EGYPTIAN DENTAL JOURNAL
www.eda-egypt.org
VOL. 70, 3835:3846, OCTOBER, 2024
PRINT ISSN 0070-9484 • ONLINE ISSN 2090-2360
CONSERVATIVE DENTISTRY AND ENDODONTICS
Submit Date : 02-07-2024 • Accept Date : 22-07-2024 • Available online: 05-10-2024 • DOI : 10.21608/EDJ.2024.300929.3098

WEAR AND GAP FORMATION ASSESSMENT OF THERMOS-VISCOUS RESIN COMPOSITES

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ABSTRACT

Composites are popular for tooth restorations due to their aesthetic appeal, mechanical properties, and low cytotoxicity. However, they have drawbacks like polymerization shrinkage stress and viscosity. Flowable composites minimize gaps but may cause higher shrinkage. Bulk-fill composite resins offer improved physical properties and wear resistance, while VisCalor® bulk is a new approach, which is a high-viscosity composite material that can be converted to be flowable by heating in a heater or dispenser.

AIM: According to the null hypothesis, preheating high-viscosity bulk fil composite resin will increase its wear resistance and marginal adaptability.

Material and Methods: The study involves assessing linear gap and wear in extracted molar teeth using Class I prepared cavities. The cavities were divided into three groups based on resin type: Viscalor thermo-viscous composite (preheated), xtrafil bulk fil resin composite (tempered), xtrafil bulk fil resin composite (non-tempered). After curing, finishing, and polishing, the restorations were analyzed using scanning electron microscopy and Auto-Desk Auto-Cad program. Wear was determined using weight loss and optical profilometry integrated with an image analyzer system. Data were recorded, tabulated and statistically analyzed.

Results: The study revealed a significant difference in gap percentage values across different groups, with Xtrafil having the highest value, followed by Xtrafil tempered and Viscalor.($p<0.001$). Results of wear assessment showed that there was no significant difference between weight and volume loss measured in different groups ($p>0.05$).

Conclusions: Preheating bulk fil composite increased marginal adaptability but may not improve wear resistance.

KEY WORDS: VisCalor Bulk-fill composite, xtrafil Bulk-fill composite, linear gap, wear, Preheating.

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INTRODUCTION

These days, composites are the preferred material for direct restorations on anterior and posterior teeth because of their suitable mechanical qualities, low cytotoxicity, and good aesthetic qualities. However, their main disadvantage is polymerization shrinkage stress, which compromises the integrity of the tooth/restoration interface[1].

The weakening of the dentin-restorative material relationship results in the creation of marginal gaps, which invite microleakage. Failure of restorations, recurrent caries, pulpal inflammation, and post-operative discomfort are caused by fluids moving via the microleakage area through dentin into the pulp[2]. High viscosity and stickiness are two more disadvantages of composites that make them challenging to handle and manipulate and lead to inadequate marginal adaptation to preparation walls. Reduce the amount of space between the restoration and the tooth by using flowable composite. Their low filler content, however, might result in increased net shrinkage, which would impair the restoration's mechanical qualities. Using traditional composites that have been pre-heated in a chairside warming device before to polymerization is one current alternative innovation[3]. Pre-warming offers greater flexibility, a shorter curing period, and longer-lasting and less stressful restorations[4].

The shortcomings of traditional composite resins were addressed with the introduction of bulk-fill composite resins. One layer of these composite resins, with a thickness of 4-6 mm, can be applied. Bulk-fill composite resin manufacturers assert that their materials simplify the clinical application process while offering superior physical qualities and wear resistance compared to traditional composite resins[5].

During the mastication process, composite restorations are repeatedly subjected to mechanical forces and chemical impacts. When forces greater than the composite's mechanical strength are applied, wear results. The anatomical contour of the composite restorations is lost due to occlusal wear. Thus, a composite resin's ability to withstand wear is crucial to the long-term viability of restorations. Wear resistance that is equivalent to that Wear resistance that is on par with that of natural teeth is therefore a crucial need for dental restorative materials[6].

