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Significance of Silver Diamine Fluoride in Dentistry

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Abstract

Silver diamine 2luoride (SDF) contains silver and 2luoride that forms a complex with ammonia, which is a colourless alkaline solution that is effective in the treatment of dental caries. The application of SDF to prevent dental caries is a non-invasive, straightforward process. It does have disadvantages such as blackening carious teeth and an unpleasant metallic 2lavour. However, because of its low cost and ease of application it can be used in community dental health initiatives. SDF has gained prominence as a minimally invasive treatment option for arresting caries, especially in young children, elderly patients, and those with special needs. It has been evaluated in >20 clinical studies and reviewed in systemic reviews. The material was recently approved by the Food and Drug Administration for desensitising cold-sensitive teeth and has been used off-label to treat carious lesions. This literature review aims to explore the mechanism of action of SDF in caries

arrest, its effectiveness, and recent advancements in alternative techniques for caries management.

Keywords: Silver diamine 2luoride, dental caries, desensitising agent.

Introduction

Dental caries is a multifactorial microbial disease of the calci2ied tissues of the teeth, characterised by demineralisation of the inorganic portion and destruction of the organic substances of the tooth, which often leads to cavitation. [1] In recent years, the dental community has shown increasing interest in SDF as a versatile material for managing dental caries. This innovative therapy has garnered signi2icant attention due to its potential bene2its and effectiveness in treating tooth decay. [2] Multiple clinical studies have evaluated the ef2icacy of SDF in caries prevention and treatment, with promising results. These studies have shown that silver diamine 2luoride can penetrate deeper into the tooth compared to other 2luorides, making it a more effective option. Furthermore, SDF has been shown to have a therapeutic effect on dentinal hypersensitivity, providing relief to patients experiencing this common dental issue. Several studies have been conducted to assess the effectiveness of SDF in preventing and treating dental caries. [3]

Historical Background

SDF was developed by to prevent and treat dental caries. SDF was approved by PMDA (equivalent of FDA) in 1970 in Japan and has been used there since. [4] SDF was 2irst developed in Japan in the 1960s, by Reichi Yamaga, Misuho Nishino, and colleagues to prevent and treat caries. In Japan, it was traditionally known as Sai2lu, containing a 38% solution of SDF. [5] Following its initial use in Japan, SDF spread to other areas of Asia, South America, and, more recently, Australia and the United States. It was approved by the FDA for use in the United States in 2014 for the treatment of tooth sensitivity. However, many dental practitioners use it off-label for caries control.[6] Dental researchers are continuously studying SDF for further understanding of its ef2icacy in managing caries in various populations. With a range of studies supporting its effectiveness, SDF is becoming increasingly used and recognised worldwide as a potent, non-invasive solution for caries management. [7]

Mechanism of action

When SDF is applied to the tooth, the following reaction occurs:

Ca10(PO4)6(OH)2+Ag(NH3)2F→caf2+Ag3PO4+NH4 OH (hydroxyapatite + SDF → calcium 2luoride + silver phosphate + ammonium hydroxide) [4]

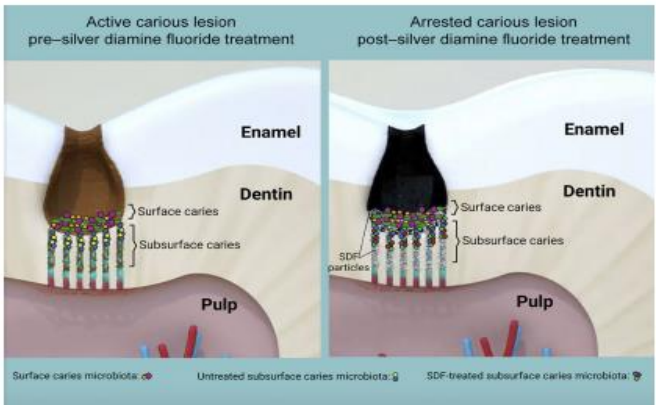

Fig 1. This reaction results in the formation of calcium fluoride, which helps to strengthen the tooth structure and make it more resistant to acid attack. At the same time, the silver ions in SDF have antimicrobial properties. They interact with the sul2hydryl groups of proteins and the DNA of bacteria, disrupting their structure and inhibiting their growth. This dual action of SDF - the formation of calcium 2luoride to strengthen the tooth structure and the antimicrobial properties of silver ions makes it an effective treatment for caries management. In addition, SDF has been shown to raise the ph of bio2ilm and reduce dentin demineralisation, further contributing to its cariostatic effects. [5] SDF

