations in the control group (X-tra fil) (16%) showed score 1. The frequency (n) and percentage (%) of scores of marginal integrity were presented in *Table (2)* and *Fig (1).*

Table 2: Frequency, Percentage and P-value of marginal integrity score for control and intervention groups

			Viscalor		X-tra fil		p-value
			n	%	n	%	
Marginal integrity	Baseline	0	27	100.0%	27	100.0%	1.00 NS
		1	0	0.0%	0	0.0%	
		2	0	0.0%	0	0.0%	
		3	0	0.0%	0	0.0%	
	6 Months	0	26	100.0%	26	100.0%	1.00 NS
		1	0	0.0%	0	0.0%	
		2	0	0.0%	0	0.0%	
		3	0	0.0%	0	0.0%	
	12 Months	0	25	96.2%	21	84.0%	0.145 NS
		1	1	3.8%	4	16.0%	
		2	0	0.0%	0	0.0%	
		3	0	0.0%	0	0.0%	

**=Significant, NS=non-significant.*

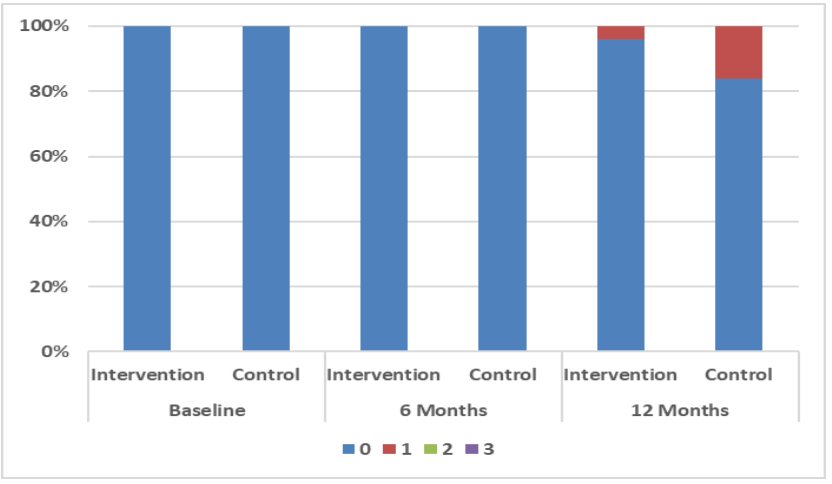

Figure 1: Stacked bar chart showing marginal integrity score distribution for tested groups

Results of marginal discoloration

Marginal Discoloration assessment was carried out visually and it depends on whether there is staining or not and if present can be polished or not, the assessment done at baseline, 6 months and after 1 year. The inter-group comparison between both groups have shown no statistically significant difference within different follow up period (p-value = 1.00, p-value= 1.00and p-value = 0.279) respectively. At baseline the scores showed (0) for all restorations (100%); while at 6 months, 26 restorations of both groups showed score (0) representing 100%; after 12 months, 3 restorations in the control group (12%) showed *score 1*, while 1 restoration in the intervention group (16%) showed *score 1*. The frequency (n) and percentage (%) of scores of marginal discoloration were presented in *Table (3)* and *Fig (2).*

Table 3: Frequency, Percentage and P-value of Marginal Discoloration score for control and intervention groups

			Viscalor		X-tra fil		p-value
			n	%	n	%	
Marginal Discoloration	Baseline	0	27	100.0%	27	100.0%	1.00 NS
		1	0	0.0%	0	0.0%	
		2	0	0.0%	0	0.0%	
	6 Months	0	26	100.0%	26	100.0%	1.00 NS
		1	0	0.0%	0	0.0%	
		2	0	0.0%	0	0.0%	
	12 Months	0	25	96.2%	22	88.0%	0.279 NS
		1	1	3.8%	3	12.0%	
		2	0	0.0%	0	0.0%	

**=Significant, NS=non-significant.*

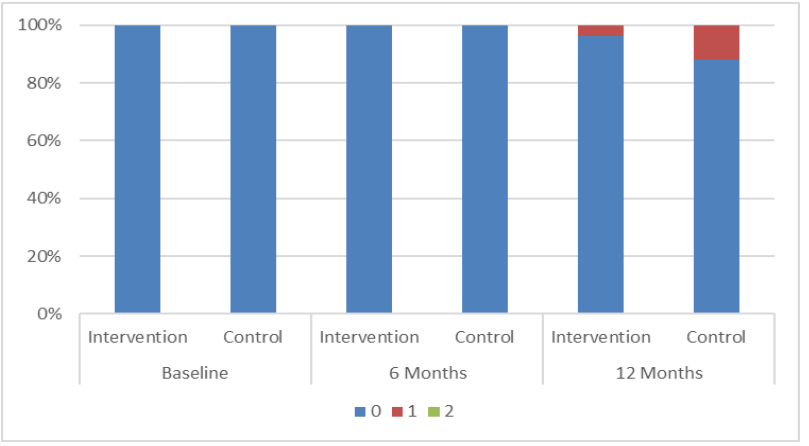

Figure 2: Stacked bar chart showing Marginal Discoloration score distribution for tested groups

