IN VITRO EVALUATION OF MICROLEAKAGE AND SHEAR BOND STRENGTH OF SELF-ADHESIVE HYBRID COMPOSITES IN PRIMARY MOLARS

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ABSTRACT

INTRODUCTION: Recently the self-adhesive hybrid composite, Surefil One™ was introduced as "bioactive materials".
OBJECTIVES: To assess microleakage and shear bond strength of Surefil One™ in comparison to Cention forte and resin-based composite used as restorations in primary molars.
METHODOLOGY: A total of 66 extracted sound primary molars were selected and randomly divided into two main groups (groups A and B). Each group was subdivided randomly into three equal subgroups. Groups (IA, IIA, and IIIA): were assigned to the microleakage evaluation test. Class V cavities were prepared and restored with Surefil One™ (IA), Cention Forte (IIA) and Spectra™ ST HV (IIIA). Teeth were thermocycled, immersed into methylene blue solution for 24h, sectioned bucco-lingually, and examined under a stereomicroscope. Groups (IB, IIB, and IIIB): were assigned for the shear bond strength test. The buccal surface was ground to expose the dentin surface and the restorative materials were applied using a cylindrical plastic mold. A universal testing machine was used to assess the shear bond strength, and a stereomicroscope was used to evaluate mode of failure in each specimen.
RESULTS: The lowest penetration percentage was recorded in the Cention forte specimens (22.87), followed by Spectra™ ST HV (50.00), whereas Surefil One scored the highest penetration percentage (65.71). the differences were significant $p<0.0001$. Cention forte samples showed the highest shear bond strength (9.89 ±3.24), followed by Surefil One (4.57 ±1.98), then Spectra™ ST HV (4.47 ±2.20) $p<0.0001$.
CONCLUSION: Cention forte demonstrated less leakage and more retention than Spectra™ ST HV and Surefil One.
KEYWORDS: Surefil One, Cention Forte, Spectra™ ST HV, Microleakage, Shear bond strength, Primary molars.
RUNNING TITLE: comparative evaluation of self-adhesive composites in primary molars.

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INTRODUCTION

Dental caries is considered one of the most prevalent chronic diseases in children. Untreated dental caries has considerable effect on growth and development of children causing them pain and compromising their quality of life (1).
Avariety of materials are commonly used in restoring carious lesions. Among these materials used, Composite resin is the predominant restorative material owing to its optical and mechanical properties. Polymerization shrinkage, on the other hand, is one of the major disadvantages as it is the main cause for marginal gaps and subsequent marginal leakage. This gap allows the entrance of bacteria, ions, and fluids and subsequently results in the failure of the restoration (2).
The bond strength is a vital factor in the clinical success of adhesive material. The shear bond strength is the maximum force which adhesive joint can tolerate before fracture. This force is applied to the adhesive area between two materials (3).
Glass ionomer cement is mostly used as a self-adhesive material in direct restorations (4). Conventional GICs are not used as permanent restorations because of their susceptibility to detachment, fracture and abrasion. Resin modified glass ionomer cements show better flexural and adhesion characteristics. However, they have lower resistance to abrasion, so they should be used as temporary restorations for permanent teeth or as final restorations for primary teeth, following the manufacturer's guidelines. (5).
Creating resins that have reduced polymerization shrinkage is considered as a method to enhance the durability of these materials through the reduction of post-operative sensitivity, cusp deflection, and gap formation, (6).

Recently, new self-adhesive resin materials, with fluoride releasing and bulk-fill properties, have been introduced as "bioactive" materials. These materials differ in the chemical composition from the GIC family (7) . They are available in the market as Activa BioActive Restorative, Cention N and Surefil One. Cention N is an "alkasite" and bulk filled restorative material, which is available as auto-mixed capsules (Cention Forte). Surefil One™ is a hybrid self-adhesive composite with dual polymerization and fluoride release capabilities (8).

The dental literature reveals limited data on microleakage of the recent bioactive self-adhesive hybrid composite, Surefil One™ when used in primary teeth. The rational of present study was to fill this gap and evaluate the microleakage and shear bond strength of bioactive self-adhesive hybrid composite in comparison to the commonly used Cention forte and Spectra™ ST HV in primary teeth.

