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Original Article

Clinical Evaluation Of Preheated Flowable Resin Composite Vs Conventional Pit And Fissure Sealants: A 12-Months RCT

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Abstract

Aim: The research was performed to clinically investigate the retention rate and caries prevention effect of the preheated flowable resin composite used as a pit and fissure sealant.
Subjects and methods: A total of (28) participants having permanent molars characterized by the deep pit and fissure with 1 or 2 lesions, the participants were allocated into two equal groups (n=14 patients), group 1 received preheated flowable composite (Filtek™ Z350Xt, 3M ESPSE, USA), group 2 received conventional resin-fissure sealant (UltraSeal XT®, Ultradent, USA). Retention rate and caries incidence was evaluated at post-operative baseline (T0) and after 3 months (T1),6 months (T2), and 12 months (T3).
Results: Regarding retention rate, baseline and 3-month follow-up periods intergroup comparisons revealed no statistically significant difference, while after 6 and 12 months there was statistically significant difference (P = 0.0003), intragroup comparison within pre-heated flowable composite and resin-based fissure sealant have shown statistically significant difference between different follow -up periods (P < 0.001). Regarding caries incidence, baseline and 3-month follow-up intergroup comparisons revealed no statistically significant difference, while after 6 and 12 months there was statistically significant difference (P = 0.0003), intragroup comparison within pre-heated flowable composite showed no statistically significant difference between different follow -up periods (P = 1.0000). While within resin-based fissure sealants have shown a statistically significant difference between different follow-up periods (P < 0.001).
Conclusion: Using pre-heated flowable resin composite as pits and fissures sealant showed acceptable clinical performance and higher survival rate over the conventional pits and fissures sealant along a 12-month follow-up period in permanent posterior teeth.

Keywords: pit & fissure caries, fissure sealants, preheated resin composite, flowable resin composite, randomized clinical trial.

Introduction

Caries is a highly common chronic disease that affects people all over the world. The occlusal surface of molars in deciduous and permanent dentition is especially vulnerable to the early start of caries lesions. Currently, there are several professional methods available to control the

initial caries lesions. These include applying fissure sealants, fluoride varnishes, silver diamine fluoride, and other professionally applied topical fluoride. [1]

Pits and fissures are abnormal depressions that serve as a breeding ground for bacteria and debris, leading to the build-up of stagnant material and tooth decay [2]. Pit and fissure sealants are employed as a prophylactic strategy for preventing dental caries in individuals who are susceptible to it, by sealing deep retentive pits and fissures in teeth. This practice applies to both adults and children, pit and fissure sealants can be used as a proactive measure to prevent tooth decay when there is a higher likelihood of caries in the tooth or the patient. Additionally, it can serve as a secondary preventive measure to halt the advancement of early-stage tooth decay. [3] .The usefulness of a sealant in a clinical setting is assessed based on its ability to adhere into the grinding surface of the tooth for the maximum period [4], which is determined by the preparation of the enamel surface. Currently, researchers are studying several enamel treatment processes to improve the penetration of fissure sealants. [3]

If a sealant is partially or fully lost, it might create a stagnant area that promotes the development and advancement of tooth decay. Therefore, there arose a requirement for a substance that possesses the ability to prevent tooth decay and promote the restoration of minerals. [5 Glass-ionomers and resin-based compounds are the most often used materials for fissure sealants. But sealants made of resin exhibit greater rates of retention. [6]

Retention is crucial for both the effectiveness of the sealing substance and its ability to penetrate the pits and cracks successfully. The morphology of the fissures considerably influences the occlusal fissure pattern, particularly in deep and narrow fissures such as I-type and IK-type where less penetration may occur. The producer incorporated fillers into the pit and fissure sealants to enhance their durability and ability to withstand wear and abrasion. Nevertheless, the addition of these fillers may cause an increase in viscosity, resulting in a loss in penetration. On the other hand, preheating the resin composite enhances the flowability of composites with regular consistency, leading to improved material adaption into the cavity walls [7] .Based on a systematic review, it was discovered that preheating resin composite enhances the flowability of regular consistency composites, leading to better material adaption into the cavity walls. [8]

This clinical trial aimed to test the null hypothesis, which proposed that there would be no differences in the clinical performance of preheated flowable resin composite used as a pit and fissure sealant compared to conventional resin-based fissure sealant in patients with deep fissures.