One technique for enhancing the handling qualities during restoration is to pre-heat uncured resin composites. By improving the wetting of cavity walls, raising the temperature of resin composites typically results in a drop in viscosity and an improvement in marginal integrity as well as a reduction in microleakage. Numerous mechanical and physical properties change as a result of preheating, which increases the mobility of radicals and monomers[7]. Recent research has suggested that increasing the temperature of a resin composite to reduce its viscosity will increase its flowability and yield several benefits, including improved handling properties, increased degree of monomer conversion, and improved marginal adaptation[8].

In the dentistry sector, a novel strategy built on thermo-viscous technology was been unveiled. VisCalor® bulk (Cuxhaven, VOCO) is thought to be a high-viscosity composite material at body temperature and room temperature. It is heated to 65° C in a composite heater or their customised dispenser to achieve a flowable consistency[7].

According to the null hypothesis, preheating high-viscosity bulk fil composite resin will increase its wear resistance and marginal adaptability, decreasing the linear gap.

MATERIAL AND METHODS

MATERIALS

Two different commercially available bulk fill resin composites were used in the study, table (1).

TABLE (1) Types, insertion technique, composition, manufacturers and batch number of the materials used in this study.

Product	Material type	Insertion Technique	Shade	Matrix Composition	Filler by weight %	Manufacturer	Batch number
Viscalor	Thermoviscous bulk fill paste like resin composite	Heated	A2	Bis-GMA, aliphatic dimethacrylate, inorganic fillers	83	VOCO, Cuxhaven, Germany	2220693
X-tra fil	Bulk-fill packable posterior composite	Heated	A2	Bis-GMA UDMA TEGDMA, inorganic fillers	86	VOCO, Cuxhaven, Germany	2146655
X-tra fil	Bulk-fill packable posterior composite	Injectable	A2	Bis-GMA UDMA TEGDMA, inorganic fillers	86	VOCO, Cuxhaven, Germany	2146655
All Bond Universal	Universal light cure adhesive system	—	—	MDP, Bis-GMA, HEMA, ethanol, and water.	—	Bisco, Schaumburg, IL, USA	230001078

Abbreviations: ***Bis-GMA;*** *bisphenol-A diglycidyl ether dimethacrylate;* ***TEGDMA;*** *triethylene glycol dimethacrylate,* ***UDMA;*** *urethane dimethacrylate,* ***MDP****; 10-methacryloyloxydecyl dihydrogen phosphate,* ***HEMA;*** *hydroxyethyl methacrylate.*

Sample Size Calculation:

In order to do a statistical test of the null hypothesis—that there is no difference in wear resistance between the tested groups—a power analysis was created with sufficient power. The minimum required sample size (n) was determined to be (15) samples, with 5 samples per group, by using an alpha (α) level of (0.05), a beta (β) level of (0.2) (i.e., power=80%), and an effect size (f) of (0.978) estimated based on the findings of a previous study. For Windows, R statistical analysis software version 4.3.2 was used to calculate the sample size.

METHOD:

Wear assessment:

Grouping of samples

Fifteen discs in total were ready to be tested for wear resistance. Three groups were formed out of five specimens each for each composite.

Group A: Viscalor thermos-viscous composite preheated bulk fill. Preheating was done using VisCalor Dispenser (VOCO, Cuxhaven). Fig 1

Fig. (1) VisCalor Dispenser

Group B: Xtrafil bulk fill resin Composite tempered using the Viscalor device. Preheating was done using VisCalor Dispenser (VOCO, Cuxhaven).

Group C: Xtrafil bulk fil resin Composite (non-tempered).

