

Silver Diamine Fluoride-A Narrative Review

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Abstract

Introduction: Neglected dental caries is known to be a significant pediatric public health problem. Dental caries is a very common chronic illness affecting childhood. It often leads to lost school hours for children and lost work hours for their caregivers and also dental caries can cause a large physical toll on those with special health-care needs. Caries could be a difficult illness to treat in elderly individuals having age related issues.

Methods: The electronic databases were searched, namely-Pubmed, Scopus, Cochrane only for reviews on silver Diamine fluoride (SDF) for both children and adults since 2014 till date. Reviews written in English and involving humans were taken into consideration. The exclusion criteria included other study designs and reviews done in other languages.

Results: Consistent with the literature, topical 38% silver diamine fluoride arrests tooth decay and is effective for the short-term treatment of dental caries in pre-school age children. The effect is rapid and safe. The potential for microbial resistance appears low.

Conclusion: The antimicrobial effect of silver compounds has been approved by the one hundred-years-old use of silver metals for the management of various infections. SDF was being used in Japan to arrest dental caries during 1970s but was still not exposed much in other countries of the world. At present many countries are using 38% (44,800 ppm fluoride) SDF solution commonly to stop dental caries and decrease hypersensitivity in primary and permanent teeth. SDF (Silver Diamine Fluoride) has the potential to be a breakthrough product in the caries management world. It is a pain free, rapid and almost inexpensive option to break the caries process as a part of a total treatment plan.

Keywords: Dental Caries; Fluoride; Hypersensitivity; Smart Material

Introduction

Dental caries is an irreversible microbial disease of the calcified tissue of teeth, characterized by demineralization of the inorganic portion, and destruction of organic substance of tooth, which often leads to cavitation [1]. It is one of the most common chronic illness

affecting humans. The age-old treatment of dental caries soughts mechanical cavity preparation and restoration with suitable material [2]. This variety of treatment requires excellent clinical skills, appropriate instruments, materials, and also co-operative patients [3]. In young children, behavior problem or lack of cooperation makes the treatment of carious tooth, mostly leading to disease progression with the eminent loss of tooth [4]. Dental caries can be both prevented or arrested [5]. Preventive measures for ECC seems more cost effective than going to emergency management or restorations when disease has made firm ground [6,7]. Various evidence-based approaches for caries prevention have been given [8]. Effective ECC preventive measures include the use of fluoridated varnish and toothpaste [9-11]. The management of cavitated lesions can be done by atraumatic restorative treatment (ART). ART is painless, economical and can be applied outside the clinical setting when conventional set up is not present. This treatment has high rate of failure which is a disadvantage [12]. In countries which are developed, uncooperative children do have the option of conscious sedation or general anesthesia, but in many third world countries due to barrier of getting dental care, low socioeconomic populations are left with untreated dental caries [13,14].

A fluoridated agent, SDFs inherent ability to arrest the caries process and prevent the formation of new caries. This agent is stated to be two times as effective as fluoride varnish to prevent caries. In 2014, SDF was approved by the US FDA as a treatment for dentinal hypersensitivity [15]. SDF had been used off-label for caries arrest; however, it has been recently approved. SDF is a solution of 25% silver, 8% amine, 5% fluoride, and 62% water (AgNH_2F) and known to be the most concentrated fluoride product available for caries management. Populations in the low socioeconomic group and people with special health care needs have high disease rates compared with the rest of the general people [16]. Management of dental caries in the pediatric group, specially children under age of three years, mostly require pharmacological behavior management techniques, including sedation and/or general anesthesia. They are expensive approaches and has the potential risk of death. For children who are under three years of age, there are questions about neurological damage with prolonged or repeated general anesthesia [17]. The use of SDF to prevent or delay surgical intervention until after the age of 3 years makes it a potentially attractive adjunctive therapy for managing caries in the very young pediatric population. SDF has also been used as an effective management tool for root caries where restorative treatment can be challenging. The key question for this narrative review was-Is SDF effective in dental caries and hypersensitivity both in children and adults. The material is reviewed here to know the complete areas of use in dentistry and not just as an anti caries agent in pediatric dentistry.

Development

The first known use in medicine for silver was found to be around 1000 BC [18]. Recent utilisation of silver compounds in medicine has to be application of silver foil, and silver sutures. Stebbins was the first to use silver amalgam and nitric acid on carious teeth and found that caries inhibition took place. Later on Howe's solution came to be used as silver nitrate [19].

Methodology

Research selection

he electronic databases were searched, namely-Pubmed, Scopus, Cochrane only for reviews on silver Diamine fluoride for both children and adults since 2014 till date. Reviews written in English and involving humans were taken into consideration. The exclusion criteria included other study designs and reviews done in other languages. The eligibility protocol was strictly applied, and the reports were assessed independently. All the articles thus obtained went through an abstract review and/or full article review to confirm the eligibility. The author(s) were personally contacted where required. We tried to find the multiple roles of SDF in reviews in dentistry.

Application of silver diamine fluoride in dentistry

Craig reported use of silver fluoride way back in 1970. Similar to this a compound named silver diamine fluoride had been accepted in Japan to be used as a therapeutic agent [20]. SDF has an alkaline pH between 8 and 9. It is more stable than AgF solution. SDF was used in dentistry at a concentration of thirty eight percent [21].