Results of secondary caries

All restorations (100.0%) showed *score 0* at different follow up periods for both groups, No statistical differences did exist between the two groups at (p-value = 1.00. The frequency and percentage of scores of secondary caries were presented in *Table (4)* and *Fig (3).*

Table 4: Frequency, Percentage and P-value of Secondary caries score for control and intervention groups

			Viscalor		X-tra fil		p-value
			n	%	n	%	
Secondary caries	Baseline	0	27	100.0%	27	100.0%	1.00 NS
		1	0	0.0%	0	0.0%	
	6 Months	0	26	100.0%	26	100.0%	1.00 NS
		1	0	0.0%	0	0.0%	
	12 Months	0	26	100.0%	25	100.0%	1.00 NS
		1	0	0.0%	0	0.0%	
p-value			1.00 NS		1.00 NS		

**=Significant, NS=non-significant.*

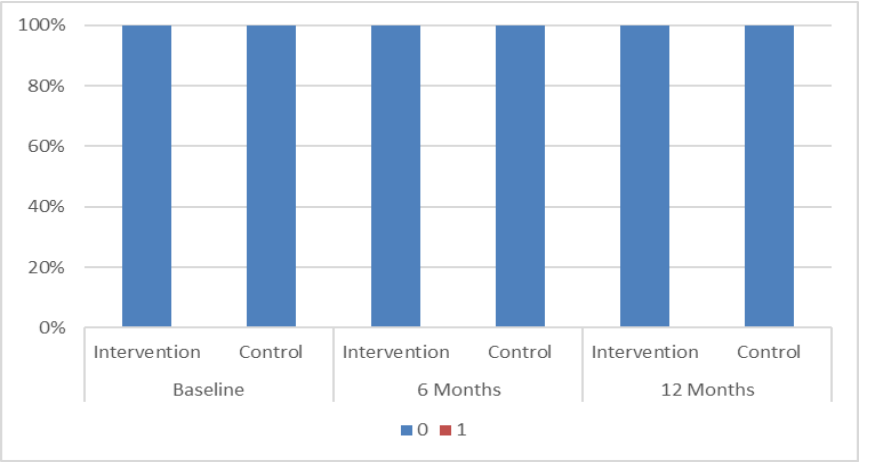

Figure 3: Stacked bar chart showing Secondary caries score distribution for tested groups

Results of postoperative sensitivity

For the assessment of the post-operative sensitivity the patient were asked if there is pain or hypersensitivity or not and if present ask about its intensity and if it is transient or not, at baseline (after 7 days) only one restoration showed score 1 in the intervention group (3.7%) while 2 restorations in the control group showed score 1 (7.4%); while after 6, 12 months all the reported scores in both groups were score 0. The inter-group comparison between both groups have shown no statistically significant difference within different follow up period (p-value = 0.552, p-value= 1.00and p-value = 0.145) respectively. The frequency, percentage and p-value scores of postoperative sensitivity were presented in *Table (5)* and *Fig (4).*

Table 5: Frequency (n) and Percentage (%) of Postoperative sensitivity score for control and intervention groups

			Viscalor		X-tra fil		p-value
			n	%	n	%	
Postoperative sensitivity	Baseline	0	26	96.3%	25	92,6%	0.552 NS
		1	1	3.7%	2	7.4%	
		2	0	0.0%	0	0.0%	
	6 Months	0	26	100.0%	26	100.0%	1.00 NS
		1	0	0.0%	0	0.0%	
		2	0	0.0%	0	0.0%	
	12 Months	0	26	100.0%	25	100.0%	1.00 NS
		1	0	0.0%	0	0.0%	
		2	0	0.0%	0	0.0%	

