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Effect of Silver Diamine Fluoride on Micro-Tensile Bond Strength of Composite to Dentin on Primary and Permanent Teeth

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Abstract

Aim of the Study: The aim of the current study was to investigate the effect of silver diamine fluoride on micro-tensile bond strength of composite to dentin and on the bonding mechanism of dentin surface on primary and permanent teeth. **Material and methods:** This study included two groups: group one included twenty-four primary molars and group two included twenty-four premolars. Each group was further subdivided equally into sub-group A and sub-group B. Sub-group A had a self-etch bonding system treatment, and 4-mm thick composite buildups were applied in 1 mm increments. Sub-groups B were treated with 38% SDF, followed by the same self-etch bonding method as sub-group A, and composite was added. After being maintained in distilled water for 24 hours at 37°C, the restored specimens were cut into serial slabs about 1.0 mm thick using a slow-speed water-cooled diamond saw. Each slab was separated into composite/tooth structure beams with cross sections measuring 1.0*1.0 mm., which were then fastened to the test block of a micro-tensile testing apparatus to measure the maximum tensile force that could be applied before failure. A slab from each sub-group was examined using a scanning electron microscope, and microphotographs were recorded. **Results:** The results of the current study showed a non-significant reduction of micro-tensile bond strength in SDF-treated subgroups and showed significant reduction of micro-tensile bond strength in primary molars compared to premolars. Microphotographs showed significant reduction in numbers and extend of resin tags into dentin surface in SDF-treated samples. **Conclusions:** 1) The micro-tensile bond strength of composite to dentin is unaffected by SDF application. 2) Premolars have a stronger micro-tensile bond strength to dentin than primary molars. 3) SDF has a negative effect on resin tag formation.

Key words: silver diamine fluoride, dental caries, micro-tensile bond strength, composite restoration.

1. Introduction

Dental caries is considered one of the most common oral diseases of childhood and is considered a major public health problem. Despite efforts made in every country to decrease the prevalence of dental caries as much as possible, it is still considered as the most prevalent disease worldwide and the major cause behind tooth loss. (1)

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Research demonstrated that carious dentin consists of two differentiated layers: an outer layer of bacterially infected dentin, and an inner layer of affected dentin, the outer layer was characterized as being highly demineralized, physiologically un-remineralizable and showing irreversible denatured collagen fibrils with a virtual disappearance of cross linkages. (2)

Silver diamine fluoride (SDF) is an effective, efficient, equitable and safe caries-preventive agent appearing to meet the World Health Organization's Millennium Goals for 21st century medical care. (3) (4)

From the proposed treatment modalities is restoring the tooth with an adhesive restoration after SDF application, there is a concern about the bonding efficacy after application of SDF. As there are no sufficient studies performed for assessment the effect of silver diamine fluoride on microtensile bond strength of composite to dentine, therefore, the purpose of this study was to assess the effect of silver diamine fluoride on microtensile bond strength of composite to dentin of both primary and permanent teeth.

2. MATERIALS AND METHODS:

The Dental Research Ethical Committee of Faculty of Oral and Dental Medicine, Future University in Egypt (FUE.REC (4)\4-2019, Meeting 4/4/2019) approved the study. (Appendix 1).

2.1 Sample size:

Based on previous studies (5) (6) the proposed sample size was 48 teeth divided into two groups: 24 primary molars and 24 premolars.

2.2 Eligibility criteria:

According to the following criteria for eligibility, teeth were selected:

Inclusion criteria:

Twenty-four primary molars and twenty-four premolars were collected from the output clinic of Pediatric Dentistry and Dental Public Health department, Faculty of Oral and Dental Medicine, Future University in Egypt.

- The extracted teeth were conformed to the following criteria:

a) Molars were only extracted upon a clear clinical indication such as over-retained primary molars, molars near exfoliation, showing an erupting successor tooth or for orthodontic reasons.

b) Molars were free of any form of carious lesion, hypo-calcification, or restorations.

c) Premolars were only extracted upon a clear clinical indication such as ankylosed premolars or for orthodontic reasons.

2.3 Teeth grouping:

After evaluation of these criteria, the samples were randomly divided into two groups of twenty-four teeth each. Each group was further subdivided into two sub-groups of twelve teeth.

2.4 Preparation of the extracted teeth:

Forty-eight non-carious, extracted primary molars and premolars were collected according to human subjects' regulations and stored in 0.9% sodium chloride. A cylindrical Teflon mold (15-mm diameter and 40-mm height), with a corresponding metal ring with two opposing screws at its top (Figure 1) was used to produce acrylic resin blocks. The screws were used to hold the tooth in place in a centralized position, parallel to the long axis of the mold, during the setting of acrylic resin (figure 2). Teeth that were fixed already in acrylic resin blocks were then mounted in an automated diamond saw (Isomet 4000, Buehler Ltd., Lake Bluff, IL, USA) (Figure 3), this is a low speed cutting machine that is designed for cutting various types of materials with minimal deformation which was used for all sectioning procedures in this study. Occlusal surfaces were flattened to expose flat mid-coronal dentin (Figure 4) under copious water coolant (Cool 2 water-soluble anticorrosive cooling lubricant, Buehler Ltd., Lake Bluff, IL, USA), with a concentration of 1:30, lubricant: water. (7) (8)

Figure 1 (Top view) shows a teflon mold with a corresponding metal ring and parallel screws.

