



ABSTRACT

This randomized controlled clinical trial (n = 44) compared liquid and gel formulations of silver diamine fluoride (SDF) for arresting dental caries. Patients received either liquid (n = 18) or gel (n = 26) SDF applied to visible lesions. The liquid formulation showed consistently higher effectiveness at 3, 6, and 12 months (87%, 50%, 50%) compared to the gel (46%, 40%, 25%). Increased active lesions in the gel group may be influenced by inconsistent follow-up, oral hygiene, and diet. Overall, while liquid SDF demonstrated greater efficacy, the gel formulation offers advantages in application and retention, supporting its clinical use.

INTRODUCTION AND BACKGROUND

Dental caries remains the most common chronic disease affecting children, particularly among those with high caries risk, special health care needs, or limited access to traditional restorative care. Silver diamine fluoride (SDF) has emerged as an effective, minimally invasive treatment for arresting dental caries without the need for local anesthesia or mechanical tooth preparation.

SDF arrests caries through a dual mechanism: the antimicrobial effects of silver ions and the promotion of remineralization via fluoride, which contributes to the formation of acid-resistant fluorapatite. The standard 38% SDF solution consists of approximately 25% silver, 5% fluoride, and ammonia, resulting in an alkaline pH that enhances its therapeutic effect. Despite its effectiveness, SDF use is often limited by aesthetic concerns, including metallic taste and black staining of treated lesions.

To address these concerns, newer SDF gel formulations have been introduced. The gel form is designed to improve application control, reduce unintended staining, and enhance retention on the lesion surface. However, limited clinical data exist comparing the effectiveness of gel versus liquid SDF formulations in arresting dental caries.

The purpose of this randomized controlled clinical trial was to compare the effectiveness of liquid and gel formulations of silver diamine fluoride (Advantage Arrest®) in arresting dental caries in pediatric patients, while also evaluating clinical feasibility and patient tolerance.

MATERIALS AND METHODS

An IRB-approved randomized controlled clinical trial was conducted in February 2024 involving pediatric patients with non-pulpal dental caries. Forty-four patients (99 tooth surfaces) were randomized to receive either liquid SDF (n = 18 patients; 38 surfaces) or gel SDF (n = 26 patients; 61 surfaces).

All lesions were treated with 38% silver diamine fluoride (Advantage Arrest®) following American Academy of Pediatric Dentistry guidelines. Teeth were isolated with cotton rolls, and SDF was applied to cavitated lesions using a micro-brush, with a maximum of five teeth treated per visit. Fluoride varnish was applied after treatment.

Follow-up evaluations were scheduled at approximately two weeks and three months, with additional 6- and 12-month data collected when available. Caries arrest was defined clinically and radiographically as hard, black-stained lesions without evidence of progression. Effectiveness was calculated as the proportion of arrested surfaces to total treated surfaces for each formulation.

RESULTS

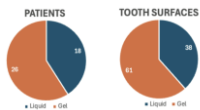


Figure 1: A total of 44 patients - 18 got liquid and 26 got gel



Figure 2: A total of 99 surfaces - 38 got liquid and 61 got gel

Figure 3: At 3-month follow up, with an arrested surfaces and active surfaces based on clinical and radiographic evaluation.



Figure 4: At 6-month follow up, with an arrested surfaces and active surfaces based on clinical and radiographic evaluation.

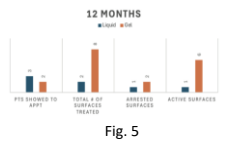


Figure 5: At 12-month follow up, with an arrested surfaces and active surfaces based on clinical and radiographic evaluation.

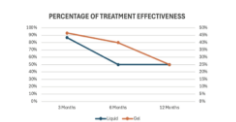


Figure 6: This graph compares the effectiveness of gel and liquid SDF. Effectiveness was measured by the ratio of arrested carious lesions to total treated surfaces. Liquid is more effective.

DISCUSSION

This study demonstrated that liquid SDF was consistently more effective than gel SDF in arresting dental caries at 3-, 6-, and 12-month follow-up intervals. Although the gel formulation offered improved handling characteristics and higher follow-up attendance, it showed lower overall caries arrest rates compared to the liquid formulation.

Follow-up compliance emerged as a significant limitation in this study. Scheduling follow-up visits exclusively on Mondays restricted attendance due to school obligations, illness, and caregiver work conflicts. More flexible scheduling and shorter evaluation intervals (e.g., 3-month rather than extended follow-ups) may improve patient retention and data completeness in future studies.

Inconsistent follow-up documentation and variability in assigned providers further contributed to challenges in outcome assessment. Improved chart review processes and continuity of care—such as assigning study participants to designated providers—may strengthen data reliability and clinical consistency.

Parental acceptance of SDF was also influenced by aesthetic concerns related to tooth staining. The adjunctive use of potassium iodide (KI) may reduce discoloration and improve acceptance, particularly for anterior teeth. Incorporating additional caregiver education on the benefits of caries arrest versus cosmetic outcomes may further enhance acceptance.

Future research should explore alternative therapies such as nano silver fluoride (NSF) and combined protocols, including SDF followed by KI, using split-mouth study designs. These approaches may help balance efficacy, aesthetics, and caregiver satisfaction while expanding minimally invasive options for caries management.

CONCLUSION

Participant numbers and treated surfaces are summarized in Figures 1 and 2 (found in Results section). Follow-up scheduling limited to Mondays reduced attendance due to school, illness, and work conflicts. SDF liquid demonstrated significantly higher lesion arrest rates at 3- and 6-month intervals. Gel group showed higher follow-up attendance but lower overall effectiveness. Effectiveness was measured as the ratio of arrested to treated surfaces. Inconsistent follow-ups, unchanged home care, and dietary habits contributed to continued lesion activity. Overall, SDF liquid was more effective and consistent across all evaluated intervals.

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