Dental Research Journal

Review Article

# Effectiveness of silver diamine fluoride in preventing and arresting dental caries in pediatric dentistry

**Bahareh Abbaspanah[1], Ashkan Mozdgir[2]**

[1]Department of Biology, Faculty of Science, Kharazmi University, [2]Department of Industrial Engineering, Faculty of Engineering, Kharazmi University, Tehran, Iran

**Received:** 12-May-2025
**Revised:** 15-Sep-2025
**Accepted:** 08-Nov-2025
**Published:** 28-Jan-2026

**Address for correspondence:**
Dr. Bahareh Abbaspanah, Department of Biology, Kharazmi University, Tehran, Iran.
E-mail: b.abbaspanah@gmail.com
Dr. Ashkan Mozdgir, Department of Industrial Engineering, Faculty of Engineering, Kharazmi University, Tehran, Iran.
E-mail: a.mozdgir@khu.ac.ir

## ABSTRACT

**Background:** Dental caries is one of the most prevalent chronic diseases among children worldwide. Conventional caries management methods such as fluoride sealants and varnishes are widely used; however, newer noninvasive therapies like silver diamine fluoride (SDF) have gained attention. SDF has been proposed as a topical treatment for pediatric carious lesions, with advantages including arresting caries progression, reducing pain, and promoting remineralization with minimal intervention.
**Materials and Methods:** This review summarizes available evidence on the effectiveness of SDF as a caries prevention and arrest agent in primary teeth. It is based on a comprehensive analysis of current clinical studies and trials, focusing on biochemical mechanisms of action (including antimicrobial effects and increased dentin hardness), alongside practical considerations such as safety, application ease, and cost-effectiveness.
**Results:** Across reviewed clinical studies and trials, SDF demonstrates effectiveness in preventing and arresting caries in primary teeth. Evidence supports underlying mechanisms including antimicrobial activity and enhancement of dentin hardness. The review also highlights practical strengths (safety profile, ease of application, and cost-effectiveness) and limitations, particularly esthetic concerns and staining. It also notes potential usefulness in pediatric populations with limited access to dental care or special healthcare needs.
**Conclusion:** SDF can be applied safely, effectively, and cost-effectively as a caries-preventive and caries-arresting approach for young primary teeth.

**Key Words:** Caries arrest, caries prevention, dental caries, pediatric dentistry, silver diamine fluoride

## INTRODUCTION

Dental caries remains one of the most common chronic diseases of childhood, impacting both children's oral health and overall health. Early childhood caries is a destructive model of tooth decay in young children, which can lead to pain and infection, in addition to eating and speech difficulties. Caries are widely spreading in children, and conventional surgical methods are associated with drawbacks, so interest has been raised in noninvasive concepts. Silver diamine fluoride (SDF) is one such alternative option that has recently gained tremendous popularity as a topical agent showing great promise in the prevention and arrest of caries, notably in primary teeth.[1]

Access this article online

**Website:** www.drj.ir
www.drjjournal.net
www.ncbi.nlm.nih.gov/pmc/journals/1480
**DOI:** 10.4103/drj.drj_246_25



**How to cite this article:** Abbaspanah B, Mozdgir A. Effectiveness of silver diamine fluoride in preventing and arresting dental caries in pediatric dentistry. Dent Res J 2026;23:2.

SDF is a simple, cost-effective agent composed of silver and fluoride ions, which act in concert to arrest active carious lesions and prevent further destruction.[2,3] Silver ions can impart an antibacterial mechanism against cariogenic bacteria, and fluoride assists in the remineralization of demineralized tooth structures, which ultimately prevents caries progression.[4] As a result, SDF has gained popularity in pediatric dentistry, especially in children with caries at an early stage and dental anxiety or who have limited access to restorative care through traditional means.[5]

The top three benefits of SDF are that it is easy to use, noninvasive, and can halt or inhibit the progression of caries without the use of dental drills or anesthesia. Clinical studies have shown that SDF is very effective in arresting caries, especially in primary teeth, and is associated with a reduced need for restorative therapy.[6,7] Furthermore, its affordability and the ability to apply it in a single session make it an attractive choice in resource-limited settings, where access to more conventional treatments may be restricted.[8] However, despite these benefits, esthetic concerns related to the staining of treated teeth remain a notable limitation and may affect its acceptance among patients and caregivers.[9,10] Figure 1 shows some characteristics of SDF in dental caries treatment.

This review aims to provide a current, comprehensive evaluation of the efficacy of SDF for the prevention and arrest of dental caries in children. It reviews the most recent research on SDF's antibacterial capabilities, safety, and efficacy in the child population and how it can increase access to dental care in underprivileged areas. The review also explores the drawbacks and restrictions of SDF, especially esthetic issues and its long-term effects on tooth structure and function.