Subjects and Methods

Twenty-eight patients were selected from the out-patient clinic of conservative department, Faculty of Dentistry - Cairo University. All the patients were have permanent tooth with deep pit and fissure.

All materials used in this study as well as their active ingredients, and manufacturer are listed in **Table (1)**

According to a study carried out by Erdemir et al in 2014, [10] the anticipated sample size was 23. The sample size was augmented by 20% to accommodate potential dropouts during follow-up periods, resulting in a total of 28 instances, with 14 cases in each group: pre-heated flowable composite and conventional resin-based fissure sealant. The process of determining the appropriate sample size was conducted using G*Power 3.1.9.2, employing the chi-square test.

The study was designed as a double-blinded trial, parallel-arm randomized clinical trial with an equal allocation ratio, meaning that both the participants and the outcome assessors were unaware of the treatment assignments. This trial was recorded in compliance with the CONSORT Statement. The randomization process was conducted utilizing a computerized sequence creation method known as simple randomization. This was achieved by utilizing the Homepage (www.random.org), to generate a series of numbers ranging from 1 to 28, which were

then organized into two separate columns. The randomization list was securely stored to prevent any tampering with its contents. Each participant selected a number at random from a sealed envelope that could not be seen through.

The investigation was carried out over 12 months, with a total of four visits: first visit (post-operative baseline: T0), second visit (3 months: T1), third visit (6 months: T2), and final visit (12 months: T3).

The participants in this study were individuals aged between 16 and 22, who possessed permanent molar teeth with profound pit and fissure morphology. Patients with deep structural pits and fissures prone to dental decay, patients with moderate to good oral hygiene, and permanent molar teeth with stained grooves. The patients excluded from this study exhibit uncooperative conduct. constitute that the random list hasn't been manipulated. From a sealed envelope that was opaque, each participant selected a random number.

Patients with a hypersensitivity to sealing material, Individuals with a prior medical condition, the teeth have partially erupted, and there is a considerable restoration on the biting surface. Additionally, the teeth that are showing signs of dental fluorosis and hypo calcification. [9]

Screening of patients seeking dental treatment at the conservative dentistry department was maintained until the intended population was reached. The patients were examined thoroughly and diagnosed utilizing dental records. After identifying patients suitable for this study, the research operator contacts them to describe the study and gauge their interest. If necessary, further examinations and preparations have been done.

Clinical procedure

Dental prophylaxis and scaling.

A scaling procedure was performed for every patient, accompanied by preventive measures with a pumice slurry and a rotating brush to remove any plaque or food particles from the fissures. [11]

Isolation

The teeth to be sealed were isolated with the help of installing a rubber barrier following the appropriate choice of rubber dam clamps and sheets.

Intervention (Filtek™ Z350Xt supreme Flowable Restorative, 3M ESPSE, USA).

All materials were used according to manufacturer instructions.

Enamel etchant was administered to the pits and fissures using a dispensing syringe tip was done for 30 seconds. Rinsing the etchant for 20 seconds. Drying of etched Enamel until a uniform whitened surface with a chalky-white appearance was obtained .[10]

A Single coat of the adhesive (single bond) was applied with agitation movement to the etched surface, blown with gentle air flow for 2– 3 s then light cured for 20 s .The point of the light was positioned as close to the tooth as necessary. [10]

Heated Flowable resin composite was heated by a Dental Resin Composite Heater (DM-C-HEAT ,China) at a specific temperature of 50°C for five minutes .A homogeneous coating of heated flowable resin composite was meticulously placed from the center fissure towards the cusps to avoid any gaps or air bubbles and then cured using light for 20 seconds.

Conventional resin fissure sealant (Ultra-Seal XT®):

The etched pits and fissures were covered with a uniform layer of conventional resin fissure sealant and cured for 20 seconds under light. Checking occlusion was done using 40 nm articulating paper, High spots were removed with yellow coded stones. Polishing of the sealant by using a composite polishing kit [12].