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Figure (2): Teeth fixed to acrylic block.

Figure (3): Isomet 4000, used for preparations of the teeth beams.

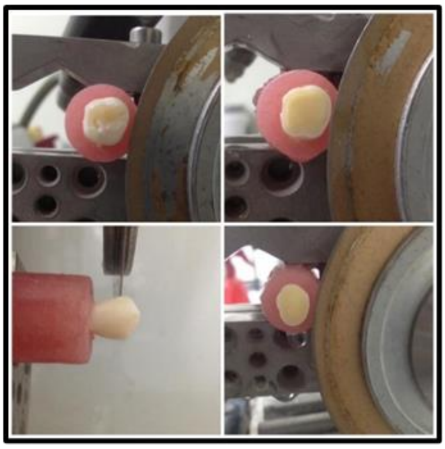

Figure (4): Teeth mounted to automated diamond saw to make occlusal flattening.

After flattening of all molars and premolars, each group was randomly divided into two sub-groups and treated as following:

Group 1: Primary molars:

Sub-group A1: Exposed flat dentin surface of twelve primary molars were treated with universal bonding system according to manufacturer's instructions.

Sub-group B1: Exposed flat dentin surface of twelve primary molars were treated with a 38% SDF solution for three minutes, then rinsed with distilled water for 30 seconds. After that, the dentin surface was treated with the same universal bonding system as sub-group A.

Group 2: Premolars:

Sub-group A2: Exposed flat dentin surface of twelve premolars were treated with universal bonding system according to manufacturers' instructions.

Sub-group B2: Exposed flat dentin surface of twelve premolars were treated with 38% SDF solution for three minutes, followed by a rinse for 30 seconds with distilled water. (9) (10) Then the dentin surfaces were treated with the same universal bonding system used in sub-group A.

Following treatment with respective adhesives (according to manufacturers' instructions), 4-mm thick buildups of composite (Ceram·X® restorative composite) were placed with increments limited to 1 mm. Curing was accomplished with a LED curing light. After storage in distilled water for 24 hours at 37°C (8) (11) the restored specimens were sectioned occluso-gingivally into serial slabs approximately 1.0 mm thick by a slow-speed water-cooled diamond saw. Each slab was sectioned into composite/tooth structure beams measuring approximately 1.0*1.0 mm in cross-section by the same slow-speed water-cooled diamond saw. (5) (12)

2.5 Beam preparation:

The objective of longitudinal sectioning of restored teeth was to obtain composite-dentin beams of (1 mm x 1 mm). Each beam was composed of composite and dentin with adhesive at the interface, for the longitudinal sectioning to be perpendicular to the flat occlusal surface of restored teeth, a specially designed gripping attachment was used to hold acrylic blocks with mounted teeth firm in place, parallel to the sectioning direction, thus maintaining the perpendicular relation between the cutting disc and the occlusal surface.

The L-shaped attachment (Figure 5) was composed of a cylindrical metal ring (16-mm in diameter, 3-mm height, 2-m thickness) soldered at its base to a metal rod (Figure 6), which was used to mount the attachment into the

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diamond saw machine. Two axial grooves, perpendicular to each other, were made on the top surface of metal ring to facilitate accurate positioning and rotation of acrylic blocks inside the gripping attachment. The final components were two 5-cm long screws in-line with each other to fix acrylic blocks in place with minimal movement during sectioning.

After mounting in the gripping attachment, restored teeth were serially sectioned, using a 0.3-mm thick diamond coated disc (Buehler, IL, USA), in 2050 rpm; 8.8 mm/min feeding rate (Figure 7); under copious coolant. Serial sectioning was done in bucco-lingual direction then rotated 90° clockwise and sectioned in mesio-distal (Figure 8). A final horizontal cut was done to a level of cemento-enamel junction obtain beams. (5)(13)

The resultant beams were 0.9±0.1 mm in thickness and 5.5±1 mm in length. A digital caliper (Mitutoyo, Tokyo, Japan) was used to check the thickness and length of all beams (Figure 9). Each beam was stored in distilled water at room temperature in a tight-seal plastic cone labeled according to subgroup and tooth.

Figure (5): L-Shaped gripping attachment (Front view) with perpendicular axial grooves (arrows).

Figure (6): L-Shaped gripping attachment (Rear view) - Perpendicular metal rod (arrow).

Figure (7): Operating parameter of the diamond saw machine. (Isomet 4000).

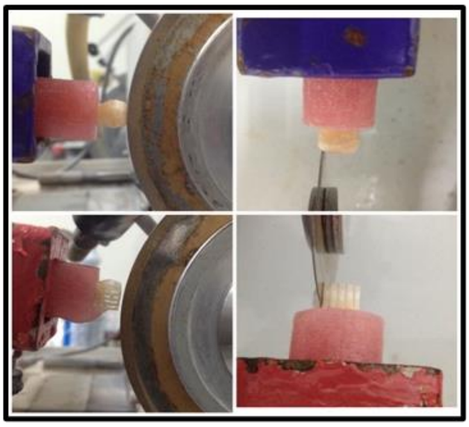

Figure (8): Sectioning the tooth in the bucco-lingual and mesio-distal direction.