**=Significant, NS=non-significant.*

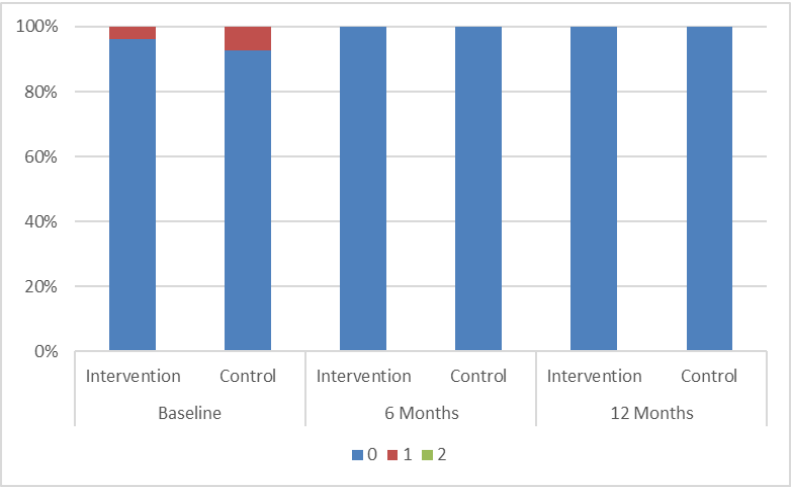

Figure 4: Stacked bar chart showing Postoperative sensitivity score distribution for tested groups

Discussion

The conventional incremental layering is considered to be the gold standard for the placement of the dental resin composite, as the conventional resin composite are placed in layers of 2 mm thickness where each increment is separately polymerized from 10s to 40 s, depending on several standards as the light intensity, the shade, translucency and the photo-initiator system. [9]. Several innovations and techniques have been done in order to increase the durability and the clinical performance of dental resin composites and to minimize the technique sensitivity and clinical time. In the last years, the bulk-fill resin composites have been introduced in the market in response to the growing demand for more efficient resin composite with more simplified application protocol that can be placed into cavities in thick increments of 4 to 5 mm in short time of polymerization ranging from 10 to 20 s. [10]

A new approach was taken by the thermo-viscous technology with the nano-hybrid bulk-fill composite VisCalor bulk (VOCO, Cuxhaven) which is a resin composite material with high viscosity at room and body temperature and converted to be flowable in consistency prior to heating at 65°C in special dispenser. The material flows into the cavity and even in narrow and undercut areas as the internal line and point angles, facilitates the application material. On the other hand, VisCalor bulk again reaches the normal body temperature within a short time when it contacts the tooth and returns to be highly viscous material easy to be sculptured. VisCalor bulk combine both the flowable and sculptable resin composite materials with 1.44 vol.-% polymerization shrinkage and 4.6 MPa shrinkage stress. [11]

The polymerization shrinkage is caused by the approximation of the monomers during polymerization, On the other side it should be distinguished between the polymerization shrinkage and the stress generated at the tooth- restoration interface as it is considered to be most deleterious factor as it is one of the reasons for the failure of resin-based restorations, due to the gap formed between

the tooth between the resin composite and cavity walls which may produce de-bonding, cuspal deflection, microleakage, post-operative hypersensitivity and/or secondary caries. Thus, if the magnitude of the stress formed could be reduced or controlled, the clinical performance of the composite resin would be improved. [12][13]

The conventional incrementally packed resin composite has higher polymerization shrinkage and more stress induced at the tooth restoration interface. In an effort to overcome the drawbacks associated with the incremental approach, the bulk-fill restorative materials had been introduced. Comparing the incremental filling technique to the bulk-fill resin composite, the bulk-fill technique is less time consuming, easier and the voids are less. [14] In this clinical study a conventional bulk-fill resin composite material was used as the control group is the Xtra fil (Voco, Cuxhaven, Germany) which is fast bulk-fill packable posterior composite with 1.7% shrinkage due to the combination of a new multi-hybrid filler technology with an innovative initiator system formed the basis for a filler material exhibiting minimal polymerization shrinkage and excellent depth of cure. The pre-heating of resin composites is used for advancing of the material handling properties where the increase in the temperature of resin composites prior to curing decreases its viscosity, which leads to superior marginal adaptation and improves the wetting of the composite resin to the cavity walls. [7] The VisCalor® bulk was used as the intervention group based on the thermo-viscous technology and the nano-hybrid filler technology. VisCalor® bulk is pre-heated prior to the application where the temperature increase leads to reduced viscosity and thus effortless insertion into the cavity.