Accordingly, the proposed null hypothesis of this study was the assumption that no significant differences exist among Surefil One™, Cention forte and Spectra™ ST HV, regarding microleakage and shear bond strength in primary teeth.

MATERIALS AND METHOD

This investigation was performed as an in-vitro experimental study, that was conducted at the Department of Pediatric Dentistry and Dental Public Health and the laboratories of Dental Biomaterials Department, Faculty of Dentistry, Alexandria University, Egypt.

This study was done after the approval of Research Ethics Committee of Alexandria University Faculty of Dentistry (IRB No. 001056 – IORG 0008839).

Sample size estimation

The Sample size was calculated based on the assumption of 5% alpha error and 80% study power. The mean ± SD microleakage values for Bioactive Resins were 3371.1 ± 1548 and 1285.9 ± 724.1 for Nanohybrid Composite (9). Based on the difference between independent means, a highest SD of 1548 was used to ensure enough study power, and a sample of 10 samples per group was required, yielding an effect size of 1.347. This was increased to 11 samples to make up processing errors. Total sample = Number per group x Number of groups x Number of tests = 11 x 3 x 2 = 66 samples. Sample size was based on Rosner's method (10) calculated by G*Power 3.1.9.7 (11).

Study sample

Inclusion criteria included only sound primary molars collected at the exfoliation time or extracted for orthodontic reasons (serial extraction). Teeth with enamel defects, cracks or developmental anomalies were excluded from the study (12).

Randomization technique and allocation (13)

Teeth that met the inclusion criteria were randomly allocated to two test groups (A and B) using a computer-generated list of random numbers. Teeth in each test group were further randomized into three subgroups according to the type of restorative material used. The randomization was done using computer programming (13).

Blinding

Because of different methods of application and evaluation, only the operator assessing the Failure Mode of the material in the shear bond strength test, and the statistician analyzing the results were blinded to the treatment groups.

Grouping:

Selected teeth were randomly allocated to two test groups:

- Group A: Microleakage group.
- Group B: Shear bond strength group.

Teeth in each test group were randomly divided into three subgroups according to the tested material.

1. Microleakage groups: (Group A)

Group IA (test) (n=11): assigned for microleakage evaluation and were restored with Surefil One™ (Dentsply-Sirona, Konstanz, Germany, in 2019).

Group IIA (test) (n=11): assigned for microleakage evaluation and were restored with Cention Forte composite (Ivoclar-Vivadent AG, Schaan, Liechtenstein, in 2016).

Group IIIA (control) (n=11): assigned for microleakage evaluation and were restored with Spectra™ ST HV nanohybrid composite (Dentsply-Sirona, Konstanz, Germany).

Shear bond strength groups: (Group B)

Group IB (test) (n=11): evaluated for shear bond strength of bioactive resin (Surefil One™).

Group IIB (test) (n=11): evaluated for shear bond strength of Cention Forte composite.

Group IIIB (control) (n=11): evaluated for shear bond strength of Spectra™ ST HV nanohybrid.

Method:

Sample preparation (14)

Selected teeth were cleaned with fluoride free pumice and water to remove surface-adhered debris. Teeth were examined for defects in enamel using magnifying glass according to selection criteria to exclude teeth with any defects. The accepted teeth were stored in distilled water until required for use.

Outcome evaluation tests

1. Microleakage test

Teeth in group IA, group IIA and group IIIA were submitted to the microleakage test. Each tooth was fixed in a chemically cured acrylic resin block with its long axis parallel to the mold.

Cavity preparation (15)

Standardized Class V cavities were prepared on the buccal surface of each primary molar tooth with standardized dimensions of 2 mm height, 4 mm width and 1.5 mm depth. The cavity was prepared with # 330 carbide bur on a high-speed hand piece with water spray. The length of bur was used as guide for cavity depth. Each bur was replaced after five preparations (16) **(Figure 1)** .

The following procedures were used according to the manufacturers' instructions for each material.

Group IA: The capsule was activated and then promptly placed in a capsule mixer set to 4200–4600 oscillations per minute for 10 seconds. Using the Capsule Extruder 2, the material was dispensed continuously into the deepest part of the cavity without removing the application tip. It was applied in excess and spread toward the margins during the working time of 1 minute and 30 seconds. The surface layer was then light cured for 20 seconds. and the restorations were polished using rubber cups (9).