## APPLICATION

The SDF is easy to apply and nonintrusive. A patient is treated after her teeth are cleaned and dried. The process goes as follows: a tiny brush is used to apply a single drop of SDF to every affected tooth. After 1 min, the subject reacts with the tooth surface, and the tooth changes color from colorless to dark brown or black, indicating the arrest of carious lesions.[11] SDF is an effective method in pedodontics as it not only arrests the progression of existing carious lesions but also acts as a preventive measure against new carious lesions.

## MATERIALS AND METHODS

The mechanism of action of the SDF is multifunctional and plays a crucial role in its efficacy in the treatment of carious lesions. The two active ingredients of SDF, silver ions and fluoride, have synergistic properties and impart several positive effects on dental tissues, as well as on oral microbial communities.[12]

### Antibacterial properties

SDF's silver ion has bactericidal properties and can either kill or inhibit bacterial metabolism. Its antibacterial activity not only inhibits carcinogenic biofilms but also remarkably decreases the microbial burden of tooth caries[13]. The interaction of SDF with oral microbial communities also indicates its potential role as a microbiome modulator; it enhances its cariostatic effects through changes in the population of bacteria in the oral cavity.[14] It is shown that silver presents very effective antimicrobial action against a wide range of oral bacteria involved in the dental caries process, including *Streptococcus mutans*, *Streptococcus sobrinus*, *Lactobacillus*, and *Actinomyces naeslundii*. Mechanistically, the reduced microbial adherence upon exposure to SDF can be attributed to the formation of

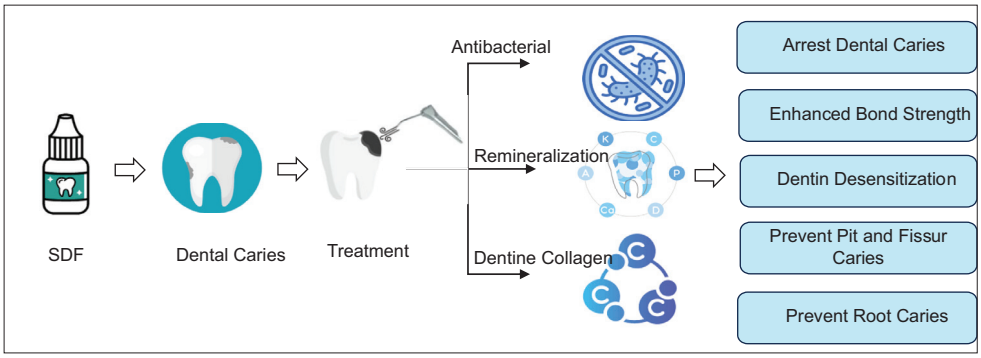


**Figure 1:** The effects of silver diamine fluoride in preventing dental caries. SDF: Silver diamine fluoride.

a silver hydroxyapatite layer as a result of silver ion–hydroxyapatite interaction, which has low conductivity for microbial cell adherence.[15] Silver ions may also interfere with the glucosyltransferase enzyme pathway inhibiting glucan production from sucrose. These glucans are important for the adherence of microbe to tooth surfaces.[16,17] Furthermore, elemental silver is a known inhibitor of *Candida* extracellular phospholipase production, which is a pathogenicity factor of this yeast.[18] Numerous studies have shown that yeast phospholipases are important in some major processes in yeast, such as surface adhesion, yeast-to-hyphal phase transition, and tissue penetration. All these processes are critical prerequisites for successful colonization of the host.[19,20] Consequently, the phospholipase-mediated suppression of adhesion could be a contributing factor to the limited yeast colonization observed. Furthermore, silver ions have been shown to interact with bacterial cell membranes, increasing permeability and causing cell lysis. Also, silver ions have been shown to interact with bacterial DNA, inhibiting replication and transcription and ultimately leading to bacterial cell death. In addition, the silver ions are reactivated when they come into contact with alive bacteria after killing them, which kills the remaining live bacteria. This phenomenon is referred to as the "zombie effect," and it has been observed in the study of SDF. The SDF method establishes a sustained reservoir of silver ions, which maintain their activity over time to impede bacterial recolonization, thereby rendering bacteria resistant to silver challenging to achieve.[21]

While silver has demonstrated strong antibacterial activity, fluoride at high concentrations also inhibits the growth of cariogenic bacteria in dental plaque. This effect can be attributed to the ability of fluoride to either directly inhibit the relevant cellular enzymes or to enhance the proton permeability of cell membranes.[22,23] Fluoride is known to interact with the structural components of a bacterial cell at elevated levels, preventing biofilm formation and making it a natural antimicrobial agent. The underlying mechanism of action entails the direct inhibition of cellular enzymes and the augmentation of cell membrane permeability through the generation of hydrogen fluoride, culminating in the suppression of plaque metabolism.[24] Fluoride can inhibit several nonmetalloenzymes (e.g. phosphatases) responsible for acid production in dental plaque. However, the duration of this inhibitory effect is limited, and its impact on reducing caries is often negligible.[25]