Using a Teflon mould, ten conventional cylindrical discs with a thickness of 10 mm and a diameter of 5 mm were created. Using a plastic tool, the composite resin was packed into the mould. To remove any superfluous material from the mould, a glass slide with a thickness of 1 mm and a clear Mylar strip (Mylar Uni-strip, Caulk/Dentsply, Milford, DE, USA) were placed on top of the specimen and gently squeezed. Mylar strips were positioned on both sides of the mould throughout the curing process to guarantee uniform, smooth surfaces and stop the development of an oxygen-inhibited layer. Using a 9 mm diameter pestle to apply positive pressure and ensure equal pressure distribution, each specimen was extruded from the mould following 20 seconds of light curing with an LED light-curing device (Woodpecker, Guilin, China; wavelength 455 nm ± 10 nm, light intensity 1,000 mW/cm^2).

Wear simulation

The recently created four-station multimodal ROBOTA chewing simulator, which runs on a servomotor and is integrated with a thermocyclic protocol, is model ACH-09075DC-T from AD-TECH Technology CO., LTD. in Germany. The two-body wear testing was carried out using the ROBOTA chewing simulator, which contains four chambers that simulate simultaneous vertical and horizontal movements in a thermodynamic setting. Programmable logic controlled apparatus was utilised in the testing. Each chamber features an upper Jackob's chuck that acts as a tooth antagonist holder and can be screwed securely, and a bottom plastic sample holder where the specimen can be implanted. (Fig. 2).

The lower sample holder's Teflon housing contained the implanted specimens (Fig. 2). A 5 kg weight was used, which is equivalent to 49 N of chewing force. A prior study8 found that in order to clinically recreate the 6m chewing condition, the test was repeated 75000 times. Table 2 In this study, wear antagonist screws were utilised to tighten natural teeth (Enamel) that were affixed to the machine holder.

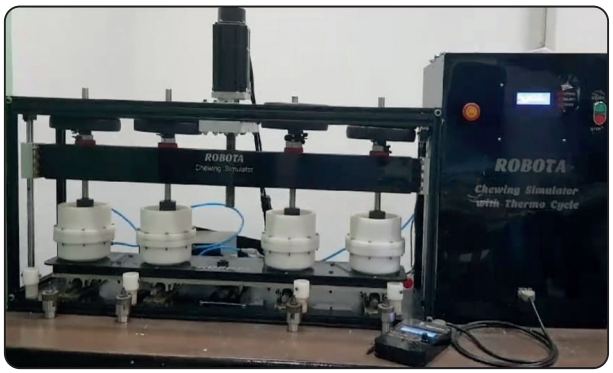

Fig. (2) Four stations multimodal ROBOTA chewing simulator

TABLE (2) Wear test parameters

Cold/hot bath temperature: 5°C/55°C	Dwell time: 60 s
Vertical movement: 1 mm	Horizontal movement: 3 mm
Rising speed: 90 mm/s	Forward speed: 90 mm/s
Descending speed: 40 mm/s	Backward speed: 40 mm/s
Cycle frequency 1.6 Hz	Weight per sample: from 3 kg

Torque; 2.4 N.m

Wear Testing:

Wear by weight loss: Composite specimens (W1) were weighed with an accuracy of 0.0001 gr. in an Electronic Analytical Balance (Sartorius, Biopharmaceutical and Laboratories, Germany) prior to wear simulation in order to assess the weight change between them before and after 75000 cycles.

Weighing the specimens in the electronic analytical balance allowed us to calculate the substance loss that occurred after loading. All of the

installed disc values and antagonist sample values were precisely measured because this electronic balance featured a micro weighing scale and completely automated calibration technology.

The specimen was weighed on the same balance for the purpose of measuring weight after wear (W2) following wear simulation. Due to the completely automated calibration technology and micro weighing scale of this electronic balance, the weight loss was determined by subtracting the weight before and after the wear tests (W1-W2). The demand for quantitative, non-contact surface topography characterization is typically satisfied by optical approaches. This image acquisition system was used to capture the images:

1) A vertically positioned digital camera (U500x Digital Microscope, Guangdong, China) with a resolution of 3 Mega Pixels was put 2.5 cm away from the samples. The angle formed by the light sources and the lens's axis is roughly 90 degrees. A suitable personal computer was attached to the digital microscope's camera.