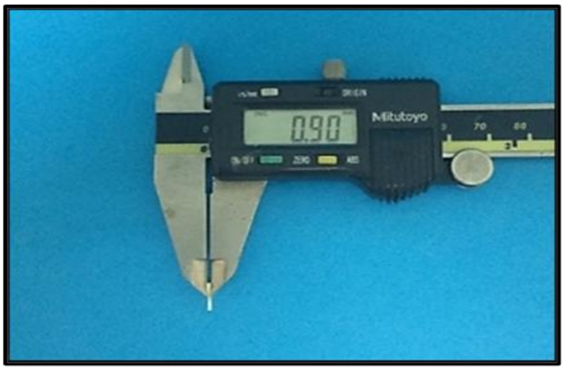

Figure (9): Measuring the beam's thickness at the composite-dentine interface.

2.6 Micro-tensile bond strength measurement:

For each subgroup, 36 beams were tested, 3 from each tooth. Geraldeli's jig (Figure 10) was used to mount beams onto the universal testing machine (Instron, MA, USA). Each beam was adjusted in the central groove of the jig and fixed in place by its ends using cyanoacrylate-based glue (Zapit, DVA Inc, USA). The hardening of the glue was accelerated by zapit accelerator. [14]

The jig was in turn mounted into the universal testing machine (Instron, MA, USA) with a load cell of 500 N (Figures 11-12). Tensile load was applied, at a crosshead speed of 0.5 mm/min, until bonding failure of the specimen occurred. Bond strength was calculated in MegaPascal (Bluehill Lite software, Instron, MA, USA) (Figure 13).

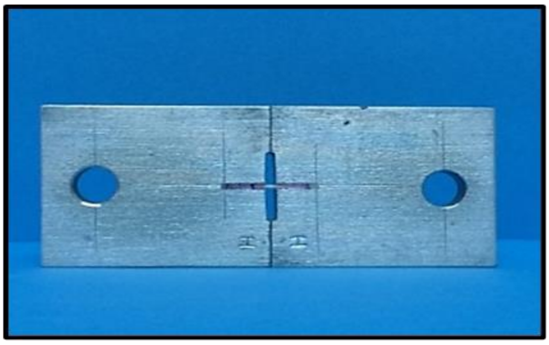

Figure (10): Beam mounted on Geraldeli's jig.

Figure (11): Jig mounted on the Universal testing machine.

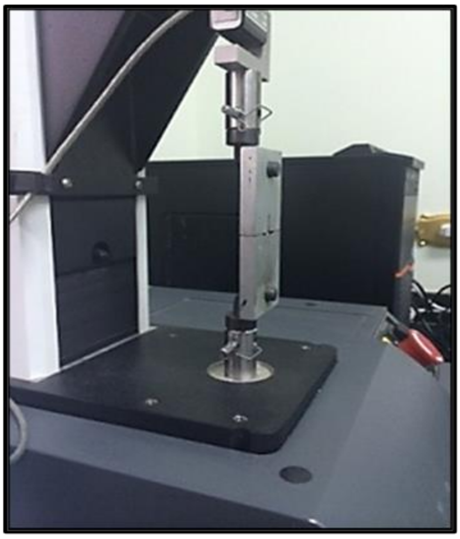

Figure (12): Parallel alignment of the jig.

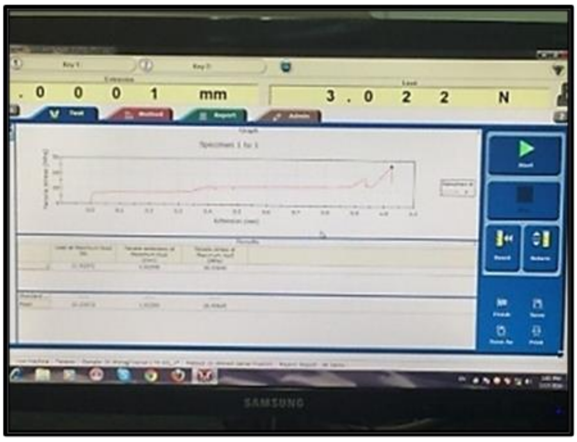

Figure (13): Bluehill Lite machine operating software.

2.7 Preparation of teeth for micro-photography:

For scanning electron microscopy (SEM) analysis, additional representative samples (n=4) from each subgroup were restored using the same techniques that were previously described. The same technique used to create beams was utilized to section the samples into 2-mm-thick slices, the slices were fixed with double sided sticky strip on aluminum stubs (Figure 14) and gold coating for 60 s at 45 mA in a vacuum metalizing chamber (QUORUM Q 150T ES, England) (Figures 15 and 16) were applied before observation by SEM (TESCAN-VEGA3, CZECH REPUBLIC) operated under 20 kV in different magnifications. (Figure 17) (8)

Figure (14): Slices fixed to metal rings.

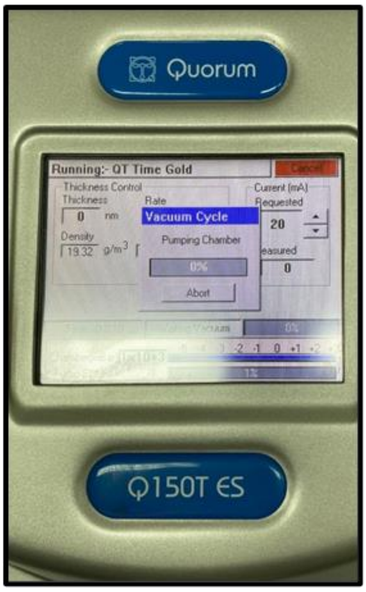

Figure (15): QUORUM Q 150T ES.