Outcome:

Outcomes were assessed by two blinded outcome assessors**,** who were pre-calibrated and trained to evaluate the

restoration at follow-up points: T0: baseline ,T1: 3 months, T2: 6 months, T3: 12 months.

Primary outcome:

Measuring the retention rate by using retention criteria (Table 2) Also, retention rate measurements were done at baseline post-operative, three, six, and twelve months.

secondary outcome:

Measuring the caries incidence by using ICDAS-II visual criteria (Table 3) Also, caries incidence measurements were done at baseline, three, six, and twelve months.

Statistical Analysis

The data was analyzed using Medcalc software, version 19 for Windows, developed by MedCalc Software Ltd in Ostend, Belgium. The categorical data was analyzed by calculating the frequency and percentage. To compare the interventions within each group, the test known as the Chi-square test was employed to compare the different interventions, Cochran's Q test was utilized. The level of statistical significance was established at $P < 0.05$. The clinical importance was evaluated using relative risk. The survival rate was determined with the Kaplan-Meier methodology and examined by the Log-rank test. The confidence level was established at 95% with a statistical power of 80%, and all tests were conducted using a two-tailed.

Results

Demographic data

This study was conducted on a sample of 28 people whose assignments were random to either the intervention group or the control group. Each group consisted of 14 lesions. After the completion of a 12-month duration,26 individuals completed the follow-up, resulting in a retention rate of 92.8%. However, 2 patients chose to discontinue their participation. According to the data shown in **Table 4**, there was no statistically significant difference in age between the two groups (P=0.079). The distribution of teeth is illustrated in **Table 5**. There was no statistically significant difference between the two groups in terms of jaw distribution (P=0.0991).

Clinical evaluation:

Retention:

Comparing the 2 materials, there was no statistically significant difference found between them during the baseline and three-month follow-up periods. However, after six and twelve months, there was a statistically significant difference observed. Statistically significant differences were seen in an intragroup comparison of a pre-heated flowable composite at different follow-up intervals. Comparing resin-based fissure sealants within the same group has revealed a statistically significant difference throughout various follow-up periods. **(Table 6).**

Caries incidence around sealants:

Comparing the two materials, there was no statistically significant difference between them during the follow-up periods of baseline and three months. However, after six and twelve months, there was a statistically significant difference observed. An analysis of the data from comparing different follow-up times in a pre-heated flowable composite material did not reveal any statistically significant differences. Comparing resin-based fissure sealants within the same group has revealed a statically significant distinction among various follow-up durations**. (Table 7)**

Survival analysis:

The 12-month survival rate of fissure sealants was assessed. All 12 fissure sealants in the resin-based group experienced failure within 12 months. The failure of the sealants was linked to either a decrease in the ability to retain them or the development of caries in the surrounding area. The Kaplan-Meier method was utilized to produce survival curves, and these curves were then compared using the Log-rank analysis. The findings mentioned a statistically significant disparity Among the two sealants ($P < 0.0001$). **(Figure 1)**

Table (1): materials specification**,** composition**,** manufacturer and lot number

Material	Composition	Manufacturer
Flowable resin composite (Filtek™ Z350Xt)	The mentioned resins: bisphenol A-glycol dimethacrylate,and procrylat. The fillers consist of a blend of yytterbium trifluoride filler , silica filler ,and zirconia/silica cluster filler , The weight percentage is 65% and the volum percentage is 46%.	**3M ESPE USA Inc** Dental Products & Supplies: ESPE, Oral Care | 3M-US
Conventional resin fissure sealants (Ultra Seal XT®)	Diurethanedimethacrylate, bisphenol A-glycidyl methacrylate, dimethyl aminoethyl methacrylate, sodiummonofluorophosphate, Titanium dioxide, 53wt% mixture of inorganic filler particles (non-disclosure).	Ultra-dent, USA Inc Ultra dent Products, Inc.
ETCHANT (Meta Biomed)	Formulation includes silica filler, bisphenol A-glycidyl methacrylate, 2-hydroxyethyl methacrylate, dimethacrylates, ethanol, water, a new photoinitiator system, and a copolymer of polyacrylic and polyitaconic acids with methacrylate functionality.	Meta biomed, Korea Inc META BIOMED (meta-biomed.com)
Total etch bonding agent (3M Espe Adper Single Bond)	Formulation includes silica filler, bisphenol A-glycidyl methacrylate, 2-hydroxyethyl methacrylate, dimethacrylates, ethanol, water, a new photoinitiator system, and a copolymer of polyacrylic and polyitaconic acids with methacrylate functionality.	**3M ESPE USA Inc** Dental Products & Supplies: ESPE, Oral Care | 3M-US