works through a dual mechanism of action. First, the silver ions in the solution have an antimicrobial effect, inhibiting the growth and activity of bacteria that cause dental caries. This antimicrobial action helps to arrest active carious lesions and prevent the progression of new caries. Second, the 2luoride component of SDF promotes remineralisation of the tooth structure. This remineralising effect helps to strengthen and repair the tooth, reversing the early stages of decay and preventing further damage. In addition to the clinical techniques mentioned above, it is important to note that ongoing research and advancements in SDF treatment continue to expand our understanding of its potential applications and ef2icacy in various patient populations. [6] Furthermore, SDF has been found to have a high af2inity for dentin, allowing it to penetrate and bind to the tooth structure, providing long-term protection against caries. Moreover, its ease of use and non-surgical approach make it particularly desirable for populations with low accessibility to basic dental procedures, such as those in low-income countries. [7] As ongoing research and advancements in SDF continue to expand our understanding of its potential applications and ef2icacy in various patient populations, it is important to constantly update our knowledge and incorporate this therapy into our clinical practice. [2]

Properties and Benefits

SDF has properties that make it a bene2icial treatment option for dental caries. Its antimicrobial effect on bio2ilms helps prevent caries development and progression. In addition, SDF promotes the remineralisation of carious lesions, aiding in the restoration of tooth structure. This non-invasive treatment option is particularly advantageous in situations where traditional restorative techniques may be dif2icult or costly. The use of SDF has proven to be effective in preventing caries and inhibiting the growth of harmful bacteria. Furthermore, SDF is more effective than sodium 2luoride in arresting caries. Research studies have consistently supported the effectiveness of SDF in arresting and preventing caries in both primary dentition and older adults. [4] SDF has found widespread use in dental practice for various clinical applications. These include the treatment of active carious lesions, prevention of new caries, and stabilisation of patients with extreme caries risk or who are medically compromised. [2] One of the major advantages of SDF is its ease of use. The application process is simple, requiring minimal time and effort. [8]

Indications of SDF

- SDF is predominantly indicated for the non-invasive management of dental caries.
- SDF is recommended for those with a high risk of carries, including young children, seniors, and those with special healthcare needs.
- Various studies have supported the use of SDF in reducing the incidence of new caries lesions.
- The FDA approved the use of SDF for the treatment of tooth hypersensitivity
- Medically compromised patients & patients with dif2iculty accessing oral care: These include patients who cannot tolerate traditional dental care due to anxiety or physical limitations.

Contraindications of SDF

Discolouration is a common reported side effect of SDF. The black/dark brown staining is thought to result from silver phosphate (Ag3 PO4), which is formed when hydroxyapatite in carious tooth reacts with SDF. [17] • As SDF contains silver, it should not be used on patients with a known allergy to silver. [6] • Studies suggest that SDF should not be applied to open wounds or ulcerative gingivitis and stomatitis as it may cause irritation or

exacerbate in2lammatory response. [18] • SDF is contraindicated if there is a pulpal involvement on primary or permanent teeth. [19] • Pregnancy • Breastfeeding • Caries in the aesthetic zone • Signs or symptoms of periapical pathology [10]

Current Clinical Techniques

Currently, several clinical techniques involve the use of SDF in dental practice.