Figure (16): Slices after gold coating.

Figure (17): TESCAN-VEGA3.

2.8 Statistical Analysis:

The data was examined using IBM SPSS software, version 20.0. (Armonk, NY: IBM Corp.) Quantitative data were described in terms of percentage and number. The Kolmogorov-Smirnov test was used to determine whether the distribution was normal. Quantitative data were described using the range (minimum and maximum), mean, standard deviation and median. The significance of the findings was established at the 5% level.

1. Mann Whitney test:

For abnormally distributed quantitative variables, to compare between two studied groups.

2. Kruskal Wallis test:

For abnormally distributed quantitative variables, to compare between more than two studied groups and Post Hoc (Dunn's multiple comparisons test) for pairwise comparisons.

3. Two-sample t-test:

The two-sample t-test (also known as the independent samples t-test) was used which is a method used to test whether the unknown population means of two groups are equal or not.

3. Results:

3.1 Micro-tensile bond strength measurements:

A) Microtensile bond strength measurements of primary teeth:

The mean value of bond strength of sub-group A1 was 22.95(±0.82) MPa and for sub-group B1 22.76(±0.66) MPa and P value was 0.5366 which made SDF's impact on the microtensile bond strength of the composite to the primary molar's dentin not statistically significant. (Table 1) (Figure 18)

Table (1) Microtensile bond strength measurements of group 1:

	n, beams	Group 1 (mean ± SD)	P value	Statistically significant
Maximum load				
Sub-group A1	36	22.95±0.82	0.5366	N. S
Sub-group B1	36	22.76±0.66		
Statistical test used: Tow sample T Test				
p-value≤0.05 considered statistically significant (95% confidence interval).				

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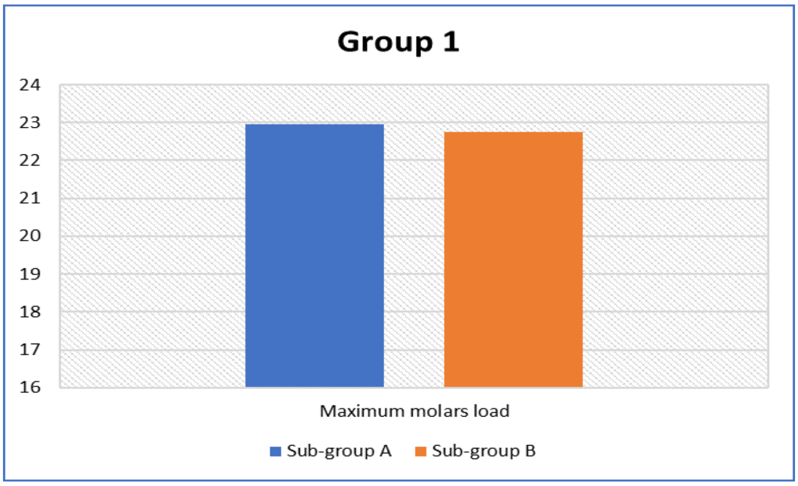

Figure (18): Microtensile bond strength measurements of group 1.

B) Microtensile bond strength measurements of premolars:

The mean value of bond strength of sub-group A2 was 31.47(±1.4) MPa and for sub-group B2 31.17(±1.26) MPa and P value was 0.5853 Thus rendered the impact of SDF on Micro-tensile bond strength of composite to dentin of premolar not statistically significant. (Table 2) (Figure 19)

Table (2) Microtensile bond strength measurements of group 2:

	n, beams	Group 2 (mean ± SD)	**P value**	**Statistically significant**
Maximum load				
Sub-group A2	36	31.47±1.4	0.5853	N. S
Sub-group B2	36	31.17±1.26		
Statistical test used: Tow sample T Test				
p-value≤0.05 considered statistically significant (95% confidence interval).				

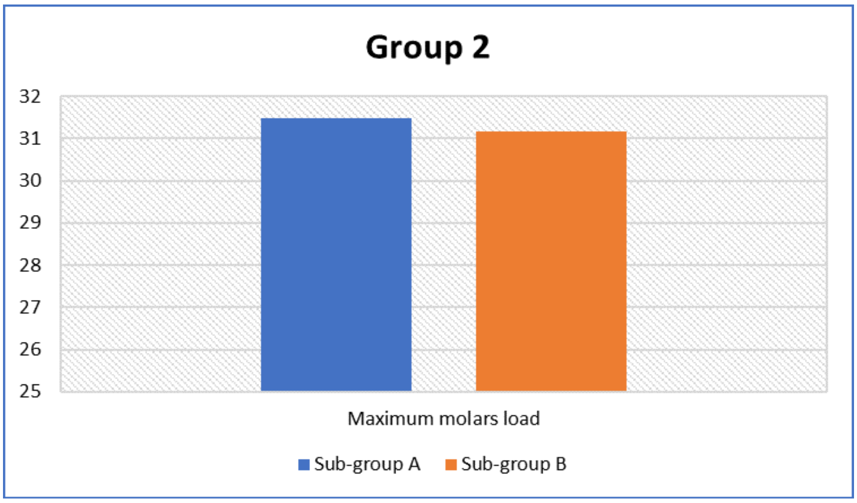

Figure (19): Microtensile bond strength measurements of group 2.