2) 8 LED lamps, each with a control wheel for adjustment, were used to provide illumination, and the colour index was about 95%.

3) A fixed magnification of 120X was used to capture the photos at maximum resolution (2272·1704 pixels) every image.

Using Microsoft Office Picture Manager, digital microscope pictures were cropped to 350 × 400 pixels in order to define and standardise the measurement area for roughness. The final images were examined using WSxM software (Ver5 develop 4.1, Nanotech, Electronica, SL) to detect roughness areas. to calculate volumetric changes (μm3), maximum heights stated in μm, and the average height (Ra), which are presumed to be trustworthy indicators of surface alterations brought on by wear. In conclusion, a digital image analysis system (Image 1.43U, National Institute of Health, USA) was utilised to capture a three-dimensional representation of the surface profile of the composite samples.

Marginal Adaptation (Percentage Linear Gap Formation) Assessment:

Grouping of samples

Linear Gap assessment:

A total of fifteen class I cavities were prepared to assess the percentage linear gap formation. They were divided into three groups, five specimens for each composite.

Group A: Viscalor thermos-viscous composite preheated bulk fill.

Group B: Xtrafil bulk fill resin Composite tempered using the Viscalor device.

Group C: xtrafil bulk fil resin Composite (non-tempered)

Tooth selection and cavity preparation:

Fifteen freshly extracted, caries-free human molars were selected for this study. The collected molars were subjected to a thorough ultrasonic cleaning (Pro-sonic 300 MTH, Sultan Chemists, Englewood, NJ, USA) to eliminate both soft and hard surface deposits. Next, the molars (n=5) were randomly assigned to each of the three test groups according to the type of resin composite.

One operator (M.M.T.) created a standardised occlusal cavity in each tooth that measured 4 mm in mesio-distal diameter, 3 mm in bucco-lingual diameter, and 4 mm in depth. Using a carbide bur (#245, SS White, Meta Dental Com, Korea) connected to a high-speed air turbine with water cooling, cavities were created. Following each of the five preparations, the bur was changed. The periodontal probe was used to confirm the cavity's dimensions.

Bonding procedure:

Using the selective enamel etching technique and All Bond Universal (Bisco, Schaumburg, IL, USA) universal adhesive, the bonding process was completed for every cavity. On the other hand, the hollow enamel edges were completely cleaned for 20 seconds, dried, and then etched for 30 seconds. Afterwards, in accordance with the manufacturer's instructions, the bonding agent was applied to the cavity walls using a disposable microbrush, rubbed for 20 seconds, dried with a gentle stream of air for 5 seconds, and cured using an LED light-curing device (Woodpecker, Guilin, China) with 1000 mW/cm2 of power intensity for 10 seconds at a distance of 1 mm.

Restorative procedures

Group A: Viscalor thermos-viscous composite preheated bulk fill for application of the Viscalor Bulk caps, the pre-heating was done by using VisCalor Dispenser (VOCO, Cuxhaven) selecting **setting 1** for Viscalor bulk, which has a warm-up time of **30 s**. The materials are then kept warm for **2 min 30 seconds** (working time).

Group B: Xtrafil bulk fill resin Composite tempered using the Viscalor device_for application of the pre-heated xtrafil, the tempering was done by using VisCalor Dispenser (VOCO, Cuxhaven) selecting **setting 2** which has a warm-up time of **70 s**. The materials are then kept warm for **1 min 50 seconds** (working time).

The prepared cavities were restored with bulk-fill resin composite in one increment. The caps were placed into the prepared cavity directly, starting from the lowest point (from bottom to top), till fill the cavity while keeping the caps tip submerged in the material.