Table (2): Retention rate (retention criteria scoring system)

Measuring unit	Description
Full retention	the materials were fully present on the occlusal surfaces.
Partially lost	the materials were present, but as a result of either wear or loss of the material, part of a previously sealed pit or or fissure, or both, was exposed.
Totally lost	no trace of materials was detected on the surface.

Table (3): ICDAS-II visual scoring system

Measuring unit	Description
Score 0	sound tooth surface adjacent to the sealant margin.
Score 1	after prolonged air drying of the surface, the first visual change is consistent with the demineralization.
Score 2	distinct visual change in enamel adjacent to sealant margin.

Table (4): Gender distribution among groups

Gender	Preheated flowable resin composite	Resin based fissure sealant	Total
Males	2 (14.3%)	4 (28.6%)	6 (21.4%)
Females	12 (85.7%)	10 (71.4%)	22 (78.6%)
Total	14 (50%)	14 (50%)	28

Table (5): Teeth distribution among groups

Teeth distribution	Preheated flowable resin composite	Resin based fissure sealants	Total
Maxillary 1st molar	170.8	1.09	308.3
Maxillary 2nd molar	775	3.9	508
Mandibular 1st molar	4.15	0.25	0.00
Mandibular 2nd molar	83.3	0.56	158.3
Total	14 (50%)	14 (50%)	28

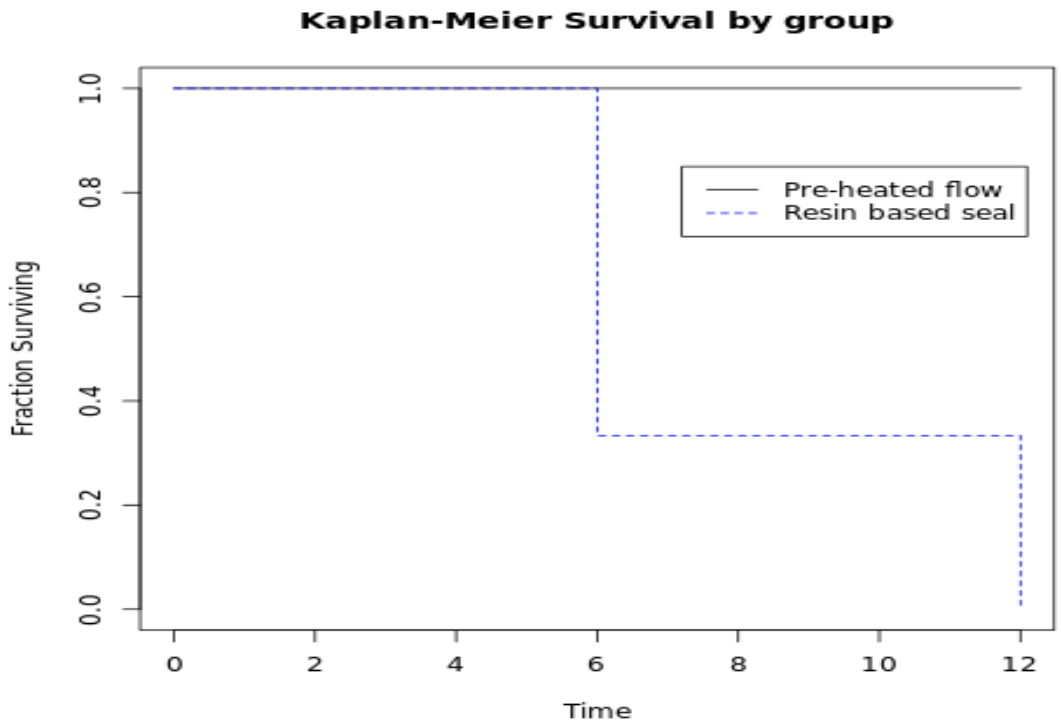
Table 6: Frequency and percentage for retention: The scores are used to compare different materials within each follow -up period and to compare different follow -up periods within each material.