C) Comparison of microtensile bond strength measurement between sub-groups A in each group:

The mean value of bond strength of sub-group A1 was 22.95(±0.82) MPa and for sub-group A2 was 31.47(±1.4) MPa and P value was <0.0001 which made the difference of microtensile bond strength between primary and permanent teeth without SDF pretreatment statistically significant. (Table 3) (Figure 20)

Table (3) Comparison between sub-groups A in each group:

	n, beams	Sub-group A (mean ± SD)	P value	Statistically significant
Maximum load				
Group A1	36	22.95±0.82	<0.0001	Sig.
Group A2	36	31.47±1.4		
Statistical test used: Tow sample T Test				
p-value≤0.05 considered statistically significant (95% confidence interval).				

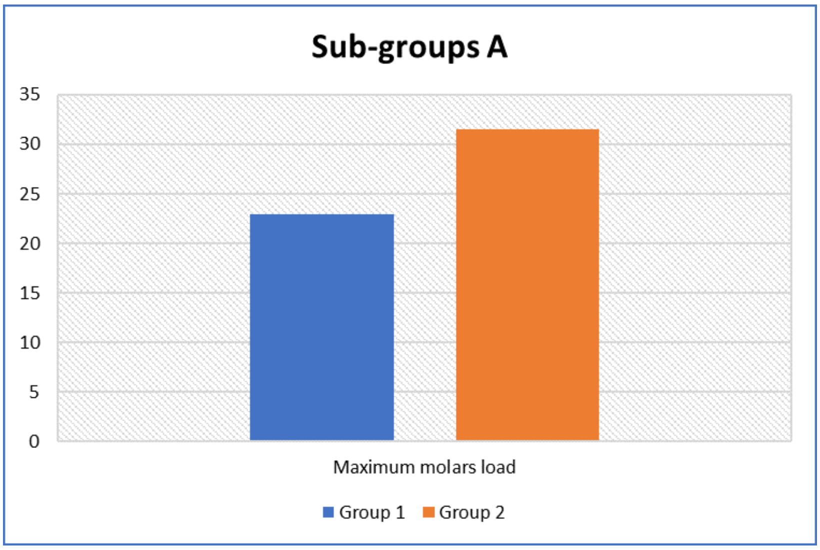

Figure (20): Comparison between sub-groups A in each group.

D) Comparison of microtensile bond strength measurements between sub-groups B in each group:

The mean value of bond strength of sub-group B1 was 22.76(±0.66) MPa and for sub-group B2 was 31.17(±1.26) MPa and P value was <0.0001 which made the difference of micro-tensile bond strength between primary and permanent teeth after SDF treatment statistically significant. (Table 4) (Figure 21)

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Table (4) Comparison between sub-groups B in each group:

	n, beams	Sub-group B (mean ± SD)	P value	Statistically significant
Maximum load				
Group B1	36	22.76±0.66	<0.0001	Sig.
Group B2	36	31.17±1.26		
Statistical test used: Tow sample T Test				
p-value≤0.05 considered statistically significant (95% confidence interval).				

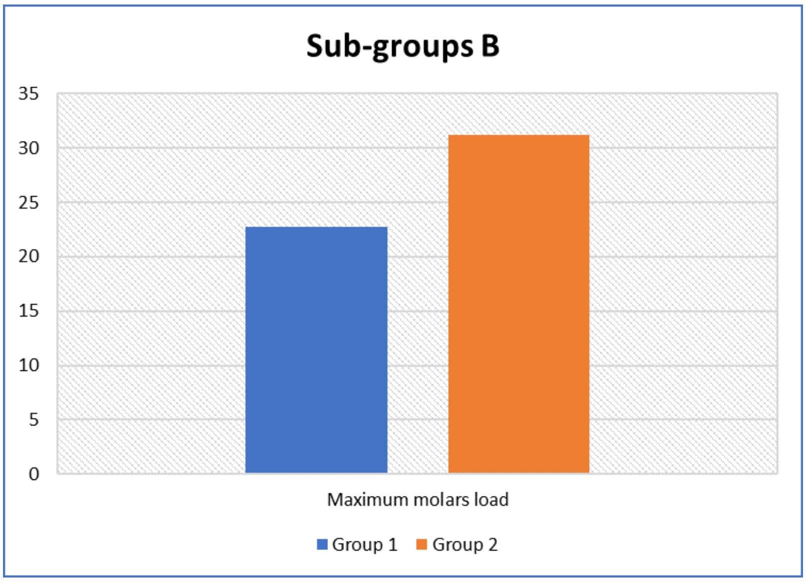

Figure (21): Comparison between sub-groups B in each group.