Group C: Xtrafil bulk fil resin Composite (non-tempered). After Insertion of the caps into the opening of the caps dispenser and ensure its position by applying slight pressure. The trigger was squeezed slowly and smoothly to extrude the material into the cavity as one increment then light-cured it for 20 seconds).

After curing, finishing and polishing were performed using finishing and polishing kit (Enhance finishing & polishing systems, DENTSPLY, Caulk, Milford).

Sectioning of teeth:

Utilizing a water-cooled diamond saw at 300 rpm each sample was sectioned mesio-distally through the centre of the composite resin in two halves. Sections of crowns, through the composite restorations and tooth were then cleaned under running tap water.

Using double-stick carbon tape, samples were secured to standard-diameter aluminium stubs. Under operating conditions of accelerating voltage 20 K.V. and resolution for Gun.1nm, a scanning electron microscope (SEM) (Model FEI Quanta 3D 200i) attached with an EDX Unit (Energy Dispersive X-ray Analyses / thermofisher pathfinder) was used to inspect the morphological structures and elemental composition of the samples.

A quantitative and qualitative assessment of the interface between the composite biomaterials and the tooth biostructure as influenced by the restorative materials is made possible by the SEM evaluation and marginal gap measuring performed using AutoCAD software. It offers incredibly precise drawings that are drawn to scale. The measurements for the drawing were made at a 50X magnification. Prior to measuring the length of the marginal gaps along the composite/enamel interface, the cavities' full length was measured. Next, the percentage of gap for every restoration was determined. Representative images of different samples were selected. (Fig 3)

All data of measurements of the percentage length of gaped margins in enamel and dentin were collected, tabulated and statistically analyzed.

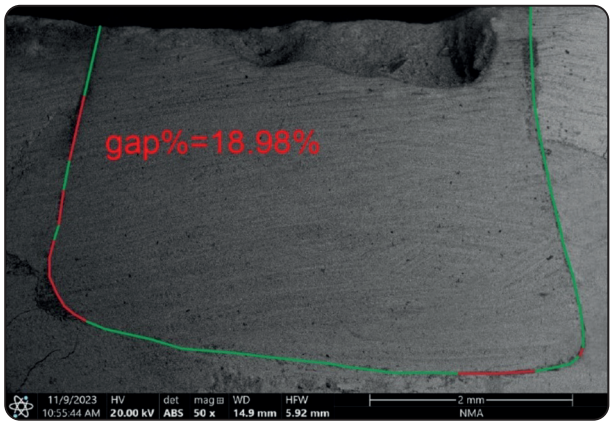

Fig. (3) Measurements of the percentage length of gaped margins; green line is gap free margin, red line is margin with gap.

Statistical analysis

The mean and standard deviation figures were used to present numerical data. The assumptions of variance homogeneity and normality were confirmed by the use of Levene's and Shapiro-Wilk's tests, respectively. One-way ANOVA was used to analyse the data, and Tukey's post hoc test was then performed. R statistical analysis software version 4.3.2 for Windows (R Core Team, 2023) was used to conduct the statistical analysis. R: A statistical computing environment and language. Vienna, Austria: R Foundation for Statistical Computing. https://www.R-project.org/)

RESULTS

Summary statistics and results of intergroup comparison for linear gap formation percentage are presented in table (3) and in figure (4). Results showed there was a significant difference between gap percentage values measured in different groups with Xtrafil group having the highest value followed by Xtrafil tempered and with Viscalor having the lowest value ($p<0.001$).

Summary statistics and results of intergroup comparisons for weight and volume loss after chewing simulation are presented in tables (4) and (5) in figures (5) and (6) respectively. Results showed there was no significant difference between weight and volume loss measured in different groups ($p>0.05$).

TABLE (3) Summary statistics and Intergroup comparison of linear gap formation percentage.