The various uses are:

- 1. In pediatric patients for caries arrest/control without sedation or anesthesia:** The FDA released a stern warning that the repeated or lengthy use of general anesthetic and sedation drugs during surgeries or procedures in children who are younger than three years may affect the neurological development [22]. This along with a number of recent, dental anesthesia related adverse effect has increased the demand from parents for minimally invasive treatment options for their children. In just one minute, SDF can be painlessly brushed on a carious tooth and arrest eighty% of lesions. Young patients can benefit from SDF treatment as an interim treatment until they are older and/or more cooperative for traditional restorations and/or until the teeth exfoliate without the need for surgical intervention [23,24].
- 2. Caries control in special needs and medically compromised patients:** There are many patients who can have SDF treatment, unable to have proper restorative dentistry due to special needs or complex medical problems. Special needs patients can benefit from the lucid and non-invasive SDF treatment [24,25].
- 3. Caries control in patients with extensive treatment needs:** There are many patients especially children who need treatment for multiple carious teeth, the treatment cost of which can go beyond their monetary power. SDF can act as an interim treatment until the patient can get the money to take up the extensive treatment so that the condition does not worsen [25,26].
- 4. Silver modified atraumatic restorative treatment (SMART):** SDF cannot restore form or function, so cavitated lesions will benefit from a restoration [24]. The material of choice for SMART is high viscosity glass ionomer cement (HVGIC), such as Fuji EQUIA Forte (GC America). HVGIC is a self-curing, bulk-fill restorative material. It is better than resin composite as it is a biocompatible material. It produces significantly lower shrinkage, bonds with chemical and micro-mechanical adhesion, and releases and recharges with fluoride [27].
- 5. Hypersensitivity:** Molar incisor hypomineralization (MIH) is a clinical condition seen in as many permanent first molars [28]. These teeth are hypersensitive and difficult, to adequately anesthetize, and have a ten-fold higher risk of developing caries. Restoration of MIH affected molars has invasive, expensive, and generally unpleasant procedures which is not beneficial for both the patient and dentist. A newer option for these teeth is SDF, which desensitize the teeth, and HVGIC as a less invasive restoration [29].
- 6. Recurrent caries at restoration margins:** Caries is biofilm disease which has no cure, and restorations lasts less longer. Owing to this, we've all faced the clinical scenario where a patient develops recurrent caries at a restoration margin. Even if it is a filling or a crown, the treatment by SDF is a simple and effective way. The ease of use and cost effectiveness of the treatment is particularly pleasing to patients [30].
- 7. Incipient proximal lesions:** Early interproximal lesion is clinical challenge because accessing the lesion involves removal of a large amount of sound tooth structure. Most lesions, in particular those lesions arrested within enamel, can be arrested and remineralized. SDF can be put in the interproximal area using floss [31]. Clean, isolate, and dry the affected area, then place the floss into the contact. Apply SDF to the floss and allow it to soak in the interproximal space for one to three minutes. This approach can conserve natural tooth structure and postpone or even prevent the need for a surgical intervention.

Discussion

This narrative review reveals the use of SDF in prevention of caries and in hypersensitivity of teeth apart from the various uses in dentistry. This review reveals that limited published literature exists in the form of reviews-systematic or otherwise. Analysis of data from the studies reveals that the annual application of 38% SDF can significantly arrest caries and reduce the incidence of new caries.

Burgess and Vaghela in their review stated that SDF has a major role in arresting caries in deciduous teeth [31]. An excellent current review of the clinical effectiveness of SDF in children was recently published [33]. Although SDF is not well known or used in the United States, a survey of U.S. dental schools reported that, of the 62 schools responding, 55% stated that SDF was being taught in their cur-

ricula and agreed that SDF is indicated for arresting caries on primary teeth. A recent review stated that applying a 38% solution of SDF to children, adolescents (with mixed dentitions), and elderly (age > 60y) produced similar results [37]. Compared with topical fluoride or fluoride varnishes, SDF produced caries arrest in 96.1% (fluoride 21.3%) and the preventive fraction (or new lesions prevented) was 70.3% with SDF and 55.7% with fluoride. Most reviews reported that caries in primary teeth is arrested slightly more than carious lesions in the permanent dentition, but more recent reviews demonstrated that SDF is effective in the permanent dentition [30].

Clinical Recommendation

Complete removal of carious dentin before SDF application is not always needed. Carious dentin excavation only reduces the black discoloration after it has been arrested. Hence, it is only considered for esthetic reason. The application time ranges from 10s to 3 minutes with an ideal value of 1 minute, using a gentle flow of compressed air drying. No eating or drinking after application of silver Diamine fluoride for 30 minutes to 1h is recommended in several literature [32].

Silver Diamine fluoride is an effective caries arresting agent which can be used for those patients who have difficulties in accessing proper dental care [33].

Conclusion

The list of clinical uses for SDF can be endless. The low-cost, low-technology and low-technique sensitivity of the treatment offers a versatility which can be added to virtually any clinical setting. Whether we work in a private practice or public health, treating patients that are young, old, and everything in between, we are bound to find a use for this exceptional oral medicine. Available literatures suggest that 38% silver Diamine fluoride is effective in caries prevention. It stops the caries progression. According to different studies, silver Diamine fluoride does not produce any pulpal insult. It is simple to use, cost-effective and can be stored in a stable concentration. It is very useful for the management of caries in young children as well as adults. The SDF is a versatile material and has the potential to make dentistry (specially pediatric) a non surgical approach and also to cut down the cost of treatment.

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Conflict of Interest

Nil.

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