Follow up	Preheated flowable resin composite			Resin based fissure sealants			P value
	Full retention	Partial retention	Total loss	Full retention	Partial retention	Total loss	
Baseline	14(100%)	0 (0%)	0 (0%)	14(100%)	0 (0%)	0(0%)	P=1.000 NS
3 months	0 (0%)	14(100%)	0 (0%)	0 (0%)	12(100)	0(0%)	P=0.6949 NS
6 months	0 (0%)	14(100%)	0 (0%)	0 (0%)	4(33.3%)	8(66.7%)	P=0.0003*
12 months	0 (0%)	14(100%)	0 (0%)	0 (0%)	0(0%)	12(100%)	P<0.0001*
P value		P < 0.001*			P<0.001*		

Table 7: Frequency and percentage for caries incidence around sealants: The scores are used to compare different materials within each follow -up period and to compare different follow -up periods within each material.

Follow up	Preheated flowable resin composite			Resin based fissure sealants			P value
	0	1	2	0	1	2	
Baseline	14(100%)	0 (0%)	0 (0%)	14(100%)	0 (0%)	0(0%)	P=1.0000 NS
3 months	14(100%)	0(0%)	0 (0%)	12(100%)	0 (0%)	0(0%)	P=0.6949 NS
6 months	14(100%)	0(0%)	0 (0%)	4(33.3%)	8(66.7%)	0(0%)	P=0.0003*
12 months	14(100%)	0(0%)	0 (0%)	0 (0%)	2(16.7%)	10(83.3%)	P<0.0001*
P value		P=1.0000 NS			P<0.001*		

Figure 1: Survival analysis



Discussion

Dental caries remains a widespread condition in the global population, despite the implementation of several conventional and innovative preventive measures. Despite significant advancements in the dental health of children, dental caries remains the prevailing childhood ailment. [13]

Fluoride treatments exhibit excellent efficiency in inhibiting tooth decay on smooth surfaces, their efficacy in protecting occlusal surfaces is not as pronounced. The pits and fissures of permanent posterior teeth account for around ninety percent of dental decay. Molars are the tooth kind that is most susceptible to this problem .Pit & fissure sealants are often recognized the most effective approach for avoiding occlusal caries. They aid in Controlling caries by the physical restriction of the pits and fissures. [14]

Therefore, the degree to which the sealant remains intact became a crucial factor in determining its effectiveness as a preventive measure against tooth decay. Several variables have been identified as influential factors in the retention of sealants, such as the type of sealant used, the type of tooth being sealed, and the proficiency factors to consider are the operator's expertise and the patient's age. Sealants have a low likelihood of remaining fully intact for the whole lifespan of the tooth and therefore need to be reapplied. Even with optimal application conditions, a yearly loss of 5-10% of sealants occurs. [15]

In order to extend the lifespan of pit-and-fissure sealants, numerous materials and techniques have been developed. using flowable composite resins as sealants for pits and fissures. Because of their higher filler content and hence lower surface wear, flowable composites are primarily justified in their use as pit-and-fissure sealants. [16]

The retention scores were assessed based on three categories: full retention (FR), partial loss (PL), and total loss (TL). Full retention refers to the materials being completely intact on the occlusal surfaces. Partial loss indicates that the materials are still present, but some part of a previously sealed pit or fissure has been exposed due to wear or loss of the material. A "total loss" refers to a condition when no traces of the material can be found on the surface. [10]

When comparing the retention scores of different materials at various follow-up periods, there was no statistically significant disparity observed between the two materials at baseline and 3 months. However, after 6 and 12 months, there was a statistically significant difference between the materials.

Intragroup comparison within pre-heated flowable composite as well as within resin-based fissure sealant has shown statistically significant differences between different follow-up periods ($P < 0.001$).