Group IIA: Cention primer was applied for 10 seconds then air dried. Cention Forte capsule was then activated and mixed for 15 seconds. Finally, it was placed in bulk and light cured for 20 seconds (8).

Group IIIA: The dentin was selectively etched for 30 seconds using a 37% phosphoric acid gel. It was then rinsed with an air/water spray for 20 seconds and dried with a gentle stream of air. Next, a universal adhesive system, Prime & Bond Active™, was applied according to the manufacturer's instructions. The solvent was evaporated using a gentle air stream before the area was light-cured for 20 seconds. The nanohybrid composite resin was placed in 2 mm increments and light-cured for 20 seconds. The restorations were polished (9).

***Thermocycling and Microleakage Testing** (17)*

The restored teeth were stored immediately in distilled water for 24 hours at 37 °C then thermocycled for 500 cycles between 5°C and 55°C with a dwell time of 30 seconds in each bath. All tooth surfaces were covered with two coats of clear nail polish with exception of 1.0 mm around the tooth-restoration margins that were covered with a window of adhesive tape of 2 mm height and 4 mm width.

The teeth were kept in methylene blue dye for 24 hours. After which, teeth were removed, rinsed under running water and sectioned buccolingually along the center of the restorations using a low-speed diamond disc.

Calibration for dye penetration evaluation

Calibration was done by examining 4 teeth that were not included in the sample size. Each tooth was evaluated by the same examiner for dye penetration scoring twice at one-week interval. The kappa statistics were used for determination of intra-examiner reliability of the two assessments of microleakage scores, and the result was 90%.

2. Shear bond strength test (SBS)

Teeth in group IB, IIB and IIIB were evaluated for SBS.

Specimen preparation (18)

The crowns of the collected teeth were detached from the roots at the cemento-enamel junction. Custom cylindrical metallic molds, measuring 14 mm in diameter and 20 mm in length, were filled with chemically polymerizing acrylic resin. Each crown was horizontally positioned in the resin with the buccal surface facing up. Once the acrylic resin cured, the specimens were taken out of the molds, and the convex buccal surfaces of the crowns were mechanically ground with water-cooled silicon carbide abrasive papers or discs to create a flat dentin surface.

To establish a standardized bonding area for the restorative materials, a plastic cylindrical mold with an internal diameter of 3 mm and a height of 2 mm was positioned on the cut surface of the flat dentin..

The following procedures were used according to the manufacturers' instructions for each material.

- **Group IB**: The capsule was activated and then promptly placed in a capsule mixer set to 4200–4600 oscillations per minute for 10 seconds. Using the Capsule Extruder 2, the material was applied on the flat dentin surface through the plastic mold. The surface layer was light cured for 20 seconds and the restorations were polished (9).
- **Group IIB**: Cention primer was applied to flat dentin surface for 10 seconds then air dried. The Cention Forte capsule was activated, mixed for 15 seconds. Finally, it was applied to the dentin surfaces and cured for 20 seconds (8).
- **Group IIIB:** The dentin was selectively etched for 30 seconds using a 37% phosphoric acid gel. It was then rinsed with an air/water spray for 20 seconds and dried with a gentle stream of air. Next, a universal adhesive system, Prime & Bond Active™, was applied according to the manufacturer's instructions. The solvent was evaporated using a gentle air stream before the area was light-cured for 20 seconds. The nanohybrid composite resin was placed in 2 mm increments and light-cured for 20 seconds. The restorations were polished.

Shear bond strength testing (SBS) (19)

All specimens were subjected to shear force parallel to the bonded interface until de-bonding occurred. The shear bond strength was assessed using a universal testing machine, following the equation below : (19)

Shear bond strength (MPa) =load in N /surface area in mm^2

Outcome Assessment:

1. **<u>Microleakage evaluation</u>**

The sections were examined under a stereomicroscope at ×40 magnification to evaluate the depth of dye penetration at the occlusal and gingival margins. The degree of marginal leakage and depth of dye penetration were assessed by the trained examiner according to the following criteria **(Table 1)** (20).