They include

- Application of SDF on active carious lesions: A small amount of SDF solution is applied directly to the carious lesion using a micro brush or applicator.
- Two-step application for root caries: For the treatment of root caries, a protocol involving two applications of SDF has been proposed. The 2irst application is typically followed by a second treatment a few days or a week later. This two-step application protocol helps to enhance the effectiveness of SDF in arresting and preventing root caries in older adults.
- Monitoring and follow-up: It is crucial to routinely monitor and schedule follow-up appointments to evaluate the ef2icacy of SDF treatment and make any needed modi2ications. Regular monitoring helps determine the progress of the treatment and ensures that it continues to be effective over time. Consistent monitoring also provides an opportunity to detect any potential complications or side effects early on, allowing for timely interventions.
- Education and patient counselling: Proper education and counselling of patients and their caregivers about the bene2its and limitations of SDF treatment are crucial to ensure compliance and maximize the potential bene2its of the therapy.
- Incorporation of SDF into preventive treatment plans: SDF can be utilized as a preventive tool in patients with high caries risk.
- Integration of SDF into restorative treatments: SDF can be used as a part of a comprehensive restorative treatment plan, especially in cases where conventional care may not be feasible or tolerated by the patient.
- Combination therapy with other preventive measures: SDF can be used in combination with other preventive measures, such as sealants or 2luoride varnish, to enhance its ef2icacy in preventing caries and promoting oral health.
- Complementary treatments with restorative procedures: SDF can be used in conjunction with restorative procedures, such as 2illings or crowns, to help protect and strengthen the remaining tooth structure and prevent further decay.

Minimal invasive approach in children

SDF can be regarded as a valuable strategy for managing paediatric patients with dental caries. Once the carious process has been slowed down or stopped, the caries will be removed later, once the child's capacity to reason through fear has grown with maturity.

As a Desensitising agent

SDF possesses the capacity to effectively occlude the dentinal tubules, hence exhibiting potential ef2icacy in managing dentinal hypersensitivity among patients. The underlying mechanism of action for SDF and sensitivity control involves the application of an aqueous solution containing silver and 2luoride. This solution forms a protective layer on the exposed dentin, which serves to partially occlude the dentinal tubules. Consequently, this occlusion reduces the movement of 2luids within the dentinal tubules. One of the concerns associated with the utilisation of SDF as a sensitivity agent, in contrast to

other sensitivity agents, is the potential occurrence of discolouration. In contrast, the study conducted by Castillo et al. Revealed that discolouration did not occur on the exposed dentine surface unless pre-existing cavities were present. [10]

In arresting root caries

Studies by Tan et al. (2010) and Zang et al. (2013) have indicated that the annual application of SDF is highly successful in arresting dental caries on root surfaces due to its strong caries-arresting properties.

In order to mitigate the occurrence of secondary caries

For many years, the "holy grail" of dental restorative materials has been true adhesion. In contemporary general dentistry, the majority of restorative materials exhibit a high degree of adhesion to the tooth structure or possess total insolubility in oral 2luids, such as saliva. However, it is important to note that despite these properties, the presence of gaps between the cavity walls and the restorative materials allows for the in2iltration of saliva, bacteria, and food debris. Therefore, the cavity wall is susceptible to recurring caries. In order to prevent the occurrence of recurring caries, it is important to augment the resistance of the cavity wall to caries. In their study conducted in 1976, Shimizu and Kawagoe (30) observed that primary teeth treated with SDF prior to amalgam restorations did not exhibit any instances of recurrent caries after a period of 26 months.

To treat infected Root canals

The utilisation of an ammoniated silver nitrate solution has been widely employed in the management of infected root canals. According to Tanaka, it has been demonstrated that an aqueous solution containing agf exhibits robust bactericidal and protein-coagulating properties. Additionally, this solution demonstrates a signi2icant ability to obstruct the dentinal tubules of the root canal wall in relation to electric resistance. Okamoto et al. (2019) discovered that the utilisation of the silver diamine 2luoride (SDF) solution resulted in a signi2icant reduction in the frequency of necessary treatments. According to Hiraishi et al. (2010), a 3.8% SDF solution exhibits promise as an antibacterial agent for root canal irrigation or as an inter-appointment dressing. This is particularly applicable in situations where the discolouration of dentin caused by metallic silver is not a signi2icant issue. Mathew et al. (2012) observed that the use of SDF as an endodontic irrigant demonstrated effective elimination of micro-organisms within the root canal and the surrounding dentin. [11] Overall, the current clinical techniques involving silver diamine 2luoride aim to maximize its effectiveness in arresting caries, preventing new caries, and improving patient outcomes by providing non-invasive and cost-effective treatment options.

