

Silver Diamine Fluoride, A Wonder Solution for Treating Dental Caries: A Systemic Review

Vishakha Sharma¹, Jyoti Vandan, Pankaj Kumar Singh¹, Vikrant Vaishanava¹, Sonu Kumar¹,
Sk Abdul Matin², Nilotpol Kashyap^{3*}

¹Intern, Vananchal dental college and hospital, Garhwa, India.

²Final year, Vananchal dental college and hospital, Garhwa, India.

³Professor, Department of Pediatric dentistry, Vananchal dental college and hospital, Garhwa, India.

*Corresponding Author: Nilotpol Kashyap.

Abstract

Dental caries is a multifactorial disease-causing demineralization of dental hard tissue and dissolution of soft tissue affecting most of the adult and child population of the world.

Prevention of dental caries can be done by reducing the consumption of fermentable carbohydrates and use of chemical like fluoride. Silver Diamine Fluoride when used topically has been found to arrest dental caries as well as reduce hypersensitivity in teeth. SDF has been found to effectively control active caries due to its silver ions and fluoride making it a wonder solution in prevention of dental caries.

Key Words: silver diamine fluoride; dental caries; dentine; hypersensitivity

Introduction

Dental caries is a dynamic, multifactorial, non-communicable and biofilm mediated disease, it has direct effect on dietary and oral hygiene habits. Imbalance between biological and behavioural factors can cause carious lesions to develop. Treatment of caries in children less in under developed countries and in children under 6 years of age is limited to developed countries. The peak of the disease is high among very young children aged 1-4-year-old. Dental caries is a localized chemical dissolution of dental hard tissue that is caused by acidic by-product of the metabolic processes of the biofilm covering an affected tooth surface. Dental caries is a preventable disease that can be controlled by minimum consumption of fermentable carbohydrates. It can also be prevented by the use of fluoride. Nowadays, a non-invasive agent has been given renewed interest i.e., silver diamine fluoride. SDF is efficient, affordable and effective cariostatic agent. SDF is a colourless alkaline solution containing silver and fluoride in a complex with ammonia [1].

History of SDF

First mention of the medical usage of silver dates to 1000BC or earlier. Stebbins hypothesized that caries decrease was due to antibacterial action of silver and buildup of a black crust, producing a sclerotic protective layer of secondary dentin. During the 1970s Agfa was introduced in Western Australia as a part of minimal intervention for school dental services. Silver diamine fluoride was studied first by Nishino as a part of a PhD. thesis at Osaka university in Japan in 1969. Later "diamine silver fluoride" was approved by the Central Pharmaceutical Council of the Ministry of Health and Welfare of Japan as a cariostatic agent and marketed as SafeRide {Toyo Seiyaku Kasei Co. Ltd Osaka, Japan}. They described its effects for prevention and arrest of dental caries in children, prevention of secondary caries after restoration and desensitization of hypersensitive dentin [2].

Arresting dental caries in deciduous and permanent teeth is not unfamiliar in dentistry. The very first experiment using SDF studies in rat caries model where the incident of new lesion after preventive

application was investigated. In this experiment, SDF prevented 62% of carious lesion in the molar of treated rats compared to littermate control. Severity of lesion were diagnosed as well; 30% of teeth in the control group developed deep lesions, while none of the group teeth in the SDF group had any.

Development of SDF in dentistry

SDF is a colorless solution containing fluoride ions. It is used in dentistry to promote remineralization of teeth. AgF was used in dentistry as early as 1970s. An indistinguishable compound, SDF has been accepted as therapeutic agent by the Central Pharmaceutical Council of the Ministry of Health and Welfare in Japan for dental treatment since the 1960s [3]. A solution of 38% SDF was also used in China to arrest caries. Community projects using SDF to arrest caries were planned for Cuba, Sub-Saharan Africa and in several African countries. In 2014 the United States approved SDF for sale as a product to reduce dentinal hypersensitivity. Health Canada approved it as an anti caries product. The US Food and Drugs Administration also identified SDF as a therapy in caries prevention. In the year 2017, the American Academy of Pediatric Dentistry published a guideline for the "Use of silver diamine fluoride for dental caries management in children and adolescents, including those with special healthcare needs in children and adolescents". Studies are currently underway that may result in the change of its labelling in the near future.