## Remineralization effects

SDF functions through a complex mechanism that effectively inhibits dental caries and promotes the restoration of tooth structures. Its action extends beyond antimicrobial effects, as it also facilitates the regeneration of dental tissues, particularly the hydroxyapatite in enamel and dentin, which are crucial components of tooth structure.[26] Numerous clinical studies have demonstrated SDF's superior efficacy in arresting and remineralizing carious lesions compared to alternative treatments, including fluoride varnishes. These studies provide substantial evidence for SDF's capacity to arrest caries and promote remineralization of tooth tissues.[27-29]

This interaction between SDF and hydroxyapatite forms silver phosphate and calcium fluoride. The subsequent dissolution of fluoride and calcium causes the conversion of hydroxyapatite to fluorapatite, a more stable and acid-resistant mineral. This strengthens not only the structure of the tooth but also protects against future decay, proving SDF's dual role of antibacterial activity combined with mineral enhancement.[30] While calcium fluoride serves as a source of fluoride for remineralization, its function is disputed because of its solubility and possible loss upon exposure to water or saliva.[31] Insoluble fluorapatite, a potential reaction product of fluoride ions with hydroxyapatite, is made easier by the following dissolution of fluoride and calcium. Confirming fluorapatite formation is challenging, mainly because its crystal structure is closely similar to that of hydroxyapatite. Calcium fluoride is less acid-resistant than fluorapatite. SDF application enhances the microhardness of demineralized dentine and enamel by boosting mineral content.[32] Studies indicated that SDF-treated lesions exhibit increased surface hardness, hypermineralization, and improved resistance to decay in approximately 200 μ of the treated area. Nonetheless, SDF consistently demonstrates superior penetration, fluoride retention, and remineralization compared to alternative fluoride treatments.[27,33]

## Effect of silver diamine fluoride on dentine collagen

Dentine collagen plays a crucial role in its structure, enhancing its stability and serving as a scaffold for mineral deposition. The way SDF interacts with

dentin collagen is a key factor in its ability to halt tooth decay and promote dentin remineralization.[34]

The silver component of SDF interacts with dentine collagen, facilitating crosslinking within the collagen matrix. This process enhances the dentine structure's strength, reducing its susceptibility to degradation by proteolytic enzymes such as matrix metalloproteinases (MMPs) and cathepsins, which are typically activated during tooth decay. Indeed, SDF's alkaline nature contributes to neutralizing the acidity and therefore deactivates these enzymes.[25] The silver in SDF solution strongly inhibits cathepsin B and cathepsin K while moderately inhibiting MMP-8 and MMP-9. In contrast, fluoride strongly inhibits MMP-2, MMP-8, and MMP-9. By neutralizing these proteolytic enzymes, SDF preserves the structural integrity of collagen and slows down the dental caries progression.[35]

SDF enhances the mineral density within the collagen framework, particularly near the surface of the dentine, which improves the hardness and acid resistance of the carious lesion. This highly mineralized surface becomes more resistant to subsequent bacterial invasion. The collagen matrix serves as a framework for mineral deposition and promoting remineralization. In contrast to loosely bound calcium fluoride, fluorapatite formed within the collagen structure is more stable and acid-resistant, providing long-lasting protection.[34]

## EFFECTIVENESS OF SILVER DIAMINE FLUORIDE IN PEDIATRIC DENTISTRY

The ability of SDF to arrest dental caries in children has been investigated through research and clinical studies. Several studies show that a 38% SDF may be more effective in stopping cancer progression. SDF is mainly used for patients with high caries susceptibility, which often includes patients from developing countries or deprived regions. On the other hand, untreated SDF repeated applications could effectively reduce the development of new carious lesions caused by risk factors such as poor oral hygiene, high sugar intake, or low socioeconomic conditions in children with a higher risk of caries.[36,37]

Research indicates that SDF is especially beneficial in the initial phases of caries development, including white spot lesions, as it facilitates remineralization and stops the progression of the disease. Moreover, SDF has been shown effective in arresting cavitated lesions in primary teeth. Although SDF does not rebuild tooth structure, it prevents further decay, thereby reducing the risk of pain and potential infection. Previous reviews have emphasized the efficacy of silver compounds in controlling dental caries through prevention and arresting lesions in primary and permanent dentition.[38-40]

SDF, as an alternative treatment modality, offers a noninvasive, cost-effective, and easy way to treat dental caries. A community-friendly solution through gamification would pose a less scary, anxiety-provoking proposition, especially for the younger audience.[41] Studies show that the caries-arresting properties of SDF may last up to 1 year or more after a single application. However, for maintenance of efficacy, where children are at an increased risk of caries, multiple applications may be required.[42]