Mean±SD (%)			f-value	p-value
Viscalor	Xtrafil tempered	Xtrafil		
5.71 ± 1.60^{C}	19.35 ± 5.25^{B}	31.92 ± 3.96^{A}	196.36	<0.001*

Values with different superscript letters within the same vertical column are significantly different,

****Significant (p<0.05).***

TABLE (4) Summary statistics and Intergroup comparison of weight loss after chewing simulation.

Mean±SD (mg)			f-value	p-value
Viscalor	Xtrafil tempered	Xtrafil		
1.30 ± 0.37^{A}	1.31 ± 0.63^{A}	2.95 ± 1.72^{A}	3.09	0.095

Values with different superscript letters within the same vertical column are significantly different,

****Significant (p<0.05).***

TABLE (5) Summary statistics and Intergroup comparison of volume loss after chewing simulation.

Mean±SD (μm^3)			f-value	p-value
Viscalor	Xtrafil tempered	Xtrafil		
0.35 ± 0.25^{A}	0.24 ± 0.13^{A}	0.48 ± 0.12^{A}	1.89	0.206

Values with different superscript letters within the same vertical column are significantly different, *Significant (p<0.05).

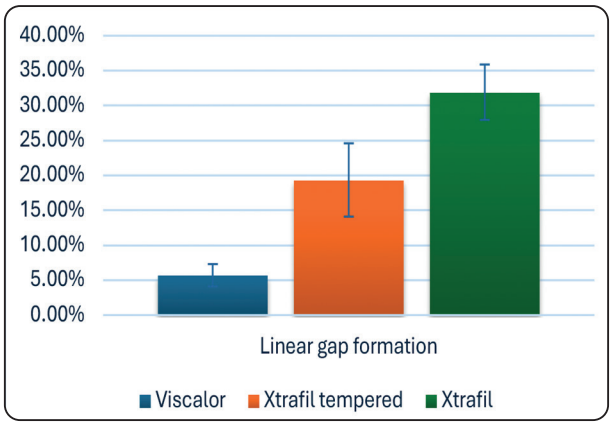

Fig. (4) Bar chart showing mean and standard deviation (error bars) values for percentage linear gap formation.

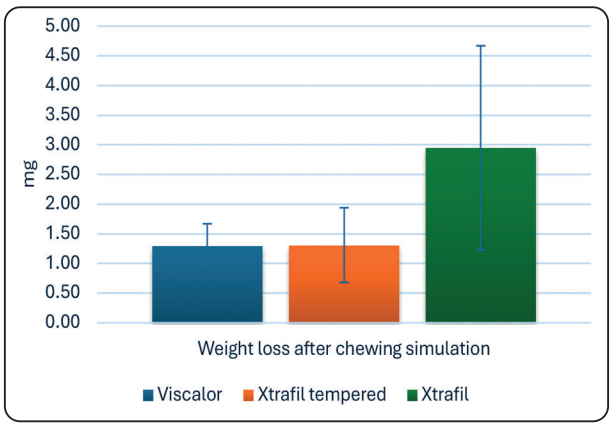

Fig. (5) Bar chart showing mean and standard deviation (error bars) values for weight loss after chewing simulation.

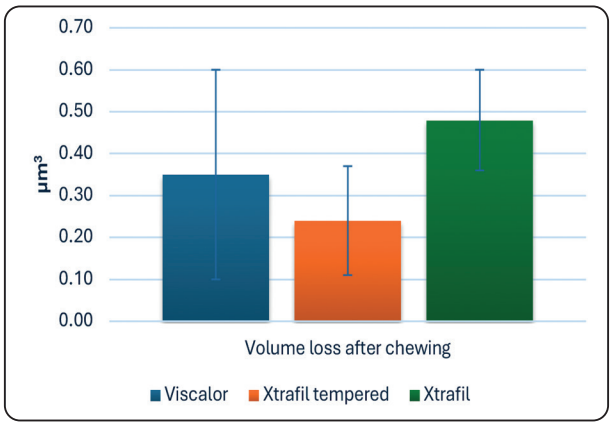

Fig. (6) Bar chart showing mean and standard deviation (error bars) values for volume loss after chewing simulation