Microleakage was also measured quantitatively by recording the distance of stain penetration at gingival and occlusal margins

The measurement was recorded in millimeters using software (Toup view, versions 3.7(2018)). Microleakage was assessed as percentage based on the following formula (21):

Microleakage percentage % = depth of dye penetration (mm) / cavity depth (mm) x 100

2. **<u>Shear bond strength evaluation (Figure 2)</u>**

Failure Mode Assessment (22)

All deboned surfaces of the specimens were evaluated by the blinded operator under a stereomicroscope at magnification 30× to record the mode of failure. After examination, failure mode was classified as:

a. Adhesive failure: indicates failure at the interface between the composite and dentin.
b. Cohesive failure: indicates failure within the composite.
c. Mixed failure: indicates a combination of both adhesive and cohesive failures.

Statistical analysis

Normality was checked using Shapiro Wilk test and Q-Q plots. Microleakage scores and percentage were not normally distributed, whereas, shear bond strength values were normally distributed. Mean, standard deviation, median, minimum and maximum values were used to present quantitate data, whereas, count and percentage were used for qualitative data.

Comparisons between groups regarding microleakage scores and percentage were done using Kruskal Wallis test followed by Dunn's post hoc test with Bonferroni correction when results were significant. Differences in shear bond strength between groups were analyzed using One Way ANOVA that was followed by Tukey's test. Pearson Chi Square was used to compare mode of failure between groups. All tests were two tailed and the significance level was set at *p* value ≤0.05. Data were analyzed using IBM SPSS, version 23 for windows, Armonk, NY, USA.

RESULTS

Microleakage score results

From the occlusal aspect, there were statistically significant differences in the median microleakage between Surefil One and Cention forte as well as with Spectra™ ST HV (p=0.001, p=0.007 respectively). No statistically significant difference was found between Cention forte and Spectra ST HV (p=0.918). The lowest median microleakage score was evident in the Spectra™ ST HV group, whereas, the highest microleakage score was seen in Surefil One.

From the gingival aspect, there was no statistically significant difference in median microleakage scores between Cention forte and Surfil One (p=0.099). There were statistically significant differences between Spectra™ ST HV and the other test groups (p<0.0001). The lowest median microleakage score recorded was for Cention forte and the highest microleakage score was in the Spectra™ ST HV group. **(Figure 3)**

Microleakage median penetration percentage scores:

From the occlusal aspect, there were statistically significant differences in the median penetration percentage between Surefil One and Spectra™ ST HV as well as with Cention forte (p=0.001), (p=0.008) respectively. A significant difference was also found between Cention forte and Spectra™ ST HV (p=0.048). The lowest microleakage percentage was recorded in the Spectra™ ST HV group, whereas the highest microleakage percentage was found in the Surefil One group.

From the gingival aspect, there were statistically significant differences between Cention Forte and Spectra™ ST HV as well as with Surefil One (p<0.0001). No statistically significant difference was found between Surefil One and Spectra™ ST HV (p=1.00). The lowest microleakage percentage was evident in the Cention Forte group, whereas the highest microleakage percentage was found in the Spectra™ ST HV group.

Averaging the occlusal and gingival aspect, scores revealed statistically significant differences in the median penetration percentage between the Surefil one and Spectra™ ST HV as well as with Cention forte (P=0.020), (p<0.0001) respectively. Significant difference was also found between Cention forte and Spectra™ ST HV (p=0.008). The lowest microleakage percentage was found in the Cention forte group (22.87), whereas the highest microleakage was recorded for the surefil one group (65.71) . **(Table 2), (Figure 4)**

Shear bond strength test results

Comparing the mean difference among the study groups showed statistically significant differences in shear bond strength between Cention forte and Surefil One as well as with Spectra™ ST HV (p<0.0001), whereas no statistically significant difference was found between Surefil one and Spectra™ ST HV (p=0.995). The highest shear bond strength was recorded in the Cention forte group (9.89), whereas the lowest value was found in the Spectra™ ST HV group (4.47). **(Figure 5)**

Failure mode assessment results

Using Pearson Chi square test, no statistically significant differences among groups were found in the mode of failure (P= 0.602). **(Table 3), (Figure 6)**

Cohesive mode of failure was not evident in any of the specimens; group IB (test) Surefil one, group IIB (Test) Cention forte and group IIIB (control) Spectra™ ST HV.

Figure (1): A Standardized box with standardized dimensions of 2 mm height, 4 mm width and 1.5 mm depth.