## SILVER DIAMINE FLUORIDE IN PEDIATRIC DENTAL CLINICAL APPLICATION

Tooth decay in early childhood often advances quickly in primary teeth, making treatment efforts difficult. SDF has been effective at arresting caries progression, and published research data demonstrate high arrest rates, particularly with a 38% solution. Biannual applications give better results than annual applications, and results on mandibular anterior teeth are also usually better than maxillary posterior teeth.[43] Compared to sodium fluoride (NaF) varnish, SDF is more effective in dentin caries arrest; however, the outcome can depend on factors including size of the lesion, time of exposure, diet, and oral hygiene habits.[44,45] Some studies suggest that teeth with higher plaque accumulation as well as children fed with milk or snacks frequently have a lower rate of caries arrest. Moreover, it has been found that the benefits of SDF exceed some restorative materials like glass ionomer in preventing the advancement of dentin caries. SDF provides an effective means to arrest the progression of dental caries in children with multiple carious lesions without resorting to invasive treatments at an early stage. This approach reduces the likelihood of necessitating more comprehensive and complex dental procedures in future.[46] Tooth pits and fissures are more prone to caries development than smooth surfaces due to their morphology

**Table 1: An overview of some clinical research on the application of silver diamine fluoride in the treatment of dental caries**

| Study | Population | SDF concentration | Application protocol | Follow-up period | Key findings | Conclusion |
|---|---|---|---|---|---|---|
| Gao *et al.*, 2016[47] | Children with high caries risk | 38% | Annual application | 12–24 months | In primary teeth, SDF demonstrated caries arrest rates of up to 81%; it proved effective for children at high risk | SDF is an effective treatment for arresting dental caries in pediatric population with high caries risk |
| Fung *et al.*, 2016[48] | Children with dentine caries | 12% versus 38% | Annual versus biannual application | 24 months | Biannual application of 38% SDF demonstrated greater effectiveness in arresting caries compared to 12% SDF, yielding the most favorable results | Higher concentrations and biannual application provide better results in caries arrest |
| Duangthip *et al.*, 2018[49] | Children with active dental caries | 38% | 3 applications at yearly intervals versus sodium fluoride varnish | 12 months | Yearly SDF application proved considerably more efficacious than FV administered every 2 weeks | Annual SDF applications were superior for caries arrest when compared to sodium fluoride varnish |
| Mabangkhru *et al.*, 2020[50] | Children aged 1–3 years | 38% | Semi-annual application | 12 months | SDF achieved a 37.5% caries arrest rate, with its efficacy influenced by children's consumption of milk and snacking patterns | SDF is more effective than sodium FV in young children, though diet and application duration affect outcomes |
| Nishino and Massler, 2017[51] | Children with fissure caries | 8% (stannous fluoride) versus 38% SDF | Single application | 12 months | In the treatment of fissure caries, SDF demonstrated superior efficacy compared to stannous fluoride and silver nitrate | SDF is more effective than other fluoride treatments for fissure caries |
| Gao *et al.*, 2020[52] | Children aged 2–6 years | 38% | Semi-annual application | 24 months | The effectiveness of SDF in halting tooth decay was demonstrated to be significant, with consistent outcomes observed over a 2-year period | SDF is effective in arresting dental caries over the long term with regular applications |
| Zheng *et al.*, 2023[53] | Children with ECC | 38% | Semi-annual application | 6–12 months | The application of SDF resulted in a decrease of up to 60% in the occurrence of new cavities | SDF is a viable treatment for caries prevention and arrest in children with ECC |
| Abdellatif *et al.*, 2021[54] | Children aged ≤4 years | 38% SDF with 5% NaF varnish or 38% SDF alone | Annual application | 9 months | The combination of SDF and NaF demonstrated a higher rate of caries arrest compared to SDF used alone, with a notable difference observed in moderate lesions but not in advanced cases. These results have potential implications for noninvasive approaches to managing ECC | NaF increases the effect of SDF in dental caries |
| Zheng *et al.*, 2023[53] | 3–4-year-old children | 38% | Annual application | 12 months | At the 1-year follow-up, SDF did not demonstrate superiority over FV in preventing caries on primary maxillary anterior teeth. Both SDF and FV treatments resulted in equally high levels of child cooperation and parental satisfaction after 1 year. No adverse effects were observed in either the short or long term | Child's cooperation and parent's satisfaction were similarly high in SDF and FV therapy. Neither short-term nor long-term adverse effects were observed |

SDF: Silver diamine fluoride; ECC: Early childhood caries; FV: Fluoride varnish; NaF: Sodium fluoride

and restricted accessibility for cleaning. Due to its antibacterial and remineralizing properties, SDF has been found effective in denoting caries in pits and fissures. It can also be used as an alternative to sealants, especially for children who cannot undergo proper sealant application procedures. Nonetheless, the dark staining caused by SDF in these regions may sometimes be confused as an initial lesion, which may result in a diagnostic challenge.[27] Table 1 summarizes some recent clinical trials on the use of SDF in the management of dental caries.