The superior retention rates of flowable composite, as opposed to conventional sealant, can be attributed to its increased filler content. This results in reduced polymerization shrinkage and therefore minimizes the likelihood of microleakage, which might compromise the retention. Another possible explanation is that the increased filler content in flowable composites may enhance the durability of the sealant material, reducing the likelihood of any sealant loss, whether partial or complete. Furthermore, in laboratory investigations, flowable composites exhibited superior physical properties when compared to traditional resin-based sealants. It appears that the increased thickness of flowable composites does not adversely impact their ability to penetrate and adhere. [17]

The aforementioned findings were substantiated by a comprehensive examination and statistical analysis. [18] The durability of fissure sealants in clinical trials was evaluated in this study, specifically comparing the usage of flowable composites as pit and fissure sealants to conventional resin-based alternatives.

This meta-analysis determined that the utilization of flowable composite as a material for sealing fissures can marginally enhance the rate at which sealants are retained, in comparison to conventional resin-based sealants.

The findings of our study align with a comprehensive review conducted by Lopes et

al in 2020. [8] They discovered that preheating resin composite enhances the flowability of regular consistency composites, leading to improved material adaption into the cavity walls. In their study, [19] explored how heat and sonic vibration affected flowable resin composite penetration. They ascertained that the use of the application of heat led to increased penetration in comparison to the standard application method. The primary positive influence on the outcome of the current study may be attributed to the increased filler content, enhanced wear resistance, and improved retention resulting from preheating. Consequently, this could serve as a motivation to undertake more studies.

Contrary to our findings**,** Oba et al in 2012 [20] conducted a clinical investigation that concluded that the flowable composite resin materials used as fissure sealants were less retentive compared to the standard resin sealants. Furthermore, Oba et al in 2012 [20] discovered a contrasting result, indicating that the retention of sealants was superior regarding the first molar teeth in comparison to the second molar teeth. This observation could be attributed to the challenges associated with distinguishing second molars from first molars. In a conducted investigation**,** [21] it was shown that mandibular teeth demonstrated higher retention rates in an in vivo experiment done with a follow-up period of 12 months.

The findings of Erdemir et al in 2014 [10] after a duration of 1 year were consistent with our own findings. A randomized controlled trial was conducted to assess the rate of retaining teeth and preventing tooth decay benefit of a flowable composite in comparison to a traditional resin-based sealant in a young population over a period of 24 months. The study determined that utilizing a flowable composite as a fissure sealing material, along with a total-etch, single-bottle adhesive, resulted in superior retention compared to the traditional fluoride-containing resin-based fissure sealant in young patients over a 24-month timeframe.

In contrary, Jafarzadeh et al in 2010 [22] found, that both the conventional pit-and-fissure sealant and the flowable composite resin showed comparable retention rates. Specifically, the flowable composite resin possessed a complete retention rate of 89.7% at twelve months, whereas the conventional sealant had a retention rate of 84.6%. Nevertheless, our analysis revealed a substantial disparity in retention rates at the 6 and 12-month marks.

Jafarzadeh et al in 2010 [22] discussed the resemblance between the two materials and acknowledged that the 12-month study period may seem little for assessing retention rates. However, [23] Research has revealed that the majority of sealant failures tend to manifest approximately at six months following the application.

The improved retention rates observed in the current investigation may be attributed to the increased penetration of the heated flowable composite. Furthermore, the flowable composite exhibits superior mechanical performance in terms of wear resistance, as compared to traditional resin-based fissure sealants, as demonstrated**.** [24, 25]

There were no statistically significant differences in the occurrence of tooth decay amongst the different materials used to seal the teeth throughout the trial. Even after the loss of a sealant, its caries prevention benefit can persist for a considerable duration, as observed and documented in ordinary clinical practice. Studies have shown that teeth that are partially sealed are significantly more resistant to decay compared to teeth that are not sealed. This could be owing to the presence of residual traces of the sealant at the base of the fissure. In their investigation**.** [26, 20]

Contrary to the previous finding, Erdemir et al in 2014 [10] stated that the chosen molar teeth exhibited no lesions or cavitated caries at the start of the study. However, after 12 months, caries were found in 4 (4.2%) of the 96 teeth treated with flowable composite and in 3 (3.1%) of the 96 teeth treated with sealant material. The most probable cause for reveals the deep cracks or a partial absence of material that leads to little leaks at the sharp edges, resulting in the formation of cavities beneath the sealant material.

