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Research Paper

Effect of light cured SDF on bond strength and microleakage of teeth treated with GIC – An in vitro study.

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ABSTRACT: ***Aim*** *of the study is to investigate the effect of light cured SDF on bond strength and microleakage of teeth treated with GIC.*
Materials and Methods *: Forty sound human permanent premolars were divided into the following two groups: group 1 SDF + GIC, group 2 SDF+LC+GIC after 24 hours, shear bond strength was measured using a universal testing machine, microleakage at enamel and dentin margins was estimated using a stereomicroscope(10x) and compared between groups.*
Results : *There were significant differences in shear bond strength between the two groups. The SDF + GIC group had the lowest shear bond strength among the groups. The microleakage test results were significantly different between groups at the enamel margin and dentin margins.*
Conclusion *: Within the limitations of this study, we conclude that incorporating SDF and light curing it before placement of GIC results in higher shear bond strength while not increasing much microleakage at the enamel and dentin margins.*
KEYWORDS: *silver diamine fluoride (SDF), light cured (LC), glass ionomer cement (GIC), bond strength and microleakage*

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I. Introduction

Dental caries is the most common chronic childhood disease, and its prevalence has increased among children of 2 to 5 years of age worldwide, making this population a global priority for action.[1] Although dental caries can be treated by conventional surgical interventions, not all affected groups have access to dental care, especially vulnerable groups such as young children in rural areas. In such situation caries can be prevented and arrested using fluoride-based materials such as professional applied varnishes.[2]

Silver diamine fluoride (SDF) has been used for arresting dental caries in children worldwide since the early 1960s, cleared by the Food and Drug Administration.[3] SDF inhibits cariogenic biofilm formation, generates a highly re-mineralized dentin surface, rich in calcium and phosphate ions so it can be used in both prevention of and arresting caries. It has been used in primary teeth especially in conditions such as early

childhood caries, patients suffering from behavioral or medical issues that make conventional therapy impossible, patients with special needs, those with salivary dysfunction, and those who cannot afford or have regular dental services.[4]

Furthermore, application of composite or glass ionomer cement (GIC) restorations after the application of SDF will mask the black color of the carious lesion for better aesthetics, improve chewing ability, prevent food accumulation and, so, maintain adequate oral hygiene. This technique is known as silver modified atraumatic restorative technique.[5] In restorative techniques, the bond of the restorative material to tooth structure is vital. Any agent applied to dentin or enamel could interfere with the bond strength.[6]

Informal evidence suggests that many clinicians routinely light cure SDF after its application; however, there is a lack of research in this aspect. Light-curing SDF increases the precipitation of silver ions. Assuming that curing SDF would result in a hardened surface layer the GIC bond to this layer would be superior to the non–light-cured SDF.[7] No formal research has been conducted in this aspect and literature research has revealed limited evidence with light-cured SDF. Based on this, the purpose of this study was to compare and evaluate the bond strength and microleakage effect of light cured SDF pretreatment on bond strength and microleakage of type IX GIC

II. Materials And Methods

A comparative study was performed in the department of pediatric and preventive dentistry. Lenora institute of dental sciences, Rajahmundry. A sample of 40 extracted permanent premolars were included in this study which were divided into two major groups. In group 1 (n=20) SDF application was done and GIC was placed immediately. In group 2(n=20) SDF was applied light cured and GIC was applied after 24 hours. Each group was dived into two subgroups. Each sub group contains a sample size of 10. One subgroup for bond strength measurement and the other group was for microleakage test in each major group.

Clinical procedure: Bond strength measurement

20 permanent premolars which were included in the bond strength testing groups were decoronated below the CEJ level with diamond disc bur under water coolant. Later the apical root ends were embedded in acrylic resin blocks exposing coronal end of each root. Dentin conditioner was applied to all the specimen surface for 10 seconds using a cotton pellet and rinsed off with water spray. Then 10 permanent premolars were assigned to group la which will be restored with type IX GIC with SDF application. The other 10 permanent premolars were assigned to group 2a in which SDF application was done and light cured later restored with type IX GIC after 24 hours. Later the tooth was stored in water for 24 hours and mounted in a universal testing machine such that the adhesive interface of the specimen was fixed within 0.5mm of the shearing blade. The bond strength data were obtained in Newtons, and converted to megapascals.