SDF is further employed in the management of dental hypersensitivity as well as symptomatic teeth with molar incisor hypomineralization. Several studies have documented that silver ions occlude dentinal tubules by protein precipitation.[55] Moreover, calcium fluoride and silver iodide formation through SDF promote dentinal tubule sealing and dentinal tubule patency reduction. While SDF has been approved for treating dentine hypersensitivity, there is insufficient robust evidence from randomized trials or systematic reviews to confirm its effectiveness in this application. In pediatric dentistry, managing extensive caries presents a significant challenge. This condition, frequently observed in children with poor oral hygiene or those affected by severe systemic illnesses, involves decay in multiple teeth that are typically caries-resistant.[56] Although fluoride-based products such as NaF effectively prevent caries, they fail to arrest caries progression in dentine.[57] SDF is a new alternative to aid in the management of extensive carious lesions, as it terminates the spread of carious lesions without needing invasive surgery to treat the affected tooth, thereby preventing the spread of infection. This makes it especially beneficial for young children and patients with systemic diseases who could greatly benefit from its known efficacy and tolerability in these groups.[58]

SDF acts as both an independent therapeutic modality and also as an adjunct treatment alongside restorative procedures, where it can be applied prerestoration placement. The integration of SDF with atraumatic restorative treatment (ART) is occasionally designated as silver-modified ART (SMART) restoration or SMART Hall when utilized in conjunction with the Hall technique. This approach can be implemented either immediately preceding restoration placement or after SDF application, allowing time for carious lesions to arrest, sensitivity to diminish, or for the patient to acclimate to the dental environment.[59] The application of SDF before the placement of restorations can reduce the risk of sealed carious lesions evolving into irreversible pulpitis or even a dental infection. However, there is currently a lack of randomized controlled trials comparing the effectiveness of SMART to other restorative approaches.

## ADVANTAGES OF SILVER DIAMINE FLUORIDE

The main benefit of SDF is that it is noninvasive and, therefore, there is no need for traditional surgical procedures such as tooth extraction and restoration. This feature is particularly useful for children with behavioral problems or patients with special healthcare needs because it reduces the use of complex pharmacologic behavior management techniques, such as sedation or general anesthesia, which carry increased health risks.[41]

## EFFICIENCY AND ACCESSIBILITY

The application of SDF is quick, taking only 60 s on average, and requires less specialized training than conventional restorative procedures. Registered nurses, in some jurisdictions, can administer SDF with the direction of licensed dentists, leading to greater healthcare access for the underserved population.[56,60] This simplified model facilitates the application of SDF in public health, which advances the goals of chronic disease management and dental health equity.[61,62]

## ECONOMIC CONSIDERATIONS

SDF application can be much more economical than the costs associated with dental surgery. SDF can reduce the need for expensive restorative treatment by arresting caries progression, improving the overall cost-effectiveness of dental care.[63] This makes SDF an appealing choice for both dental professionals and patients, as it can result in substantial long-term cost savings and improved health outcomes.

## MINIMALLY INVASIVE

The SDF technique eliminates the need for drilling and anesthesia while requiring minimal cooperation

from patients. This makes it an ideal choice for treating very young children, individuals with disabilities, and those who experience dental fear or anxiety.[64]

## SAFETY AND SIDE EFFECTS

Various safety concerns and adverse events related to SDF use have been reported. Some studies demonstrated that the most common adverse event was the darkening of carious portions, which was mainly well-audience accepted by adults and children,[63,65] and it was found that only ~7% of patients were concerned about the staining. Adverse events reported to the Food and Drug Administration (FDA) are classified as either suspected adverse reactions (meaning that the drug would have a reasonable chance of causing the event) or serious adverse events (resulting in death, hospitalization, or life-threatening conditions).[65] Many studies identified some relatively mild adverse events such as xerostomia, gingival pain, inflammation, and transient gastrointestinal disturbances, but severe ones have not been consistently observed.[64] In particular, short-lived reactions such as metallic taste, temporary discoloration of the skin, and irritation of the oral mucosa were reported, all of which usually disappeared within days.[62] According to FDA reports, these side effects are typically not a concern, as the benefits of stopping tooth decay with SDF usually outweigh cosmetic considerations. Healthcare providers are advised to inform patients about potential staining before treatment, preferably using pre- and posttreatment images of treated teeth to set appropriate expectations.[63] In addition, the FDA has approved off-label use of SDF for the arrest of caries, enhancing its safety profile when applied according to protocol.[63] To reduce risk, SDF should not be put on exposed pulp, and patients with deep cavities should be carefully followed up.[62] The serum fluoride concentration achieved after SDF application is below the oral reference dose set by the US Environmental Protection Agency indicating a low risk of toxicity.[63] However, since SDF does not reconstruct tooth structure, it may not be appropriate for children with significant decay or cases needing an esthetic response. In these cases, regular restorations may still be required. While many studies have shown positive short-term outcomes with SDF, additional long-term studies are necessary to fully explore its potential and duration of action to prevent and arrest caries over months/years.[6,9]

## FACTORS INFLUENCING USE

The choice of SDF application methodology (light-curing vs. conventional) is determined by individual preference and clinical context. Research indicates that most practitioners prefer the light-curing technique, with advantages such as a shorter treatment time and results available immediately. Still, several dentists have questioned this approach and simply lack consensus and limit scientific results validating this approach.[66]

## CONCLUSION

In pediatric dentistry, SDF is one of the highly effective, noninvasive, economical, and safe approaches for caries prevention. Its use is particularly beneficial for young children, high-risk population, and individuals with limited access to dental care. Despite worries about esthetic discoloration, SDF remains an essential tool in the armamentarium of pediatric dentistry for caries prevention and management of caries in primary teeth. Therefore, in light of its promising results, further studies and refinements of its application techniques may broaden its use and consequently its acceptance.