Studies on SDF

A study by Oliveria et al concluded that SDF is more effective than sodium 2luoride in arresting caries. There is consistent evidence supporting the ef2icacy of SDF in halting dental decay in primary teeth and preventing root caries in older individuals. [23] Contreras et al. Conducted a systematic review and meta-analysis of seven studies, SDF concentrations of 30% and 38% show promise as a caries-preventive treatment for primary and permanent 2irst molars, respectively. [21] Martin et al recommended the use of SDF with 5% Fluoride varnish as an effective secondary prevention strategy for managing Early Childhood Caries. [24] **9. Adverse Effects and Safety Considerations**

SDF can cause temporary discolouration of the tooth and a metallic taste in the mouth. In rare cases, allergic reactions to SDF have been reported, and caution should be exercised when using the treatment in patients with

known silver allergies or sensitivities. [3] Overall, the safety considerations of SDF should be weighed against its signi2icant bene2its in preventing and treating dental caries[11] The application of SDF should be limited to the affected areas and should not come into contact with healthy tooth structure. Furthermore, it is recommended to avoid saliva contamination during the application process to maximize the effectiveness of SDF. [6]

Conclusion

Overall, the use of SDF in dental practice has revolutionised the approach to caries prevention and treatment. SDF is a safe and effective treatment for dental caries in patients of all ages. It has been particularly bene2icial for patients with high caries risk, those who cannot tolerate traditional dental care, and those in underserved populations. SDF has also shown potential in preventing the occurrence of new caries through its remineralisation effects. SDF has shown consistent support in the literature for its effectiveness in different clinical scenarios. Moreover, ongoing research is needed to further explore the long-term effects, durability, and impact on the oral microbiome of SDF treatment.

References

1. Selwitz RH, Ismail AI, Pitts NB. Dental caries. The Lancet. 2007 Jan 6;369(9555):51-9.
2. Zhao IS, Gao SS, Hiraishi N, Burrow MF, Duangthip D, Mei ML, Lo EC, Chu CH. Mechanisms of silver diamine 2luoride on arresting caries: a literature review. International dental journal. 2018 Apr 1;68(2):67-76.
3. Rosenblatt A, Stamford TC, Niederman R. Silver diamine 2luoride: a caries “silver-2luoride bullet”. Journal of dental research. 2009 Feb;88(2):116-25.
4. Yamaga R. Diamine silver 2luoride and its clinical application. J Osaka Univ Dent Sch. 1972; 12:1-20.
5. Horst JA, Heima M. Prevention of dental caries by silver diamine 2luoride. Compend Contin Educ Dent. 2019 Mar 1;40(3):158-63.
6. Crystal YO, Marghalani AA, Ureles SD, Wright JT, Sulyanto R, Divaris K, Fontana M, Graham L. Use of silver diamine 2luoride for dental caries management in children and adolescents, including those with special health care needs. Pediatric dentistry. 2017 Sep 15;39(5):135E-45E.
7. Gao SS, Zhao IS, Hiraishi N, Duangthip D, Mei ML, Lo EC, Chu CH. Clinical trials of silver diamine 2luoride in arresting caries among children: a systematic review. JDR Clinical & Translational Research. 2016 Oct;1(3):201-10.
8. Favaro JC, Detomini TR, Maia LP, Poli RC, Guiraldo RD, Lopes MB, Berger SB. Anticaries agent based on silver nanoparticles and 2luoride: characterization and biological and remineralizing effects—an in vitro study. International Journal of Dentistry. 2022 Apr 19;2022.
9. Sulyanto RM, Beall CJ, Berger MB, Goodell CP, Koo S, Candamo F, Dickson JR, Kang M, Ho SP, Ng MW, Hashmi SB. Silver diamine 2luoride alters microbial communities in subsurface dentin. JADA Foundational Science. 2022 Jan 1; 1:100004.
10. Greenwall-Cohen J, Greenwall L, Barry S. Silver diamine 2luoride-an overview of the literature and current clinical techniques. British dental journal. 2020 Jun;228(11):831-8.
11. Shah S, Bhaskar V, Venkatraghavan K, Choudhary P, Trivedi K. Silver diamine 2luoride: a review and current applications. Journal of Advanced Oral Research. 2014 Jan;5(1):25-35.
12. Mei ML, Lo EC, Chu CH. Clinical use of silver diamine 2luoride in dental treatment. Compend Contin Educ Dent. 2016 Feb 1;37(2):93-8.