3.2 Micro-morphological analysis:

The micro-photographs of both primary and permanent dentin surface without SDF application revealed a well demarcated resin-dentin inter-diffusion zone and numerous tags of resin in the dentinal tubules interlacing together to form resin bundles in primary molar sample, for SDF treated group, While the resin tags were formed but the shape and consistency was not as regular as the non-treated specimen that were longer, more regular and diffused more in the dentinal tubules than that formed in SDF group. (Figure 22)

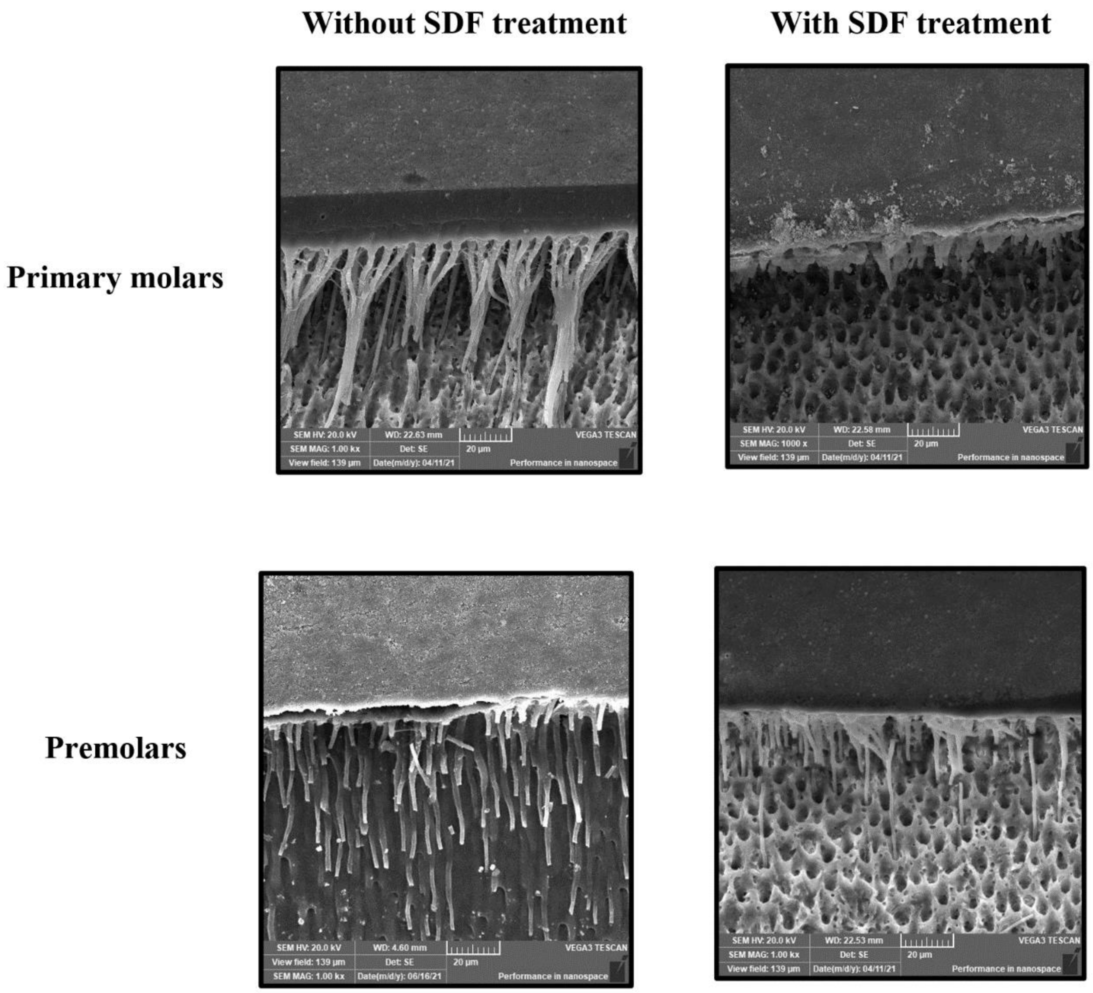

Figure (22) SEM images of the dentine and restorative materials interface; without SDF treatment (first column) and with SDF treatment (second column).

4) Discussion:

In this study, the investigators measured the micro-tensile bond strength of composite to dentine of primary and permanent teeth with and without SDF pretreatment, the results showed that both; primary and permanent teeth in the SDF groups had a non-significant drop in micro-tensile bond strength. This study's findings supported those of other research by **Quock et al. (2012)** and **Wu et al. (2016)**, which revealed that pretreating dentin with 38% SDF had no effect on the micro-tensile bond strength of composite. (5)(6)

The current study's findings agreed with those of **Wang et al. (2016)** and **Puwanawiroj et al. (2018)**, who measured the micro-tensile bond strength of glass ionomer cement to dentin before and after SDF application. Their

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findings showed that SDF had no impact on the bond strength between glass ionomer cement and primary dentin. [(2)(15)]

On the other hand, in a 2016 study, **Koizumi et al.** discovered that pretreating the surface of dentin with potassium iodide and silver diamine fluoride (SDF/KI) significantly decreased the bond strength. The inclusion of potassium iodide in their study, which was applied immediately after SDF and before bonding to reduce the dark staining brought on by SDF, may have contributed to the differences in their results. [(8)]

The current study showed a significant difference of micro-tensile bond strength of composite to dentin between primary and permanent teeth with and without SDF application which agreed with a study made by **Burrow et al.,** who evaluated the microtensile bond strengths of different dentin bonding agents to primary and permanent teeth dentin and discovered that permanent dentin had greater overall bond strengths than primary dentin. [(16)]