### Financial support and sponsorship
Nil.

### Conflicts of interest
The authors of this manuscript declare that they have no conflicts of interest, real or perceived, financial or nonfinancial in this article.

## REFERENCES

1. Zheng FM, Yan IG, Sun IG, Duangthip D, Lo EC, Chu CH. Early childhood caries and dental public health programmes in Hong Kong. Int Dent J 2024;74:35-41.
2. Ahlawat A, Dhama P, Gunti R, Tanvi T, Mishra S, Saini S. Silver diamine fluoride in pediatric dentistry: a systematic review of its efficacy in arresting caries in primary teeth. *J Med Dent Sci Res*. 2025;12 (5):1–8. doi: 10.35629/076X-12050108.
3. Alqalaleef SS, Alnakhli RA, Ezzat Y, AlQadi HI, Aljilani AD, Natto ZS. The role of silver diamine fluoride as dental caries preventive and arresting agent: A systematic review and meta-analysis. Front Oral Health 2024;5:1492762.
4. Yang Q, Li F, Ye Y, Zhang X. Antimicrobial, remineralization, and infiltration: Advanced strategies for interrupting dental caries. Med Rev (2021) 2025;5:87-116.
5. Annamalaisamy S. Management of early childhood caries with silver diamine fluoride: A review article. Saudi J Oral Dent Res 2024;9:303-8.