DISCUSSION

This in-vitro study's objectives are to measure the linear gap development to determine the marginal adaption and to examine the influence of resin composite pre-heating on wear in terms of roughness, weight, and volume loss. The Xtra fil (Voco, Cuxhaven, Germany) is a fast bulk-fill packable posterior composite with 1.7% shrinkage because of the combination of a innovative multi-hybrid filler technology with an inventive initiator system that designed the basis for a filler material showing minimal polymerization shrinkage. This conventional bulk-fill resin composite material was used as the control group in this in-vitro study.

Composite preheating is a substitute for the conventional installation of resin composites; it reduces the viscosity of the material without altering its composition or physicochemical characteristics. This lessens interior voids by enhancing the composite's capacity to conform to cavity walls. Better marginal adaptation is the outcome, as this improves the wetting of the composite resin onto the hollow walls[9, 10]. Class I cavity design was selected for this experiment in contrast to compound or sophisticated cavity designs in order to assess the degree of leakage under such high stresses generated at the maximum C-factor[11]. One type of universal adhesive system was selected to bond all the resin composite types in order to standardise the adhesion protocol and adhesive system effects[12].

The Viscalor dispenser, a recently developed heating tool to be used in conjunction with Viscalor bulk fill composite compules, is one example of current preheating technology. According to the manufacturer, the material's reduced viscosity from the dispenser application enables it to flow into cavity margins and undercuts adequately, reducing the possibility of air bubble entrapment and marginal gap risk. In mode 1, the gadget warms up to 65°C for 30 seconds of prewarming and 2.5 minutes of operation[13].

The durability of any restoration inside the oral cavity is positively impacted by marginal adaptation, which is a crucial element. Increased polymerization shrinkage stresses lead to loss of marginal adaption, ensuing microleakage, and failure of composite restorations[14].

Marginal internal adaptation has been chosen for this study in order to provide a quantitative analysis of the length of gap formed at the margins and internal marginal irregularities instead of the qualitative isolated analysis provided by microleakage. The gap percentage values assessed in the various groups varied significantly, according to the results, with the Xtrafil group having the highest value, followed by Xtrafil tempered, and Viscalor having the lowest value. The observed findings corroborated the findings of Fróes-Salgado NR et al., who found that the pre-heated composite outperformed the room-temperature groups in terms of marginal adaption[15]. When Taraboanta I et al. compared the marginal adaptation of different resin-based materials used as direct restoration applied at room temperature or after preheating at 50 and 60 ˚C in Class II cavities, they found that all filling materials showed improved adaptation, fewer gap formations, and decreased microleakage after heating at 50 or 60 ˚C[16].

However, Mohanapriya R et al. found that pre-heated composites had poor internal marginal adaptation and a higher frequency of gap development after evaluating the marginal adaptation of four distinct composite resins in an in vitro investigation[17]. The preheated group's higher frequency of gap development can be explained in terms of the resin composite's cooling curve. In addition to finding that gap formed at the gingival margin of Class II preparations was not improved in comparison to the preheating procedure, Sabatini C concluded that preheating does not lower polymerization stresses of resin composite restorations[18].

The literature justifies the higher adaptation of Viscalor warmed composite by pointing out that the thermal energy causes the composite monomers to separate, making it easier for them to slide past one another and enhance material adaptation. Furthermore, compared to the sonic fill resin composite, the Viscalor composite's cooling rate of roughly three minutes is a comparatively long duration that allows for better stress release and appropriate adaptation to cavity walls[19].