This goes in parallel to the results of a systematic review made by **Pires et al** who collected data from 37 articles, The meta-analysis showed that bonding to dentin of primary and permanent teeth was not similar, permanent dentin had higher bond strength than primary dentin, this may be due to the compositional and micro-morphological difference between primary and permanent dentin which may influence the performance of adhesives. [(17)]

Courson et al., explained that the lower concentration of calcium and phosphorus in peritubular and intertubular dentin of primary teeth might be the cause of lower bond strength to primary dentin. [(18)] In 2013 a study performed by **Lenzi et al**, showed that in primary teeth, the tubular density is higher and the intertubular dentin area was lower than permanent teeth, which might have risk on the bonding performance. [(19)]

Other studies found that the lower mineral content of primary teeth might be associated with higher susceptibility to the action of acidic conditioners, which may lead to formation of thick hybrid layer, resulting in lower bond strengths. [(20)(21)(22)]

In this study, the results of micro-morphological examination of dentin surface of primary and permanent teeth with and without the application of SDF revealed that SDF had negative effect on resin tags formation for both primary and permanent dentin samples. This result agreed with the result obtained from another study conducted by **Koizumi et al**, who concluded that samples treated with SDF showed much fewer tags formation than non-treated samples which indicated that the tubules were occluded preventing resin penetration. (8)

The negative effect of SDF on resin tags penetration was supported with other studies which stated that SDF had an important role in minimizing dentin hypersensitivity and managing the symptoms of MIH affected teeth by the ability of silver ions to occlude dentinal tubules by protein precipitation as well it stimulates calcium fluoride and silver iodide production, both of which can occlude dentinal tubules and decrease their patency. (23)(24)(25)

Although the result of the current study showed a negative impact of SDF on the resin penetration into dentinal tubules and negatively affect resin tags formation, the bond strength of composite to dentin was not affected by this finding as the role of resin tags in bonding was claimed to be very limited and not effective. Some self-etch adhesives do not produce resin tags and have high bond strength and some etch and rinse adhesives produce long and many resin tags but at the same time have low bond values which agreed with **Kwong et al.** who found that higher bond strength was achieved by using self-etch adhesive systems rather than etch and rinse systems as a result of the ability of self-etch adhesives to produce chemical bonding with tooth structure which is more important and effective than micro-mechanical bonding achieved by resin tags formation. (26)

The investigator of the current study used universal adhesives, which contain functional monomers with a specific phosphate or carboxylate group that form an ionic bond with the calcium found in the hydroxyapatite of the tooth surface which influenced the bonding strength. (27) This reaction led to formation of non-soluble calcium salts which help in promoting strong adhesion to tooth surface. (28)(29) This finding agreed with previous reports that support the fact that the role of chemical bonding is much more important than micro-mechanical bonding. (30)

One of the strength points of this study was testing the effect of SDF on the micro-tensile bond strength of composite to dentin of primary and permanent teeth, evaluating its effect on the resin-dentin interface by microphotographs, and comparing the micro-tensile bond strength of composite to dentin between primary and permanent teeth before and after SDF treatment. Moreover, all clinical procedures done in the present study

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were performed by the same operator to exclude inter-operator bias. Besides, all study participants (except the main investigator), technicians and the statistician were made blind to the type of treatment used to reduce possibility of detection and performance bias.

5) Conclusions:

The following conclusions could be taken from the current study's findings:

1) The micro-tensile bond strength of composite to dentin is unaffected by SDF application.
2) Premolars have a stronger micro-tensile bond strength to dentin than primary molars.
3) Resin tag formation is negatively affected by SDF.
4) The role of chemical bonding is much more important than micro-mechanical bonding.

6) Recommendations:

1. SDF is highly recommended to be used as caries arresting material then restoring the tooth with an adhesive restoration after SDF application which is considered as a successful alternative treatment to traditional surgical approach.
2. Further studies are required to examine the impact of SDF\KI on micro-tensile bond strength of composite to dentin.
3. Further clinical investigations are required to assess the effect of etch and rinse system on resin tags penetration into the dentinal tubules after SDF treatment.

7) References:

1. **Selwitz RH, Ismail AI, Pitts NB.** Dental-Caries-Seminar. pdf. Lancet. 2007;369(4):51-59.
2. **Seifo N, Al-Yaseen W, Innes N.** The efficacy of silver diamine fluoride in arresting caries in children. Evid Based Dent. 2018;19(2):42-43.
3. **Rosenblatt A, Stamford TC, Niederman R.** Silver diamine fluoride: a caries “silver-fluoride bullet”. J Dent Res. 2009; 88(2):116-125.
4. **Greenwall-Cohen J, Greenwall L, Barry S.** Silver diamine fluoride-an overview of the literature and current clinical techniques. J Br Dent. 2020;228(11):831-838.