Microleakage test

20 permanent premolars which were used for the microleakage test were stored in distilled water for at least 12 hours before use. A class V cavity of 3.0+1.0 mm in diameter approximately 1.5mm deep was prepared using high speed cylindrical diamond bur with water spray at mid buccal surface of each tooth. Then the tooth were randomly divided into 2 groups.

10 permanent premolars to group 1b in which SDF application was done and GIC was placed immediately. The other 10 permanent premolars were assigned to group 2b in which SDF application was done and light cured and GIC was placed after 24 hours. The specimens were immersed in methylene blue solution for 10minutes and cut longitudinally at each side of the cavity midline, using a disc bur generating three sections from each tooth. The sections were examined, with the help of a stereomicroscope, for dye penetration along the cavity walls.

III. Statistical Analysis

The data was collected, tabulated, and statistically analyzed using SPSS version 21 statistical analysis package software The shear bond strength values (MPa) were analyzed using one-way ANOVA and Tukey HSD. Statistical significance was considered at $p<0.05$. The enamel and dentin microleakage scores of each group of restorations were analyzed using the Chi-square test with statistical significance at $p<0.05$**.**

IV. Results

Bond Strength Test

The group 1 samples (SDF+GIC) had a mean shear bond strength and standard deviation (SD) of (116.69) MPa, while group 2 (SDF+LC+GIC after 24 hrs) had a mean shear bond strength of (127.70) MPa, respectively. The results of one-way ANOVA and Tukey HSD tests indicated that there was highly significant difference in shear bond strength between the groups. The group 1 had the lowest shear bond strength than the group 2 which was shown in table 1.

Table 1: Comparison of bond strength between two groups

	GROUPS	N	Mean	Std. Deviation	t value	P value
BOND STRENGTH	SDF+GIC	10	116.69	1.86	-8.861	0.000*
	SDF LC +GIC	10	127.70	3.46		

There is a statistically significant difference in bond strength between the two groups, with the SDF LC + GIC group (127.70±3.46) resulting in a higher average bond strength.

Microleakage Test

The microleakage results of all groups in enamel and dentin are presented in. At the enamel margins, the group 1 demonstrated a leakage pattern, with the majority having a 3 score (no leakage), group 2 having a score 1. The Chi-square test indicated significant differences between the groups (p>0.05). At the dentin margins, the group 1 tended to have a higher dye penetration showing a 2 score than the group 2 showing a score of 1, the difference was significant which was shown in table 2.

Score	Quality of tracer penetration at enamel margins	Quality of tracer penetration at dentin margins
0	No penetration	No penetration
1	Penetration into the enamel part of the cavity wall	Penetration into dentin/material interface but not including the pulpal floor of the cavity
2	Penetration into dentin/material interface but not including the pulpal floor of the cavity	Penetration including the pulpal floor of the cavity
3	Penetration including the pulpal floor of the cavity	–

Table 2: Comparison of micro leakage within Enamel and dentin between two groups

		Enamel			P value
		1.00	2.00	3.00	
SDF+GIC	Count	1	4	5	0.014*
	% within GROUPS	10.0%	40.0%	50.0%	
SDF LC +GIC	Count	6	4	0	
	% within GROUPS	60.0%	40.0%	0.0%	

Dentin			P value
0	1.00	2.00	
0	3	7	0.002*
0.0%	30.0%	70.0%	
4	6	0	
40.0%	60.0%	0.0%	

