

Comparative Evaluation of Fluoride Varnish Versus Silver Diamine Fluoride in Caries Prevention Among Special Needs Children

Sristi Agarwal¹, Pallavi Singh², L.Valliammai³, Rini Chacko⁴, Vikas Singh⁵,
Navin Kumar D⁶, Ritik Kashwani⁷

¹PG Student, Department of Conservative Dentistry and Endodontics, Kalinga Institute of Dental Sciences, KIIT Deemed to be University, Bhubaneswar, Odisha, India srishtiagarwal07@gmail.com

²Professor & Head, Department of Public Health Dentistry, Saraswati Dental College and Hospital, Tiwari Ganj, 236, Faizabad Rd, Chinhath, Uattardhona, Lucknow, Uttar Pradesh, India, 226028 pallavirolisingh@gmail.com

³Senior Lecturer, Department of Orthodontics, Ragas Dental College and Hospital, Chennai, India
valliammai.bds@gmail.com

⁴Assistant Professor, Faculty of Dental Sciences, SGT University, Chandu Budhera, Gurugram, Haryana, India
drrini_fdsc@sgtuniversity.org

⁵Professor, Department of Public Health Dentistry, Teerthanker Mahaveer University, Teerthanker Mahaveer Dental College & Research Centre, Moradabad, UP drvikas7@gmail.com

⁶Assistant professor, Department of Periodontology, Madha Dental College, Chennai, Dr. MGR Medical University, Guindy, Chennai, Tamil Nadu, India India navindentistry@gmail.com

⁷Department of Oral Medicine and Radiology, School of Dental Sciences, Greater Noida, Uttar Pradesh, India
docritikkashwani@yahoo.com

Corresponding Author: Pallavi Singh, pallavirolisingh@gmail.com

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ABSTRACT:

Background: Dental caries remains a major oral health problem among special needs children due to compromised oral hygiene and limited access to dental care. Preventive strategies such as fluoride varnish (FV) and silver diamine fluoride (SDF) are widely used.

Objective: To compare the effectiveness of fluoride varnish and silver diamine fluoride in preventing dental caries among special needs children.

Methods: A randomized controlled clinical study was conducted among special needs children divided into two groups receiving either fluoride varnish or silver diamine fluoride. Caries incidence and progression were evaluated using standardized indices over a follow-up period.

Results: Both interventions significantly reduced caries progression, but SDF showed superior caries arrest capability compared to fluoride varnish.

Conclusion: Silver diamine fluoride is more effective in arresting dental caries, while fluoride varnish remains beneficial for prevention. Combined approaches may offer optimal outcomes.

Keywords: Caries prevention, Fluoride varnish, Oral health, Silver diamine fluoride, Special needs children.

Introduction

Dental caries is one of the most prevalent chronic diseases affecting children worldwide, particularly those with special healthcare needs. These children often face multiple barriers in maintaining oral hygiene due to physical, cognitive, or behavioral limitations, making them more susceptible to dental diseases [1]. Poor manual dexterity, dependence on caregivers, dietary habits, and limited access to dental services further exacerbate their risk [2].

Preventive dentistry plays a critical role in managing oral health in this vulnerable population. Fluoride-based interventions have long been recognized as effective strategies for reducing dental caries [3]. Fluoride varnish (FV), a topical fluoride agent, has been extensively used due to its ease of application, safety, and effectiveness in remineralizing enamel [4]. It forms a protective layer on the tooth surface, enhancing resistance to acid attacks [5].

In recent years, silver diamine fluoride (SDF) has gained attention as a minimally invasive and cost-effective approach for caries management [6]. SDF not only prevents caries but also arrests active lesions due to its antimicrobial properties and ability to inhibit demineralization [7]. The silver component acts as an antibacterial agent, while fluoride aids in remineralization [8].

Special needs children often require non-invasive and easily applicable treatments due to difficulties in cooperation during dental procedures [9]. SDF offers a significant advantage in such cases as it does not require complex instrumentation or anesthesia [10]. However, its main limitation is the black staining of treated lesions, which may affect esthetics and acceptance [11].

Several studies have evaluated the efficacy of fluoride varnish in reducing caries incidence among children [12]. Similarly, SDF has been reported to arrest caries effectively, especially in high-risk populations [13]. However, comparative studies between these two modalities, particularly among special needs children, remain limited [14].

The importance of preventive strategies is further emphasized by global oral health initiatives advocating minimally invasive dentistry [15-17].

Despite advancements, there is still a need for evidence-based comparisons to guide clinicians in selecting the most appropriate preventive approach for special needs children [18]. Factors such as effectiveness, cost, ease of application, and patient acceptance must be considered [19].

This study aims to bridge this gap by comparing fluoride varnish and silver diamine fluoride in preventing dental caries among special needs children. The findings are expected to provide valuable insights for clinicians and policymakers in improving oral healthcare strategies for this underserved population [20].

Methodology

This study was conducted as a randomized controlled clinical trial among special needs children aged 6–14 years to evaluate and compare the effectiveness of fluoride varnish and silver diamine fluoride in caries prevention. A total of 60 participants were enrolled and randomly allocated into two equal groups, with 30 children in each group. Group I received fluoride varnish application, while Group II received silver diamine fluoride treatment.