6. Zheng FM, Yan IG, Duangthip D, Gao SS, Lo EC, Chu CH. Silver diamine fluoride therapy for dental care. Jpn Dent Sci Rev 2022;58:249-57.
7. Choi SE, White J, Mertz E, Normand SL. Analysis of race and ethnicity, socioeconomic factors, and tooth decay among US children. JAMA Netw Open 2023;6:e2318425.
8. Duangthip D, He S, Gao SS, Chu CH, Lo EC. Effectiveness of silver diamine fluoride for preventing occlusal caries in the primary teeth of preschool children: Protocol for a randomized controlled trial. JMIR Res Protoc 2022;11:e35145.
9. Soares GH, Poirier B, Cachagee M, Turton B, Werneck R, Jamieson L. Perspectives of patients, dental professionals, and stakeholders on the use of silver diamine fluoride for the management of dental caries: A qualitative systematic review. J Dent 2024;147:105145.
10. Marshman Z, Day PF, O'Callaghan C. Aesthetic concerns with silver diamine fluoride: A review of patient and parent perceptions. Br Dent J 2021;230:343-8.
11. Zhao IS, Gao SS, Hiraishi N, Burrow MF, Duangthip D, Mei ML, *et al*. Mechanisms of silver diamine fluoride on arresting caries: A literature review. Int Dent J 2018;68:67-76.
12. Chibinski AC. Fluoride in Pediatric Dentistry. Dental Caries. 2021 May 5:97.
13. Manuschai J, Sotozono M, Takenaka S, Kornsombut N, Takahashi R, Saito R, *et al. In vitro* inhibitory effect of silver diamine fluoride combined with potassium iodide against mixed-species biofilm formation on human root dentin. Antibiotics (Basel) 2024;13:743.
14. Klanliang K, Asahi Y, Maezono H, Sotozono M, Kuriki N, Machi H, *et al*. An extensive description of the microbiological effects of silver diamine fluoride on dental biofilms using an oral *in situ* model. Sci Rep 2022;12:7435.
15. Chen W, Liu Y, Courtney HS, Bettenga M, Agrawal CM, Bumgardner JD, *et al. In vitro* anti-bacterial and biological properties of magnetron co-sputtered silver-containing hydroxyapatite coating. Biomaterials 2006;27:5512-7.
16. Tamesada M, Kawabata S, Fujiwara T, Hamada S. Synergistic effects of streptococcal glucosyltransferases on adhesive biofilm formation. J Dent Res 2004;83:874-9.
17. Wu MY, Suryanarayanan K, Van Ooij WJ, Oerther DB. Using microbial genomics to evaluate the effectiveness of silver to prevent biofilm formation. Water science and technology. 2007 Apr 1;55 (8-9):413-9.
18. Samaranayake L. OralCandidain health and disease: deciphering the pathogenicity of an opportunist commensal. Oral Surgery, Oral Medicine, Oral Pathology and Oral Radiology. 2024 Apr; 137 (4):402-7.
19. Alshahni RZ, Alshahni MM, Hiraishi N, Makimura K, Tagami J. Effect of silver diamine fluoride on reducing *Candida albicans* adhesion on dentine. Mycopathologia 2020;185:691-8.
20. Modrzewska B, Kurnatowski P. Adherence of *Candida* sp. to host tissues and cells as one of its pathogenicity features. Ann Parasitol 2015;61:3-9.
21. More PR, Pandit S, Filippis A, Franci G, Mijakovic I, Galdiero M. Silver nanoparticles: Bactericidal and mechanistic approach against drug resistant pathogens. Microorganisms 2023;11:369.
22. Marquis RE, Clock SA, Mota-Meira M. Fluoride and organic weak acids as modulators of microbial physiology. FEMS Microbiol Rev 2003;26:493-510.
23. Kaewkamchai S, Thanyasrisung P, Sukarawan W, Samaranayake L, Tuygunov N, Songsiripradubboon S. Efficacy of silver diamine fluoride (SDF) in arresting dentin caries against inter-kingdom biofilms of *Streptococcus mutans* and *Candida albicans*. PLoS One 2024;19:e0308656.
24. Koo H. Strategies to enhance the biological effects of fluoride on dental biofilms. Adv Dent Res 2008;20:17-21.
25. Contractor IA, Girish MS, Indira MD. Silver diamine fluoride: Extending the spectrum of preventive dentistry, a literature review. Pediatr Dent J 2021;31:17-24.
26. Rogalnikovaitė K, Narbutaitė J, Andruškevičienė V, Bendoraitienė EA, Razmienė J. The potential of silver diamine fluoride in non-operative management of dental caries in primary teeth: A systematic review. Medicina (Kaunas) 2024;60:1738.
27. AlSheikh RN. The use of silver diamine fluoride to prevent/treat enamel carious lesions: A narrative review. PeerJ 2024;12:e17897.
28. Yassin R, Amer H, Tantawi ME. Effectiveness of silver diamine fluoride versus sodium fluoride varnish combined with mother's motivational interviewing for arresting early childhood caries: A randomized clinical trial. BMC Oral Health 2023;23:710.
29. Bhadule SN, Kalaskar R. Role of silver diamine fluoride in caries prevention: A narrative review. SRM J Res Dent Sci 2021;12:210-5.
30. Kaur M, Anderson P, Shahid S, Wong FSL. Chemical kinetics of silver diammine fluoride in demineralization and remineralization solutions—an *in vitro* study. *Front Oral Health*. 2024;5:1374333.
31. Seifo N, Robertson M, MacLean J, Blain K, Grosse S, Milne R, *et al*. The use of silver diamine fluoride (SDF) in dental practice. Br Dent J 2020;228:75-81.
32. Dorozhkin SV. Dissolution mechanism of calcium apatites in acids: A review of literature. World J Methodol 2012;2:1-17.
33. Sulyanto RM, Kang M, Srirangapatanam S, Berger M, Candamo F, Wang Y, *et al*. Biomineralization of dental tissues treated with silver diamine fluoride. J Dent Res 2021;100:1099-108.
34. Mei ML, Ito L, Cao Y, Li QL, Lo EC, Chu CH. Inhibitory effect of silver diamine fluoride on dentine demineralisation and collagen degradation. J Dent 2013;41:809-17.
35. Mei ML, Li QL, Chu CH, Yiu CK, Lo EC. The inhibitory effects of silver diamine fluoride at different concentrations on matrix metalloproteinases. Dent Mater 2012;28:903-8.
36. Sharma G, Puranik MP, Sowmya KR. Approaches to arresting dental caries: An update. J Clin Diagn Res 2015;9:E08-11.
37. Shah S, Bhaskar V, Venkatraghavan K, Choudhary P, Ganesh M, Trivedi K. Silver diamine fluoride: A review and current applications. J Adv Oral Res 2014;5:25-35.
38. Peng JJ, Botelho MG, Matinlinna JP. Silver compounds used in dentistry for caries management: A review. J Dent 2012;40:531-41.
39. Chu CH, Lo EC. Promoting caries arrest in children with silver diamine fluoride: A review. Oral Health Prev Dent 2008;6:315-21.