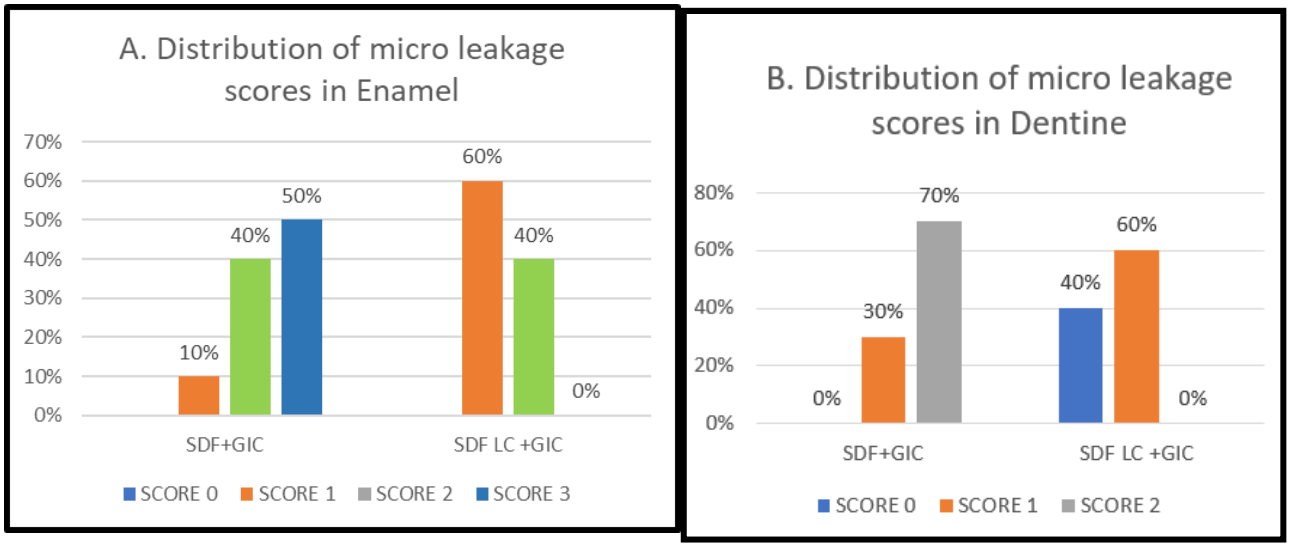

Fig 1: A. Number of surfaces with leakage at the enamel margins, (using the Chi-square test with statistical significance at $p<0.05$). **B.** Number of surfaces with leakage at the dentin margins (using the Chi-square test with statistical significance at $p<0.05$).

V. Discussion

The objectives of this study were to investigate if adding light curing to SDF and GIC would affect its bond strength and microleakage. The results demonstrated that the shear bond strength of the GIC containing SDF which was light cured was improved and that the microleakage was not adversely affected.

The current study found that light-curing SDF increases the bond strength of conventional GIC as compared to non–light-cured SDF. **Toopchi et al.** have reported that light-curing SDF will increase the hardness of SDF by reducing the silver ions to form an insoluble dense black silver sulfide.[8] It may be hypothesized that light curing may help the SDF to solidify completely thereby increasing the bond strength. Previous studies evaluated the effect of light-curing SDF on penetration depth and dentin hardness and have reported that the use of curing light acts as an initiating agent for SDF. They concluded that light-curing SDF resulted in more silver precipitation in the infected dentin, increased hardness, and reduced SDF penetration into sound dentin.[9]

Coming to the microleakage, in the present study, it was noticed that most dye leakage of specimens scored between score 1& 2 in the SDF light cured group. This could be attributed to the fact that the dentinal tubules could be occluded by proteins precipitate formed by silver ions. Moreover, the reaction of fluoride ions with calcium ions forms a precipitate of calcium fluoride (CaF2) plugging the dentinal tubules.

Results of this study came in accordance with **Gupta J, et al.** who reported that silver diamine fluoride (SDF) pretreated premolar teeth have a significant difference in microleakage between resin modified GIC and tooth structure when compared to other groups not treated by SDF.[10] **Soliman N, et al.** also concluded that there was significance difference between the dentin of primary teeth pretreated with SDF 38% group and the control group as regard to the microleakage and found that there was a influence on the marginal seal of resin modified GIC to dentin of primary teeth.[11]

Because our study was short-term in nature, a long-term clinical trial of GIC-containing SDF is necessary to assess its intraoral performance. Based on the differences in the crystal orientation between permanent and primary teeth, a study on primary teeth should be performed.

VI. Conclusion

Based on this study's results, the following conclusions can be made:

Incorporating SDF which was light cured into GIC resulted in a higher shear bond strength compared with GIC and SDF without light cured and did not adversely affect the microleakage at the enamel and dentin cavity margins; GIC-containing SDF which was light cured could be a potential restorative material; however, a long-term clinical trial of GIC-containing SDF light cured to assess its intra-oral performance should be performed.

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