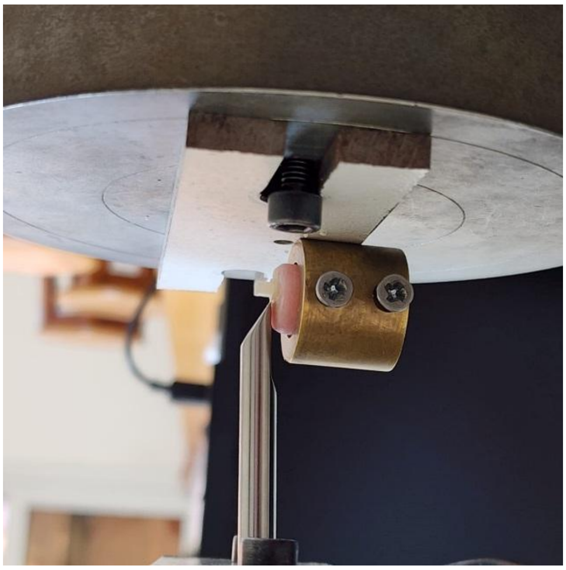

Figure (2): The specimen mounted to Universal testing machine for shear bond strength evaluation test.

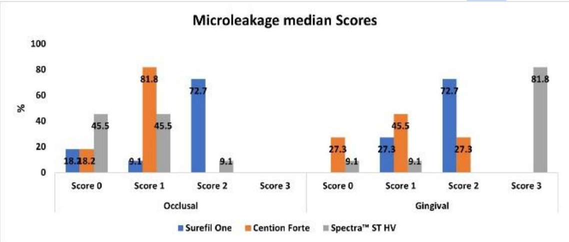

Figure (3): Comparison of microleakage median scores among the study groups.

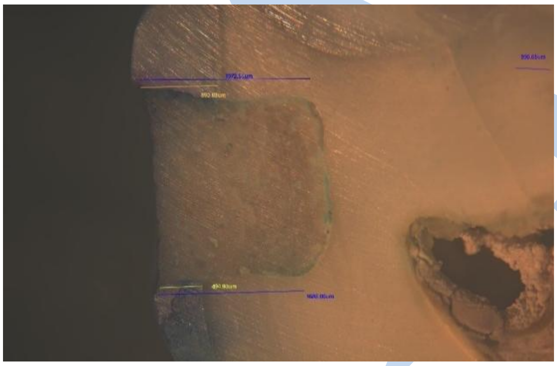

Figure (4): Shows microleakage scores of group IA (Surefil one).

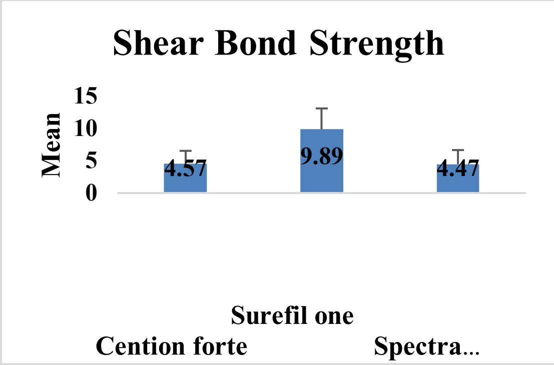

Figure (5): Comparison of shear bond strength among the study groups.

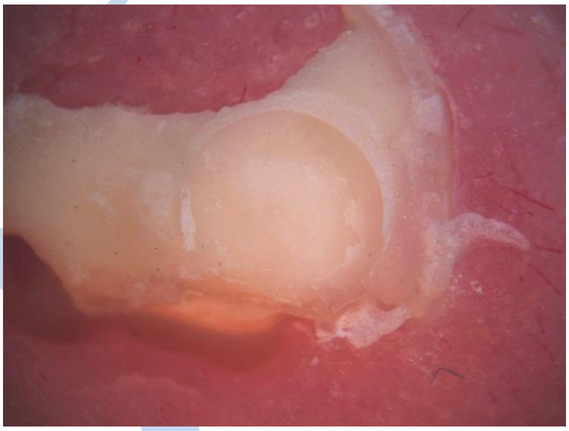

Figure (6): group IIB: Cention forte (mixed failure).

Table 1: Dye penetration scoring for marginal microleakage along the occlusal wall.

Score	Criteria
0	No dye penetration.
1	Dye penetration into enamel only.
2	Dye penetration between the restoration and the tooth in the enamel and dentin.
3	Dye penetration into the pulpal chamber.

