RESEARCH ARTICLE

Comparison of Microleakage under Amalgam Restoration: An *In Vitro* Study

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Abstract

Aim of the study: To compare the microleakage in teeth restored using silver diamine fluoride (SDF) and dental varnish under amalgam restoration.

Materials and methods: Twenty premolar teeth were used in the study. Class I cavity was prepared and restored using silver amalgam. In group I, the dental varnish was used under restoration, and in group II, the SDF was used. All samples were tested for microleakage using methylene blue assay and evaluated under stereomicroscope.

Results: Group I samples showed minimal microleakage when compared with group II with a *p* value <0.002.

Conclusion: Silver diamine fluoride would not be an alternative to dental varnish.

Keywords: Dental varnish, Secondary caries, Silver diamine fluoride.

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Introduction

Secondary caries or recurrent caries is defined as a primary carious lesion detected at the margins of the existing restoration.[1] The management of such caries-affected restorations is by replacement or repair. Repair should be preferred over replacement as the strength of the tooth reduces as a result of the repeated replacement of restorations.[2,3] Also, it would be a financial burden to the patient and time-consuming for the dentist. Hence, prevention of recurrence of carious lesion becomes an important step.

Various materials are used to prevent the occurrence of secondary caries like 5% NaF varnish, 10% NaF solution. Forty-two and 25% silver nitrate, carbon dioxide laser, etc. One more material used in 38, 12, and 30% is silver diamine fluoride (SDF). It has been proven to be effective in preventing primary caries. Since the cause for secondary caries is similar to primary caries, SDF can be a preventive measure for the occurrence of secondary caries. Studies have shown that microleakage into gaps around the restoration is one of the causes for secondary caries. Other factors like acidic environment, cariogenic bacteria, quality, and quantity of saliva.[1]

Silver amalgam is the most commonly used restorative material for posterior teeth to date. Though recent advances in materials have evolved it is been popularly and regularly used at least in dental institutions. The material has certain properties like the lack of adhesion with tooth structure and difference in thermal coefficient of expansion with dental tissue.[4] This leads to microleakage. This leakage may lead to postoperative sensitivity and in the worst cases leads to secondary caries.[5] Copal varnish liners cannot maintain long-term sealing because of their solubility.

Silver diamine fluoride is an alternative material composing of silver and fluoride. It is hypothesized that fluoride ions act on the tooth surface and silver particles at an antimicrobial agent. The rationale for this short-term study was to investigate the early microleakage of amalgam restorations as long-term would lead to sealing effects primarily related to amalgam corrosion products.

Silver diamine fluoride can be used as a dental varnish. In patients with high caries index when the restoration is planned SDF can be used instead of traditional varnish. This would help in preventing the occurrence of secondary caries. But how well SDF seals the space between the tooth and restoration has not been investigated. Hence in this study, the microleakage was evaluated in class I cavity for amalgam with varnish and with SDF.

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Materials and Methods

A total of 20 human intact premolars were used in the study. Teeth with cracks, caries, and any malformations were not used. Class I cavity preparations of 4 mm mesiodistally, 2 mm buccolingually, and 2 mm depth were accomplished with carbide bur #245.

The teeth were randomly divided into 10 in each group.

In group I, the cavities were coated with two coats of dental varnish.

In group II, SDF was used to coat the walls and floor. Silver diamine fluoride was applied with the microbrushes and left for 3 minutes.

Then, all teeth were restored with high copper silver amalgam and burnished. Nail varnish was applied for all teeth except 1 mm from the restored Cavo surface margins. The teeth were submitted to thermocycling in deionized water at 55 ± 4°C up to 500 cycles

with baths of 15 seconds, and then stored in 0.5% aqueous solution of methylene blue for 24 hours at 37°C. The teeth were washed in tap water for 24 hours for removal of the excess dye at the surface. The teeth were sectioned in a mesiodistal direction, yielding approximately four 1.0 mm slices for each tooth. Evaluation of the marginal microleakage was performed using stereomicroscope (Wuzhou New Found Instrument Co. Ltd, China Model: XTL 3400E) under 10× magnification. The readings were analyzed using the Image Analysis System (Chroma Systems Pvt. Ltd., India Model: MVIG 2005).

Results

The results of the study are summarized in Table 1.

Score 1—Samples in which >50% of length leakage was noticed.

Score 2—Samples in which >75% of leakage was noticed.

Score 3—Samples in which leakage occurred to full length was noticed.

Results show that minimal microleakage was evident in group I with a score of 1 whereas the majority of samples in group II scored 2.

Discussion

The contemporary caries management philosophy has changed to a medical model from the traditional surgical approach. This includes the use of fluoride therapy.[6] Thus, providing such materials with antibacterial properties prevents the formation and development of caries. New biomaterials are crucial where oral health behavior is not well implemented. Hence in this study, one such material SDF was used as a varnish under the most common material amalgam and evaluated for microleakage. Silver diamine fluoride is a solution composing of diamine silver ion and fluoride ion. This diamine silver ion is produced by attaching two ammonia molecules to the silver ion. Although it is available commercially in 12 and 38%. Most SDF products used are at 38%.

Microleakage is one of the significant problems associated with amalgam restorations due to interfacial gap formation. Eventually, the corrosion products may seal these gaps. But the initial microleakage has to be prevented. This is possible with adequate cavity preparation, use of varnish, dentinal adhesion, and proper amalgam condensation and burnishing. Hence in this study, the traditional varnish was used as a control group. Silver diamine fluoride was used as a test group.

Microleakage can be tested by various methods. In our study, microleakage was assessed using the dye penetration method using methylene blue. The dynamic environment of the oral environment was simulated by exposing the restoration to thermal changes via thermocycling.

Results of the study showed that the SDF group had more microleakage than the varnish group. This could be because the SDF when applied onto the tooth surface forms precipitates in the form of calcium fluoride and silver phosphate. There is as such no matrix to hold these crystals which are precipitated. As a result of which microleakage could be enhanced in the SDF group. Also, studies have shown that calcium fluoride and silver phosphate dissolves or disappears after washing in water or when immersed in artificial saliva.[7,8] Hence, this study shows that SDF cannot be used for amalgam restoration and also shows that it cannot replace dental varnish.

Anyway, further studies need to be done to evaluate the effect of mixing diamine with varnish on microleakage.

Table 1: Microleakage values in both the groups

Microleakage	*Group I*	*Group II*	*Total*	*Fisher's exact test*
No microleakage	4 (100)	0 (0)	4 (100)	$\chi^2 = 13.667$, $p = 0.002$*, (Sig.)
1	5 (83.33)	1 (16.67)	6 (100)	
2	0 (0)	6 (100)	6 (100)	
3	1 (25)	3 (75)	4 (100)	
Total	10 (50)	10 (50)	20 (100)	

*p value significant at < 0.05. The values in parenthesis denote the percentage of microleakage score in each group

Conclusion

Although studies have shown a significant difference in microleakage in the groups, SDF is still the material of choice to help in the cessation of progression of caries.

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