13. Zhao IS, Mei ML, Burrow MF, Lo EC, Chu CH. Effect of silver diamine 2luoride and potassium iodide treatment on secondary caries prevention and tooth discolouration in cervical glass ionomer cement restoration. International journal of molecular sciences. 2017 Feb 6;18(2):340.
14. Chibinski AC, Wambier LM, Feltrin J, Loguercio AD, Wambier DS, Reis A. Silver diamine 2luoride has ef2icacy in controlling caries progression in primary teeth: a systematic review and meta-analysis. Caries research. 2017 Oct 4;51(5):527-41.
15. Chhokar SK, Laughter L, Rowe DJ. Perceptions of registered dental hygienists in alternative practice regarding silver diamine 2luoride. American Dental Hygienists' Association. 2017 Aug 1;91(4):53-60.
16. Brunet-Llobet L, Auría-Martín B, González-Chópite Y, Cahuana-Bartra P, Mashala EI, Miranda-Rius J. The use of silver diamine 2luoride in a children's hospital: Critical analysis and action protocol. Clinical and Experimental Dental Research. 2022 Oct;8(5):1175-84.
17. https://hq.moh.gov.my/ohd/images/pdf/publication/silverdiaminefluoride.pdf
18. Horst JA, Ellenikiotis H, Milgrom PL. UCSF protocol for caries arrest using silver diamine 2luoride: rationale, indications and consent. Journal of the California Dental Association. 2016 Jan 1;44(1):17-28.
19. Contreras V, Toro MJ, Elías-Boneta AR, Encarnación-Burgos MA. Effectiveness of silver diamine 2luoride in caries prevention and arrest: a systematic literature review. General dentistry. 2017 May;65(3):22.
20. Contreras V, Toro MJ, Elías-Boneta AR, Encarnación-Burgos MA. Effectiveness of silver diamine 2luoride in caries prevention and arrest: a systematic literature review. General dentistry. 2017 May;65(3):22.
21. Aldosari MM, Al-Sehaibany FS. Evaluation of the Effect of the Loading Time on the Microtensile Bond Strength of Various Restorative Materials Bonded to Silver Diamine Fluoride-Treated Demineralized Dentin. Materials. 2022 Jun 23;15(13):4424.
22. Zhang J, Got SR, Yin IX, Lo EC, Chu CH. A concise Review of silver diamine 2luoride on oral bio2ilm. Applied Sciences. 2021 Apr 4;11(7):3232.
23. Oliveira BH, Rajendra A, Veitz-Keenan A, Niederman R. The effect of silver diamine 2luoride in preventing caries in the primary dentition: a systematic review and meta-analysis. Caries research. 2019 Jun 6;53(1):24-32.
24. Martin H, Patterson B, Mittermuller BA, Lee V, Moffatt ME. The effectiveness of silver diamine 2luoride and 2luoride varnish in arresting caries in young children and associated oral health-related quality of life. J Can Dent Assoc. 2020;86(k9):1488-2159.