Table 2: Comparison of microleakage percentage among the study groups

		Surefil one (n=11)	Cention Forte (n=11)	Spectra™ ST HV (n=11)	*p* value
Occlusal	Mean ±SD	67.21 ±40.87	29.11 ±19.38	11.94 ±23.28	<0.0001*
	Median (Min - Max)	100.00 (0.00 – 100.00)	30.74 (0.00 – 54.13)	0.00 (0.00 – 100.0)	
Gingival	Mean ±SD	71.85 ±38.92	12.62 ±17.54	78.27 ±38.15	<0.0001*
	Median (Min - Max)	100.00 (0.00 – 100.00)	0.00 (0.00 – 67.43)	100.00 (0.00 – 100.00)	
Overall	Mean ±SD	69.53 ±22.30	20.87 ±15.35	45.11 ±23.91	<0.0001*
	Median (Min - Max)	65.71 (37.25 – 100.00)	22.87 (0.00 – 60.78)	50.00 (0.00 – 100.00)	

*Statistically significant difference at *p* value≤0.05

Table 3: Comparison of mode of failure among the study groups

	Surefil one (n=22)	Cention Forte (n=22)	Spectra™ ST HV (n=22)	*p* value
Adhesive	5 (45.5%)	3 (27.3%)	5 (45.5%)	0.602
Mixed	6 (54.5%)	8 (72.7%)	6 (54.5%)	

DISCUSSION

Composite has become the material of choice in restorative dentistry, due to their sufficient mechanical behavior, aesthetically pleasing qualities, and most importantly, their ability to preserve the tooth structure. One of the drawbacks of traditional composites is the material's volume shrinks by roughly 3% during polymerization (23). The most recent approach has focused on developing materials that require fewer steps in their application process, such as self-adhesive and bulk-fill composites.

One of these new materials is Surefil one. The primary component of Surefil One is =MOPOS, a modified polyacid with a distinctive structure that enables the development of self-adhesive restorative materials. The network development and attachment to tooth structure, that MOPOS promotes, increases the material's mechanical strength (24).

Therefore, this study was conducted to assess microleakage and shear bond strength in bioactive resin Surefil One™ in comparison to alkasite restorative material (Cention forte) and resin-based composite in primary molar teeth.

Microleakage is among the most commonly investigated properties of restorative materials. This negative aspect might lead to secondary caries and subsequently sensitivity and pulpal pathology. The main objectives of an ideal restorative material depend mainly on its ability to bond adequately to tooth structure to prevent microleakage and achieve the optimal clinical performance (25).

Microleakage was assessed in this study by the dye penetration method qualitatively and quantitatively. It is a simple method with an easy reference point for scoring. Methylene blue dye was used, as it is characterized with high dentin permeability due to its low molecular weight (26).

Thermocycling was done for 500 cycles at 5°C and 55°C with a dwell time of 30 seconds in each temperature. A 55°C was the ideal temperature which stimulates the oral temperature variations (27).

In the present study, the results of qualitative and quantitative assessment of microleakage occlusally and gingivally revealed that there were statistically significant higher differences in median penetration percentage between the Cention forte and surefil one as well as with Spectra™ ST HV. The lowest penetration percentage was found in the Cention forte group, whereas the highest penetration percentage was recorded for the Surefil One group.

The results of the current study agreed with the work done by Neves et al. (2022) (9) who evaluated the microleakage in the bioactive resin Surefil One™ in comparison with Spectra™ ST HV in class V cavities in extracted premolars and molars. The results showed that Surefil One™ does not demonstrate a lower microleakage rate compared to Spectra™ ST HV. This may be attributed to Surefil One™'s adhesion mechanism, which relies primarily on high molecular weight polyacrylic acids that enhance the hybridization of the smear layer and promote ionic interactions between dentin calcium and the carboxylic groups in MOPOS. Although the formulation contains water, Surefil One composite requires some moisture to initiate its functional acids' activation, meaning the dentin should not be completely dehydrated. This can be challenging to manage in deep, narrow cavities. It is difficult to obtain the ideal moistened dentin. This could justify the higher statistically significant values of microleakage obtained between the test and control groups.