40. Muntean A, Mzoughi SM, Pacurar M, *et al.* Silver diamine fluoride in pediatric dentistry: effectiveness in preventing and arresting dental caries—a systematic review. *Children (Basel)* 2024;11 (4):499.
41. Bridge G, Martel AS, Lomazzi M. Silver diamine fluoride: Transforming community dental caries program. Int Dent J 2021;71:458-61.
42. Oliveira BH, Rajendra A, Veitz-Keenan A, Niederman R. The effect of silver diamine fluoride in preventing caries in the primary dentition: A systematic review and meta-analysis. Caries Res 2019;53:24-32.
43. Zaffarano L, Salerno C, Campus G, Cirio S, Balian A, Karanxha L, *et al*. Silver diamine fluoride (SDF) efficacy in arresting cavitated caries lesions in primary molars: A systematic review and metanalysis. Int J Environ Res Public Health 2022;19:2917.
44. Farhadian N, Farhadian M, Borjali M, Ghaderi E. The effect of silver diamine fluoride versus sodium fluoride varnish on the microhardness of demineralized enamel: An *in vitro* study. Avicenna J Dent Res 2020;12:13-8.
45. Mani Prakash DK, Vinay C, Uloopi KS, RojaRamya KS, Penmatsa C, Chandana N. Evaluation of caries arresting potential of silver diamine fluoride and sodium fluoride varnish in primary molars: A randomized controlled trial. J Indian Soc Pedod Prev Dent 2022;40:377-82.
46. Zou J, Du Q, Ge L, Wang J, Wang X, Li Y, *et al.* Expert consensus on early childhood caries management. Int J Oral Sci 2022;14:35.
47. Gao SS, Zhao IS, Hiraishi N, Duangthip D, Mei ML, Lo EC, *et al*. Clinical trials of silver diamine fluoride in arresting caries among children: A systematic review. JDR Clin Trans Res 2016;1:201-10.
48. Fung MH, Duangthip D, Wong MC, Lo EC, Chu CH. Arresting dentine caries with different concentration and periodicity of silver diamine fluoride. JDR Clin Trans Res 2016;1:143-52.
49. Duangthip D, Fung MH, Wong MC, Chu CH, Lo EC. Adverse effects of silver diamine fluoride treatment among preschool children. J Dent Res 2018;97:395-401.
50. Mabangkhru S, Duangthip D, Chu CH, Phonghanyudh A, Jirarattanasopha V. A randomized clinical trial to arrest dentin caries in young children using silver diamine fluoride. J Dent 2020;99:103375.
51. Nishino M, Massler M. Immunization of caries-susceptible pits and fissures with a diammine silver fluoride solution. J Pedod 1977;2:16-25.
52. Gao SS, Chen KJ, Duangthip D, Wong MC, Lo EC, Chu CH. Preventing early childhood caries with silver diamine fluoride: Study protocol for a randomised clinical trial. Trials 2020;21:140.
53. Zheng FM, Yan IG, Duangthip D, Lo EC, Gao SS, Chu CH. Caries prevention using silver diamine fluoride: A 12-month clinical trial. Int Dent J 2023;73:667-73.
54. Abdellatif HM, Ali AM, Baghdady SI, ElKateb MA. Caries arrest effectiveness of silver diamine fluoride compared to alternative restorative technique: Randomized clinical trial. Eur Arch Paediatr Dent 2021;22:575-85.
55. Inchingolo AM, Inchingolo AD, Viapiano F, Ciocia AM, Ferrara I, Netti A, *et al*. Treatment approaches to molar incisor hypomineralization: A systematic review. J Clin Med 2023;12:7194.
56. Ruff RR, Barry-Godín T, Niederman R. Effect of silver diamine fluoride on caries arrest and prevention: The CariedAway school-based randomized clinical trial. JAMA Netw Open 2023;6:e2255458.
57. Hafiz Z, Allam R, Almazyad B, Bedaiwi A, Alotaibi A, Almubrad A. Effectiveness of silver diamine fluoride in arresting caries in primary and early mixed dentition: A systematic review. Children (Basel) 2022;9:1289.
58. Thakur S, Sojan M, Singhal P, Chauhan D. A comparative study to evaluate the effectiveness of silver diamine fluoride at different time durations of application in treating carious primary teeth: A randomized trial. Int J Clin Pediatr Dent 2022;15:S147-50.
59. Hegde D, Suprabha BS, Rao A. Silver modified atraumatic restorative treatment: A paradigm shift in dental caries management. Prim Dent J 2024;13:29-35.
60. Crystal YO, Marghalani AA, Ureles SD, Wright JT, Sulyanto R, Divaris K, *et al*. Use of silver diamine fluoride for dental caries management in children and adolescents, including those with special health care needs. Pediatr Dent 2017;39:135-45.
61. Edelstein BL, Basch CE, Zybert P, Wolf RL, Custodio-Lumsden CL, Levine J, *et al*. Chronic disease management of early childhood dental caries: Practices of US pediatric dentists. Prev Chronic Dis 2025;22:E01.
62. Young DA, Quock RL, Horst J, Kaur R, MacLean JK, Frachella JC, *et al*. Clinical instructions for using silver diamine fluoride (SDF) in dental caries management. Compend Contin Educ Dent 2021;42:e5-9.
63. Seifo N, Cassie H, Radford JR, Innes NP. Silver diamine fluoride for managing carious lesions: An umbrella review. BMC Oral Health 2019;19:145.
64. Crystal YO, Janal MN, Yim S, Nelson T. Teaching and utilization of silver diamine fluoride and hall-style crowns in US pediatric dentistry residency programs. J Am Dent Assoc 2020;151:755-63.
65. American Academy of Pediatric Dentistry. Policy on the use of silver diamine fluoride for pediatric dental patients. The Reference Manual of Pediatric Dentistry. Chicago (IL): American Academy of Pediatric Dentistry; 2023:103–105.
66. Phyo WM, Detsomboonrat P. Perceptions of dental professionals on the use of silver diamine fluoride with or without light-curing. BMC Oral Health 2024;24:1578.