The optimal flowing to the margins and the undercuts minimizes risk of marginal gaps as well as very good adaptation of the composite to the cavity walls. When filling of the cavity is complete, the viscosity increases again as the resin composite cools down. In this state the material is very easy to sculpt, with 1.49% shrinkage so the use of Viscalor will get the benefits of both flowability and ease of sculpting. It must be distinguished between the types of restoration failure; early failures, failures after a medium period of time (between 6 to 24 months) and the late failures after 2 or more years. Early failures classified to be as a result of faulty treatment, incorrect selection of the restorative material and could be manifested as post-operative symptoms such as pain and discomfort, while the late failures are manifested by material deterioration, secondary caries and fracture of the filling material. [15]

Following 12 months of following up of the clinical performance, all the evaluated restorations were classified as acceptable, and received either scores 0 or 1 for all assessed parameters. The majority of them were classified as 0. The parameters assessed are marginal integrity as primary outcome and marginal discoloration, secondary caries and post-operative sensitivity as secondary outcome. No significant differences were observed between the thermo-viscous bulk-fill and conventional bulk-fill resin composites in all the parameters after evaluation at the different periods. Thus, the null hypothesis was accepted. There were no statistically significant differences in the clinical efficacy between the two different bulk-fill techniques, yet the scores recorded for the thermo-viscous bulk-fill were better than that recorded for the conventional bulk-fill. The clinical success of the

restorative material might also be affected by several factors as all the restorations were carried out by one operator under optimal conditions and the operator's manual skills and knowledge regarding the material and the procedures, also the procedures were conducted on teeth that met the inclusion and exclusion criteria. [16]

The marginal integrity of thermo-viscous bulk-fill resin composite was satisfactory and comparable to that of conventional bulk-fill one. The results of in-vitro studies on pre-heating resin composite confirm that the benefit of the preheating is that the clinician could gain of the benefits of the flowable composite but without changing the properties of the resin composite regarding the mechanical properties and the restoration longevity. In accordance with [17] who reported that preheating of resin composite improved the physical properties of resin composite, lowered the polymerization shrinkage (1.7% to 3.1%), increased cure rate, and increased the degree of monomer conversion thus, improving the marginal adaption.

Marginal discoloration is one of the first clinical signs of the failure of resin composite restorations. In the current study, at baseline all the restorations showed *score 0*. No statistical differences did exist between the two groups at baseline and after 6 months. After 12 months, only one restoration (3.8%) showed score 1 in the intervention group, and 3 restorations (12%) showed score 1 in the control group. However score 1 is considered to be as an acceptable result according to the modified USPHS criteria, so no statistical differences did exist between the two groups These results were in accordance with the findings of [7][1].

The slight color changes observed after 12 months at the restoration margins may be due to the polymerization shrinkage of the resin composite which leads to formation of leaky gaps which are due to some individual factors as the eating habits, smoking and drinking (tea and coffee), as well as some factors related to the restoration as flashes or excess of restorative material, they all can contribute to increase the marginal discoloration. [18]. Also it should be noted that there is no relationships between the marginal discoloration and the loss of marginal adaptation or secondary caries and the slight marginal discoloration of the restorations could be solved with re-polishing only.

None of the evaluated restorations showed secondary caries at different evaluation periods. This is closely related to the good marginal adaptation of the restorations. Marginal adaptation is directly affected mainly by the polymerization shrinkage of the resin composite and the adhesive type, so both factors might have influenced the clinical results. [19][20] The post-operative sensitivity considered to be a problem that is related to the resin composite restorations. In the present study, only the spontaneous postoperative sensitivity was measured. This is in accordance with systematic review and meta-analysis [21] that compared the adhesive strategy type effect on the intensity and risk of the post-operative sensitivity in the posterior resin composite restorations. In this study. No statistical differences did exist between the two groups.

The lack of the post-operative sensitivity reported by patients involved in the study at 6 and 12 months, could be attributed to the type of the adhesive used Futurabond U (VOCO) which proved its effect on desensitization and sealing of the dentinal tubules. [22] Aso the presence of a functional monomer, 10-MDP monomer which establish durable and strong adhesive bond which is attributed to its interaction with the hydroxyapatite. [23] The non-detectable difference in postoperative sensitivity between the preheated resin composite and the conventional bulk-fill resin composite restorations were in line with the results obtained from [24]. Also the studies have shown that temperature of the pulp is only raised by 0.8°C after application of composite resin preheated at 60°C while the effect of 20s light curing increases the temperature of the pulp by 5°C. [25]

Conclusion

Under the limitation of this study, it could be concluded that there is no difference in the clinical performance between thermo-viscous and conventional bulk-fill resin composite compound posterior restorations over one-year evaluation period.

- Thermo-viscous bulk-fill resin composite is a promising material where esthetics is of prime importance in restoration of compound posterior cavities.
- The longevity of the clinical success of any restoration is attributed to the manipulative steps beside the modification of the chemistry and rheological properties during packing.
- Further randomized clinical trials with extended evaluation periods are required to augment the conclusion drawn from the current study.

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