The present findings were supported by the results of Mehesen R et al. (2023) (28) who evaluated and compared the marginal adaptation of class V cavities restored with Alkasite, Bulk-fil Resin Composite , resin-modified glass ionomer , and conventional high viscosity glass ionomer restorative materials. The study showed that better marginal adaptation was found in the Cention N. This finding also agrees with the study of Firouzmandi et al (29) who stated that this higher adaptation was due to patented isofiller in Cention N, which is partially functionalized by silanes in order to decrease shrinkage stress and acts as a shrinkage stress reliever.

The present findings are also supported by the results of the Sabry MM et al. (2024) (30) who stated that Surefil One showed higher microleakage rate when compared to traditionally Bulk-fill composite. Surefil One™ is based on dual polymerization, which might lead to higher shrinkage stress values in cavities filled with high C-factor. This shrinkage leads to poor adaptation at the margins, resulting in subsequent microleakage. This observation agrees with Neves et al. (9)

Shear bond strength is of a great importance to the restorative material clinically because of the shearing effect caused by significant dislodging forces at the interface between the tooth and the restoration. Accordingly, a stronger shear bond leads to a better material-to-tooth bond (31).

In the current study, the highest shear bond strength was recorded for the cention forte group that showed statistically significant higher differences with both Surefil one and Spectra™ ST HV, indicating a better bond quality of this test material over the other control material. The same finding was reported by Dhull et al. (2022) (32) who compared the adhesive bond strength of conventional glass ionomer cement (GIC) and Cention N to primary enamel and dentin using an accelerated fatigue test and found that

Cention N resisted significantly more number of endured cycles before separation from the cavity in comparison to GIC. The results of A. Sadeghyar et al (2022), (33) also supports the present findings. Their reported the shear bond strength of eight different materials to bovine dentin showed that Cention forte has the highest mean shear strengths among the other materials and that Surefil One without pretreatment had also high shear bond strengths compared to the materials.

The results of the current study concerning Surefil one support those found by Mahmoud N et al (2023) (34), who evaluated shear bond strength of Surefil One and found that the use of Surefil One without adhesive application has the lowest shear bond strength.

In contrast to these results, Pai et al. (2024) (35) found that the shear bond strength of RMGIC was higher than that of Cention N used in sound primary teeth. This outcome could be related to the application of Cention N directly without bonding to tooth, whereas preconditioning of the tooth was performed with RMGIC, indicating that the shear bond strength of Cention N might be higher when placed on the pretreated surface of the tooth.

The efficacy of bonding of any adhesive material is expressed by its mode of failure including cohesive, adhesive or mixed. The cohesive pattern of failure occurs when the filling material separates from itself. In the adhesive failure, the fracture occurs at the bond line between the two different materials. The mixed failure includes both previously mentioned patterns (36).

Concerning the mode of failure of the fractured specimens, only the mixed and adhesive failure modes were observed in the three groups. The cohesive mode of failure was not observed in any specimen. The Mixed type of failure was predominant in Cention Forte. Whereas, the adhesive pattern of failure was equally distributed in Surefil One and Spectra™ ST HV. However, the difference between the three groups was not statistically significant.

Recently Alghamdi et al (2024) (37), assessed the micro-tensile bond strength and the mode of failure of Surefil one under various dentin conditions. It was concluded that the adhesive failure mode of Surefil One was 40% adhesive, whereas, only 5% showed mixed failure. Cohesive failure in dentine was present win 55 % of the sample. These results are only in agreement with our data concerning the adhesive mode of failure of surefil one.

The present study was challenged by some limitations including its in-vitro nature, which may not fully replicate the intraoral environment, it also included use of intact dentin in the used specimens, which might not reflect the bond strength in carious dentin.

Based on the results of the current study, the null hypothesis was partially rejected. Assessment showed no statistically significant difference in microleakage between surefil one and Spectra™ ST HV. However, differences were significant between cention forte and surefil one as well as with Spectra™ ST HV. As for shear bond strength, statistically significant differences were found between Cention forte and Surefil one as well as with Spectra™ ST HV. However, no statistically significant difference between surefil one and Spectra™ ST HV were present.

CONCLUSION

Based on these in vitro results, it can be concluded that it is only Cention forte that showed the best microleakage percentage and shear bond strength compared to both of surefil one and Spectra™ ST HV.

CONFLICT OF INTEREST

The authors state that they have no conflicts of interest.

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