5. **Quock RL, Barros JA, Yang SW, Patel SA.** Effect of silver diamine fluoride on microtensile bond strength to dentin. Oper Dent. 2012;37(6):610-616.
6. **Wu DI, Velamakanni S, Denisson J, et al.** Effect of silver diamine fluoride (SDF) application on microtensile bonding strength of dentin in primary teeth. Pediatr Dent 2016; 38(2):148-153.
7. **Flury S, Peutzfeldt A, Lussi A.** Influence of increment thickness on microhardness and dentin bond strength of bulk fill resin composites. Dental Materials. 2014 Oct 1;30(10):1104-1112.
8. **Koizumi H, Hamama HH, Burrow MF.** Effect of a silver diamine fluoride and potassium iodide-based desensitizing and cavity cleaning agent on bond strength to dentine. Int J Adhes Adhes. 2016;68:54-61.
9. **Frohlich TT, de Oliveira Rocha R, Botton G**. Does previous application of silver diammine fluoride influence the bond strength of glass ionomer cement and adhesive systems to dentin? Systematic review and meta-analysis. Int J Paediatr Dent. 2020;30(1):85-95
10. **Young DA, Quock RL, Horst J, Kaur R, MacLean JK, et al.** Clinical Instructions for Using Silver Diamine Fluoride (SDF) in Dental Caries Management. Compend Contin Educ Dent. 2021;42(6):5-9.
11. **He Z, Shimada Y, Tagami J.** The effects of cavity size and incremental technique on micro-tensile bond strength of resin composite in Class I cavities. J Dent Mater. 2007;23(5):533-538.
12. **Selvaraj K, Sampath V, Sujatha V, Mahalaxmi S.** Evaluation of microshear bond strength and nanoleakage of etch-and-rinse and self-etch adhesives to dentin pretreated with silver diamine fluoride/potassium iodide: An in vitro study. Indian J Dent Res 2016;27(4):421-425.
13. **Knight GM, McIntyre JM, Mulyani.** The effect of silver fluoride and potassium iodide on the bond strength of auto cure glass ionomer cement to dentine. J Aust Dent. 2006;51(1):42-45.
14. **Mak YF, Lai SC, Cheung GS, Chan AW, Tay FR, Pashley DH.** Micro-tensile bond testing of resin cements to dentin and an indirect resin composite. J Dent Mater. 2002 Dec;18(8):609-621.

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15. **Wang AS, Botelho MG, Tsoi JK, Matinlinna JP.** Effects of silver diammine fluoride on microtensile bond strength of GIC to dentine. Int J Adhes Adhes. 2016;70:196-203.
16. **Burrow MF, Nopnakeepong U, Phrukkanon S.** A comparison of microtensile bond strengths of several dentin bonding systems to primary and permanent dentin. J Dent Mater. 2002;18(3):239-245.
17. **Pires, Carine Weber, et al.** Is adhesive bond strength similar in primary and permanent teeth? A systematic review and meta-analysis. J Adhes Dent. 2018;20(2): 87-97.
18. **Courson F, Bouter D, Ruse ND, Degrange M.** Bond strengths of nine current dentine adhesive systems to primary and permanent teeth. Journal of oral rehabilitation. 2005;32(4):296-303.
19. **Lenzi TL, Camila de Almeida BG, Arana-Chavez VE, Raggio DP.** Tubule density and diameter in coronal dentin from primary and permanent human teeth. Microsc Microanal. 2013;19(6):1445-1449.
20. **Lenzi TL, Soares FZ, Rocha RD.** Degradation of resin-dentin bonds of etch-and-rinse adhesive system to primary and permanent teeth. Bra Oral Res. 2012;26:511-515.
21. **Tuloglu N, Tunc ES, Ozer S, Bayrak S.** Shear bond strength of self-adhering flowable composite on dentin with and without application of an adhesive system. Journal of applied biomaterials & functional materials. 2014 May;12(2):97-101.
22. **Yildiz E, Karaarslan ES, Simsek M, Cebe F, Ozsevik AS, Ozturk B.** Effect of a re‑wetting agent on bond strength of an adhesive to primary and permanent teeth dentin after different etching techniques. J Niger Clin Pract. 2015;18(3):364-370.
23. **Craig G G, Knight G M, McIntyre J M.** Clinical evaluation of diamine silver fuoride/potassium iodide as a dentine desensitizing agent. A pilot study. J Aust Dent. 2012; 57(3):308-311.
24. **Willershausen I, Schulte D, Azaripour A, Weyer V, Briseño B, Willershausen B.** Penetration potential of a silver diamine fluoride solution on dentin surfaces. An ex vivo study. Clin Lab. 2015;61(11):1695-1701.
25. **Seifo N, Robertson M, MacLean J, Blain K, Grosse S, Milne R, Seeballuck C, Innes N.** The use of silver diamine fluoride (SDF) in dental practice. J Br Dent. 2020;228(2):75-81.

26. **Kwong SM, Cheung GS, Kei LH, Itthagarun A, Smales RJ, Tay FR, Pashley DH.** Micro-tensile bond strengths to sclerotic dentin using a self-etching and a total-etching technique. J Dent Mater. 2002;18(5):359-369.
27. **Munoz MA, Luque I, Hass V, Reis A, Loguercio AD, Bombarda NH.** Immediate bonding properties of universal adhesives to dentine. J Dent. 2013:41(5):404-411
28. **Van Landuyt KL, Yoshida Y, Hirata I, et al.** Influence of the chemical structure of functional monomers on their adhesive performance. J Dent Res. 2008;87(8):757-761.
29. **Yoshihara K, Yoshida Y, Hayakawa S, et al.** Novel fluorocarbon functional monomer for dental bonding. J Dent Res.2014;93(2):189-194.
30. **Sofan E, Sofan A, Palaia G, Tenore G, Romeo U, Migliau G.** Classification review of dental adhesive systems: from the IV generation to the universal type. Ann Stomatol (Roma). 2017;8(1):1-17.

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