The wear of composite materials is a complex phenomena that depends on a number of variables, including the nature of the opposing teeth, the size of the cavity, the type of material used, and the physiology of the occlusion[20]. In terms of size, distribution, and volume content, reinforcing fillers are essential components of restorative materials.

It is possible to assess the wear of composite resin restorations in both clinical and lab settings. Numerous experiments in the lab have revealed that the kind and makeup of the composite resin material affect its resistance to wear. Materials for composite resins comprise an organic matrix made up of several kinds of monomers, a coupling agent that joins the fillers to the organic matrix, and different kinds of inorganic fillers[21]. Our in-vitro study's findings demonstrated that there was no discernible variation between the groups' measured weight loss and volume reduction.

Since clinical trials are thought to be the best method for determining a material's characteristics under various circumstances. In a 36-month randomised clinical experiment, Elkaffas et al. assessed the impact of preheating resin composites versus room temperature on the clinical performance of class I restorations. Preheated nanofilled RCs demonstrated respectable clinical performance after 36 months, comparable to the non-heated ones in class I[22]. Taufin et al. conducted an 18-month clinical trial with the goal of assessing the impact of placing Ceram-X-Mono, a preheated composite based on nanoceramic resin, in Class I cavities throughout that time. According to the findings, the non-preheated group significantly lost anatomic

form, while the preheated group's nano-ceramic restorations performed better clinically[23].

Our study's findings were consistent with those of Favoreto et al., who assessed the preheating of thermos-viscous composite resin's clinical performance in the restoration of non-carious cervical lesions over the course of a 24-month randomised clinical trial. They discovered that, following a 24-month clinical evaluation period, the new preheated thermoviscous and the non-heated composite demonstrated identical clinical performance[24]. Research has indicated that an increase in resin viscosity typically results in a decrease in wear resistance[25]. Bulk-fill composites have a higher filler content, which results in a deeper cure and less resin matrix volume needed for polymerization and enhanced hardness[26].

Asadian et al. studied the wear properties of various Bulk-Fill composites, including applying sonication (lowering the viscosity using a sonic device) in terms of weights and surface roughness. They found that the results are within the acceptable range and are not different from those of a conventional composite. As in our study, there was no statistically significant difference in the results. Additionally, no statistically significant difference in findings was reported when Barakat evaluated the wear resistance of several bulk-fill composites with an enamel antagonist in terms of weight loss[27, 28].

This makes sense since less wear is seen at higher filler concentrations. It is now known that filler particle characteristics, specifically the size and concentration of the filler reinforcement and the resin formulation, affect how long composites last[29]. It has been shown that finer particles for a fixed volume-fraction of filler reduce wear by lowering the interparticle gap. The wear and colour stability of preheated bulk-fill and conventional resin composites were also studied by Abdulmajeed et al. Using a laser scanner and three-dimensional imaging software, they calculated the wear in terms of volumetric material loss. They discovered that preheating resin composites may increase their susceptibility to wear, but it has no effect on their colour stability[30]. This was explained by the fact that preheating increases the mobility of radicals, which leads to a higher degree of conversion [31]. Surprisingly, Sadeler et al. discovered that preheating reduced wear resistance for all materials when they examined the effects of preheating, thermal cycling, and varying chewing environment temperatures on the wear of several composite resins. They found that for all groups the pre-heating process caused decrease of wear resistance [32].

Therefore, the null hypothesis was partially rejected as the preheating doesn't affect the wear resistance and partially accepted as the preheating showed best marginal adaptation in comparison to the unheated group.

CONCLUSION

Within the constraints of this investigation, bulk fil composite preheating increases marginal adaptability; nevertheless, it may not improve wear resistance, and testing in an oral environment may have an impact on wear behaviour. The composition of the material determines wear resistance.

Ethical Approval:

The study was approved by Research Ethics Committee at the Faculty of Dentistry, October 6 University, Giza, Egypt, with approval number: RECO6U/32-2023.

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