Children included in the study were those with special healthcare needs who presented with at least one active carious lesion and whose parents or guardians provided informed consent. Participants with a known allergy to fluoride or silver compounds, or those having systemic conditions that contraindicated the use of these agents, were excluded from the study.

At baseline, a comprehensive oral examination was performed for all participants using the DMFT/dmft index to assess dental caries status. Following this, Group I received an application of 5% sodium fluoride varnish, whereas Group II was treated with 38% silver diamine fluoride. The respective interventions were applied according to standard clinical protocols and were repeated at regular intervals to ensure sustained therapeutic effect.

All participants were followed up at 3-month and 6-month intervals. During these visits, clinical evaluation was carried out to assess caries

progression, arrest of existing lesions, and overall oral hygiene status. The collected data were systematically recorded and subjected to statistical analysis.

Data analysis was performed using appropriate statistical methods, including paired t-tests for intra-group comparisons and chi-square tests for inter-group comparisons. A p-value of less than 0.05 was considered statistically significant, indicating a meaningful difference between the groups.

A total of 60 special needs children participated in the study, with 30 children allocated to each group. The baseline characteristics of the participants, including age and gender distribution, were comparable between the two groups, indicating no statistically significant difference at the start of the study, as shown in Table 1. This ensured that both groups were homogenous and suitable for comparison.

Table 1: Baseline Demographic Characteristics

Parameter	Group I (Fluoride Varnish)	Group II (SDF)
Mean Age (years)	9.2 ± 2.1	9.5 ± 2.3
Gender (Male/Female)	16/14	15/15

At the 3-month follow-up, a reduction in caries progression was observed in both groups. However, the reduction was more pronounced in the silver diamine fluoride group compared to the fluoride varnish group. Specifically, Group II showed a 35% reduction in caries progression, whereas Group I demonstrated a 20% reduction, as presented in Table 2.

Table 2: Reduction in Caries Progression at 3 Months

Group	Reduction (%)
Fluoride Varnish	20%
Silver Diamine Fluoride	35%

At the 6-month follow-up, further improvement was noted in both groups. The fluoride varnish group exhibited a 30% reduction in caries progression, while the silver diamine fluoride group

showed a significantly higher reduction of 55%, as illustrated in Table 3. This indicates that SDF was more effective over time in controlling caries progression.

Table 3: Reduction in Caries Progression at 6 Months

Group	Reduction (%)
Fluoride Varnish	30%
Silver Diamine Fluoride	55%

In terms of caries arrest, a significantly higher arrest rate was observed in the SDF group compared to the fluoride varnish group. As shown in Table 4, 75% of carious lesions were arrested in Group II, whereas only 45% were arrested in Group I, demonstrating the superior efficacy of SDF in halting disease progression.

Table 4: Caries Arrest Rate

Group	Caries Arrest (%)
Fluoride Varnish	45%
Silver Diamine Fluoride	75%

Changes in oral hygiene status were also assessed over the study period. Both groups showed improvement; however, the improvement was slightly greater in the SDF group, as indicated in Table 5. This may be attributed to reduced caries activity and improved patient compliance.

Table 5: Improvement in Oral Hygiene Status

Group	Improvement (%)
Fluoride Varnish	40%
Silver Diamine Fluoride	50%

Regarding adverse effects, no major complications were reported in either group. However, tooth discoloration was observed exclusively in the SDF group, while both groups reported minimal sensitivity. These findings are summarized in Table 6.