Contrasting the present investigation, Pardi et al in 2005[24] found that 4.3% of teeth sealed with flowable composite and 3.1% of teeth sealed with resin-based fissure sealant

developed caries. The difference in results between Pardi et al in 2005 [24] and the current study could be attributed to the longer duration of follow-up (2 years).

Both the investigations conducted by Erdemir et al in 2014[10] and Pardi et al in 2005 [24] observed low retention rates in the sealant material group. However, it is noteworthy that this group exhibited identical caries rates to the flowable composite group in all subsequent exams. This phenomenon willing to elucidated by the resin-based fissure sealing material liberating fluoride that dissolves and releases fluoride ions, potentially affecting the integrity of the resin. The validity of this approach has been called into doubt, as the release of fluoride from the dissolving of a soluble salt could potentially compromise the integrity of the sealant in its current position, thereby diminishing its effectiveness as a preventative agent. [27] Hence, the sealant material's ability to retain its position is crucial in establishing an effective barrier that prevents substances from escaping from the surface of teeth and entering the oral cavity. The retention of a sealant material has been mainly associated to the earlier attribution of the sealant materials success rate.

In a previous investigation carried out by Oba et al in 2012 [20] it was shown that there was no notable disparity in the occurrence of tooth decay between the conventional resin-based sealant group and the two flowable composite resin materials after a 24-month observation period.

Oba et al in 2012 [20] clarified their findings and reported that, in line with ordinary clinical practice, the caries prevention effect of a sealant can persist for a considerable duration even after its loss. Studies have shown that teeth that are partially sealed are significantly more resistant to decay compared to teeth that are not sealed. This may be attributed to the vicinity of leftover sealant at the fissure's bottom. [28] flowable resin composites have significantly superior mechanical qualities compared to pit and fissure sealants. The materials exhibited elastic behavior even at the lowest frequencies, however, there were significant variations in elasticity between different materials. Resin-based pit and fissure sealants are suitable for the prophylactic sealing of pits and fissures. Flowable resin composites that exhibit poor elasticity at low frequencies are more suited for the treatment of deeper fissures.

The results of our investigation suggest that flowable composites, which contain a higher proportion of filler particles, have better wear resistance than standard resin sealants. However, as stated by Czerner et al in 2000 [29] the typical fissure sealer has enhanced fluidity characteristics. It can be argued that this feature allowed the conventional fissure sealer to penetrate the fissure more deeply, potentially enhancing its ability to stay in place. Based on a carried-out investigation by Kakaboura et al in 2002 [30] a low-viscosity resin composite is more effective than a standard resin sealer in penetrating shallow-wide fissures. Also, the study [31] demonstrated that the utilization of flowable composite in conjunction with an adhesive system outperformed traditional resin-based sealants. Therefore, the null hypothesis proposed was rejected.

Limitations of the study:

This study assessed preventative measure treatment which is important for public health, but it has certain limitations. To begin with complexities of dental caries, as well as participant behavioral changes, could influence the final results. Finally, lengthier Further randomized clinical trials with larger sample sizes, increasing the age range of the patients and longer follow up periods are recommended to confirm the current results.

Conclusion

Under the limitations of this trial, the following conclusion could be mentioned: using pre-heated flowable resin composite was found to exhibit acceptable clinical performance and a greater survival rate compared to conventional pit and fissure sealants throughout a 12-month follow-up period in permanent posterior teeth.

Conflict of Interest:

The authors declare no conflicts of interest.

Funding:
There is no funding for this research.

Ethics:

The processes performed in studies involving human subjects were performed by the ethical standards established by the institutional and/or national research committee this study protocol was approved by the ethical committee of the faculty of dentistry- Cairo university on: 29/3/2022, approval number:(#21/3/22).

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