

Silver Diamine Fluoride in Restorative Dentistry: An Effective Approach in Root Caries

Jazib Pervez, Suffiyan Saleem*, Bushra Ghani**, Farrukh Ahmed, Bismah Ishaq, Humara Iqbal

Department of Operative Dentistry, Bakhtawar Amin Dental College and Hospital, Multan Pakistan, *Department of Operative Dentistry, Shahida Islam Medical and Dental College, Lodhran, Pakistan, **Department of Operative Dentistry, Altamash Institute of Dental Medicine, Karachi Pakistan

ABSTRACT

Objective: To evaluate the effectiveness of Silver Diamine Fluoride (SDF) as a conservative treatment for root caries, offering an alternative to more invasive restorative procedures.

Study Design: Randomized Controlled Trial (ACTRN: 0000386513).

Place and Duration of Study: Bakhtawar Amin Dental College, Multan, Pakistan, from Mar-Aug 2023.

Methodology: The study enrolled 90 patients with caries lesions and assigned them to two groups: Group A received 38% SDF, and Group B received 5% NaF sodium fluoride varnish. Follow-up assessments were conducted at one month, evaluating caries arrest through clinical examinations.

Results: The SDF group demonstrated a higher efficacy in caries arrest (78.12%) compared to NaF varnish (35.29%). Visual inspection, lesion size measurement, and texture assessment were crucial in determining the success of SDF application. Statistical analysis revealed a significant difference between the groups, having *p*-value of .000459, supporting the superior efficacy of SDF.

Conclusion: Our study found that the 38% SDF is a better treatment option for root caries compared to NaF varnish, providing long-lasting effects.

Keywords: Minimally invasive dentistry, Silver diamine fluoride, Restorative dentistry.

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INTRODUCTION

Silver Diamine Fluoride (SDF) is a 38% solution and antimicrobial agent which promotes remineralization and inhibits cariogenic biofilm and demineralization of teeth,¹ making it a viable substitute for conventional caries management, providing a cost-effective, painless, and conservative approach to halt the progression of caries.² During initial stages of root caries, SDF treatment is sufficient to prevent progression of carious lesions but for advanced root caries lesions, restoration using appropriate restorative materials is recommended,³ as annual application of 38% SDF solution is effective in reducing the progression of root caries, particularly among elderly and high-caries risk patients.⁴ The use of 38% SDF offers an effective approach to treat early childhood caries when compared to traditional restorative treatments and it also demonstrates longevity, treatment outcome, and prognosis.⁵ However, the drawbacks include staining or discoloration, potential risk of pulp inflammation and the impairment of resin bond strength.⁶ Due to the high concentration of silver and fluoride ions and the alkaline pH, special care

should be exercised when treating root caries in proximity to the dentin-pulp complex.⁷ It is advisable to restore stained cavities using tooth-colored restorative materials, such as composites as the incorporation of SDF application with restoration is regarded as a viable approach for addressing advanced root caries,⁸ while other indications include the non-invasive treatment of caries in pediatric patients and individuals with special healthcare requirements.⁹ The use of SDF has also risen during the COVID-19 pandemic owing to its minimal invasiveness and non-aerosolizing technique, which could be routinely practiced in a pediatric dentistry.¹⁰ The rationale of this study is to investigate the effectiveness of SDF in arresting root caries following restorative dental procedures and provide insights into the efficacy of SDF as a conservative treatment option to treat root caries.

METHODOLOGY

This was a Randomized controlled study (ACTRN: 0000386513) conducted at Bakhtawar Amin Dental College and Hospital, Multan, Pakistan, from March to August 2023 after obtaining Ethics Review Board permission vide letter number 22-257. The sample size was calculated through WHO sample size calculator, using formula for hypothesis testing

Correspondence: Dr Jazib Pervez, Department of Operative Dentistry, Bakhtawar Amin Dental College and Hospital, Multan Pakistan
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between two population proportions, keeping 5% significance level, power of 90%, carries arrest potential in SDF as 82% and in NaF group as 45%.¹¹ A minimum sample size of n=64 patients with 32 in each group was found.

Inclusion Criteria: Patients of either gender, of any age, who committed to presenting to follow-up visits having teeth with cervical root caries were included.

Exclusion Criteria: Patients with known allergy to SDF, pregnant or lactating female patients, having tooth with sign and symptoms of irreversible pulpitis or clinical and radiographic evidence of apical periodontitis were excluded.