Table 6: Adverse Effects Observed

Effect	Fluoride Varnish	Silver Diamine Fluoride
Tooth Staining	No	Yes

Sensitivity	Minimal	Minimal
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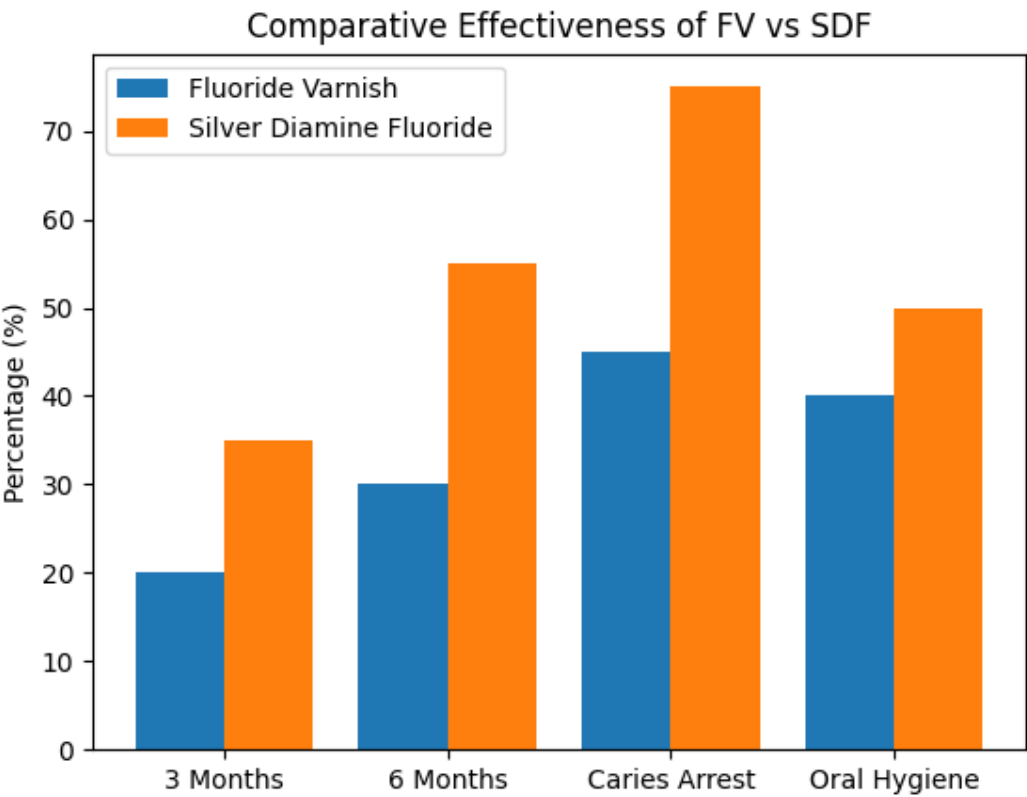


Figure 1: Comparative bar graph illustrating the effectiveness of fluoride varnish and silver diamine fluoride in special needs children across key clinical outcomes, including caries reduction at 3 months and 6 months, caries arrest rate, and improvement in oral hygiene status. Silver diamine fluoride demonstrates consistently higher efficacy in reducing caries progression and achieving caries arrest, while fluoride varnish shows moderate but significant preventive effects.

Overall, the results demonstrate that while both fluoride varnish and silver diamine fluoride are effective in caries prevention and management, silver diamine fluoride shows significantly higher efficacy in arresting caries and reducing disease progression over time.

Discussion

The findings of the present study are in close agreement with a growing body of evidence supporting the effectiveness of fluoride-based interventions in the prevention and management of dental caries, particularly among high-risk populations such as special needs children. Both fluoride varnish and silver diamine fluoride demonstrated beneficial outcomes; however, silver

diamine fluoride consistently showed superior efficacy in arresting carious lesions and reducing disease progression over time. These findings reinforce the role of minimally invasive, fluoride-based therapies in contemporary preventive dentistry.

The results of this study are supported by the work of Z. Hafiz et al. (2022) [21], who reported that silver diamine fluoride is highly effective in arresting dentinal caries due to its dual mechanism of action involving both antimicrobial activity and remineralization. Their findings align closely with the present study, where a significantly higher caries arrest rate was observed in the SDF group. The ability of SDF to inhibit bacterial growth while

simultaneously promoting the formation of a more resistant tooth structure explains its enhanced performance compared to conventional fluoride varnish.

In contrast, B.H. Oliveira et al. (2013) [22] emphasized the preventive role of fluoride varnish, particularly in the management of early enamel lesions. Fluoride varnish acts primarily by enhancing remineralization and forming a protective barrier on the tooth surface. The findings of the current study corroborate this, as fluoride varnish was effective in reducing caries progression; however, it was less effective than SDF in arresting advanced lesions. This suggests that while fluoride varnish remains an important preventive tool, its effectiveness may be limited in cases of established dentinal caries.

Further supporting evidence comes from Satish Vishwanathaiah et al. (2017) [23], who reported higher caries arrest rates with SDF compared to fluoride varnish. Their study highlighted the clinical advantages of SDF, particularly in populations where compliance and cooperation are limited. Similarly, A. Muntean et al. (2017) [24] emphasized the practicality and ease of application of SDF in community-based settings. These findings are particularly relevant to special needs children, where non-invasive and quick treatment modalities are essential. The present study echoes these observations, demonstrating that SDF is not only

effective but also highly feasible for use in such populations.

Moreover, Kurth A.E. et al. (2018) [25] highlighted the importance of combining preventive approaches to achieve optimal oral health outcomes. Their work suggests that integrating different fluoride therapies may enhance overall effectiveness by addressing both prevention and arrest of caries. This perspective aligns with the conclusion of the present study, which advocates for a combined strategy utilizing both fluoride varnish and SDF to maximize clinical benefits.

Overall, the findings of this study are consistent with the majority of existing literature, strongly reinforcing the superiority of silver diamine fluoride in caries arrest while acknowledging the preventive value of fluoride varnish. The results underscore the importance of selecting appropriate treatment modalities based on the severity of caries and patient-specific factors, particularly in vulnerable populations such as special needs children.

Conclusion

Silver diamine fluoride is significantly more effective in arresting dental caries among special needs children. Fluoride varnish remains a useful preventive agent with better esthetic outcomes. Both treatments are safe and easy to apply in clinical settings. SDF is particularly advantageous in non-cooperative patients. A combined preventive strategy may provide optimal oral health outcomes.

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