Composition

SDF is a colorless solution with alkaline pH {8-10}. It contains [2] (Figure: 1)

1. Silver {antibacterial} 255000 ppm.
2. Fluoride {remineralization} 44800 ppm.
3. Ammonia [stabilizer].



Figure 1: SDF

Mechanism of action

SDF is used to arrest dental caries and prevent dentin hypersensitivity. Topical application of SDF in case of dentin hypersensitivity results in the formation of a squamous layer in the exposed dentin resulting in the plugging of the dentinal tubules. Regarding of treatment of dental caries, SDF forms a squamous layers of silver protein conjugate on the decayed surface. These silver protein conjugate increases the resistance to acid dissolution and enzymatic digestion. On the exposed surface, hydroxyapatite and fluorapatite along with silver chloride and metallic silver is deposited. The treated lesion thus increases in mineral density and decreases in lesion depth. The silver ions present in SDF are bactericidal. When bacteria killed by silver ions are added to living bacteria, the silver ions are activated so that the dead bacteria kill the living bacteria in the lesion through a "zombie effect". This reservoir effect helps to explain why silver particles deposited in bacteria and dentin has sustained antimicrobial effect [4].

Indications

1. Patient with high- risk caries [2]
2. To prevent pit and fissure caries [5]
3. Management of dental hypersensitivity [4].
4. To arrest secondary caries [4].
5. Root caries arrest in adult [2].
6. Control caries lesion prevention [2].

SDF can access area which are not approachable by traditional ways such as partially erupted third molar, furcation and under around existing restoration [2].

As part of the silver modified atraumatic restoration technique [SMART] [2].

SDF is an excellent desensitizer often it reduces or eliminates need for local treatment [2].

Contraindications

- Silver allergy [1]
- Any oral ulcers [4]
- Caries with pulpal involvement [5]
- If patient complains due to colour change [5]

Advantages

1. SDF is effective in preventing caries progression [5].
2. Low cost [5].
- Procedures are simple [6].
- Does not require expensive instrument [4].
5. Arrest 80% of treated lesion [1].

6. Minimally invasive and painless [6].

Disadvantages

1. Causes black discoloration [5]
2. Gingival and mucosal irritation [5].
3. Aesthetics is a concern among parents and children [4].
4. SDF can stain skin and cloth [2].
5. SDF has a metallic taste which is not pleasant [2].

Non-medical side effect and safety and toxicity

At the time of application, SDF should be restricted to the carious lesion treated.

Expected side effect are darkening of treated lesion and bitter metallic taste. If SDF comes in contact with soft tissue there is brownish staining on the skin and white or greyish staining in the oral tissues which disappears after a few days [7].

Technique

According to AAPD guidelines 2017 [8].

Cover the counter with plastic and drape the patient with plastic bib.

Standard personal protective equipment to be worn by both patient and provider. 3. Dispense one drop {25 µl/10 kg per treatment visit} of SDF in a dappen dish.

Isolate and dry the affected teeth.

Minimize contact with gingiva and mucosa to prevent pigmentation or irritation. 6. Apply petroleum jelly on gingiva.

Bend micro sponge brush, dip and dab on the side of the dappen dish to remove excess liquid before application and then apply SDF directly to only the affected tooth surface.

Dry with a gentle flow of compressed air for at least one minute. Remove excess SDF with gauze, cotton roll or cotton pellet to minimize systemic absorption.

Post operative instructions

Several studies on SDF recommend 30 minutes to 1 hour restriction on consumption of food after application. Follow up is advised at 2-4 weeks after the initial treatment. Re-application and additional SDF application at recall appointments are needed [9].

Follow-up

Follow-up at 2-4 weeks after initial treatment to check the arrest of the lesions treated [10].

Re-application of SDF may be indicated if the treated lesion does not appear arrested [10].

Carious lesions can be restored after treatment with SDF [10].

When lesions are not restored after SDF therapy, bi-annual re-application shows increased caries arrest rate versus single applications [10].

Conclusion

SDF is an effective and noninvasive treatment for the management of dental caries in children. Due to its simplicity and safety, it can be used individually or at a collective level for the management of dental caries. It can be an effective mode of caries management in individuals who cannot endure conventional modalities of restorative treatment, individuals who cannot access dental care facilities and those with special health care needs. Based on all these evidences, many authors recommend annual application of SDF to high-risk surfaces in high caries risk patients. SDF fulfils the goals of the WHO Millennium Development Goals for Health and can help in the minimization of the inequities in oral health around the world as well as provide a friendly treatment approach in the daily pediatric dentistry practice.

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