Data was collected after informed consent was gained from subjects. Participants in the research were assigned to two groups using a random computer-generated sequence. In Group A, Rivastar 38% SDF was applied and in Group B, Henry Schein 5% NaF varnish was applied. In our study, a treatment approach involving two visits was utilized. The teeth were isolated with cotton rolls and gently dried. SDF was applied to root caries lesion with a disposable micro-brush according to the manufacturer's instructions. During the initial visit, the dentin had undergone slight brown discoloration but on next visit, the root caries displayed darker color and increased hardness, thus facilitating cavity preparation and subsequent composite restoration. This protocol ensured that the visual and tactile criteria were adequate for assessing the caries status on the second visit. In Group B, 5% NaF varnish was applied by micro-brush for 2 minutes and dried. Patients were recalled after 1 month and evaluated for caries arrest. Data was collected at baseline and at follow-up appointments 1 month later. The outcome measures were evaluated by single well-trained dental consultant. Statistical Package for Social Sciences (SPSS) version 26.0 was used for data analysis and efficacy was determined for both of the groups while Chi-square test was used to analyze the data where a *p*-value of ≤ 0.05 was considered as statistically significant.

RESULTS

Out of 45 patients in Group A, 13 were lost to follow-up and in Group B, 11 were lost to follow-up at 1 month. The remaining sample size in Group A was n=32 and in Group B was n=34 and the sample comprised of 66 patients of which 33(50%) were females and 33(50%) were males. The mean age of the participants was 41.68 ± 16.91 years. Efficacy in terms

of caries arrest was reported in 25(78.12%) patients in Group A and 12(35.29%) in Group B as shown in Table.

Table: Comparison of Silver Diamine Fluoride and Sodium Fluoride (n=66)

Caries Arrest Occured	Study Groups		<i>p</i> -value (≤ 0.05)
	Group A (SDF) (n=32)	Group B (NaF) (n=34)	
Yes	25(78.12 %)	12(35.29%)	< 0.001
No	7(21.87%)	22(64.70%)	

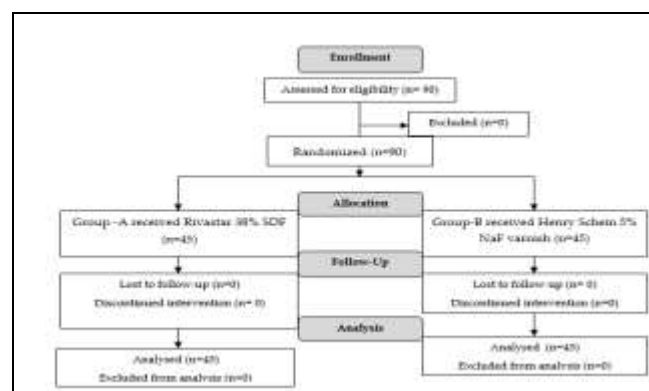


Figure: Patient Flow Diagram (n=90)

DISCUSSION

In our results, the findings indicated better efficacy of SDF solutions similar to another author who stated that the effectiveness in arresting caries was notably higher in the SDF group when compared to the NaF varnish group at 12-month intervals, with rates of 77% for SDF and 42% for NaF varnish.¹¹ However in another study, 12-month clinical trials revealed that a single application of 38% SDF did not demonstrate any superiority over NaF varnish in preventing caries in primary teeth,¹² similar to another author who reported,¹³ that caries arrest at 12 months using SDF was 66% higher compared to other materials, and significantly higher than when no treatment was administered. The outcome of SDF treatment are lesions that are harder and more resistant to decay,¹⁴ as noted in a study conducted in Pakistan, where parents exhibited a higher acceptance of SDF compared to alternative caries treatment options for children due to low cost, but concerns related to aesthetics and repeated costs were significant considerations for parents.¹⁵ In another study, tooth discoloration and parents' lack of awareness, along with their consent, were identified as significant obstacles to the widespread adoption of

SDF.¹⁶ Currently, insufficient evidence to firmly establish a tangible clinical benefit of SDF + KI treatment in relation to tooth staining,¹⁷ exists as one author reported that the application of SDF,¹⁸ may impede the penetration of the bonding agent into dentin, and cause reduction in the bond strength of resin restorations, however, this was not reported if the SDF was rinsed after application.¹⁹

LIMITATIONS OF STUDY

Limited follow-up duration, participant compliance, and generalizability of the findings to broader populations limit this study, along with disparity in its adoption in the dental practice due to risk of permanent black discoloration along with concerns regarding its acceptance by patients or parents.

CONCLUSION

This study shows that 38% SDF has better efficacy in arresting root caries compared to the NaF varnish group as the effects of SDF were long-lasting, making it a viable treatment for treating root caries.

Conflict of Interest: None.

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Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

JP & SS: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

BG & FA: Conception, data analysis, drafting the manuscript, approval of the final version to be published.

BI & HI: Data acquisition, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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