

The Usage of Silver Diamine Fluoride in Pediatric Dentistry

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ABSTRACT

Silver diamine fluoride (SDF) has been extensively researched and proven effective for caries prevention and arrest in children. Limited studies support its effectiveness in primary dentition at 38%. This systematic review examines the effectiveness of silver diamine fluoride on control of dental caries in primary dentition. Multiple search engines and databases were searched in accordance with predefined inclusion-exclusion criteria. Fourteen main studies were identified that addressed the effectiveness of SDF on deciduous dentition in children. All the fourteen studies selected were controlled clinical trials. The overall results of the studies showed that

SDF application is efficacious and safe for the control of dental caries in primary teeth. Its advantages over different other techniques or placebo have been demonstrated. Based on this systematic review, SDF is one of the best treatment approaches in control of dental caries in primary dentition

KEYWORDS: fluoride; children; caries; silver; diamine

INTRODUCTION

Early childhood caries is an infectious, and transmissible disease of teeth affecting young children caused by various factors and is related with susceptible, uninsured, and financially weak populations.(Sheiham et al. 2015) It is also the most prevalent condition included in the 2015 Global Burden of Disease Study, ranking 12th for deciduous teeth affecting 560 million children.(Petersen and Lennon 2004) Untreated decay in very young children can lead to increased risk of caries in other deciduous and permanent teeth, missed school hours, pain, and infections; costly emergency treatments; due to widespread decay and the associated requirement for general anesthesia; and limited growth as well as development.(Petersen et al. 2016) Therefore, untreated caries and underutilization of dental services are two most prominent public health problems for children in developing and undeveloped nations.(Thompson et al. 2009)

It is essential to search for an efficient, affordable method of treating dental caries in preschool children who are at high risk of caries and with restricted access to dental care to decrease the burden of untreated caries.(Chaffee et al. 2017) The conventional management for a decayed tooth involves removal of infected and demineralized tooth structure and subsequent replacement with a filling material.(Crystal 2019) Additionally, management of dental caries can be difficult and may require highly developed skill of the dentist as well as extensive instrumentation and restoration cost.(Duangthip et al. 2018; Gao et al. 2016) Also, good cooperation from patients is mandatory.(Horst 2018) This is especially difficult in case of very young children due to their limited adaptive capacity. Hence, managing a carious tooth in such children can be a riddle for the provider. In such cases, arresting caries treatment has been proposed to manage untreated dental caries.(McReynolds and Duane 2018; Mei et al. 2013)

In recent times, silver diamine fluoride (SDF) has been popularized for its capability to stop the caries progression and concurrently arrest the formation of new carious lesions.(Fung et al. 2018; Zhao, n.d.) Also, SDF can be used in children who are too young to have their carious teeth restored by traditional methods.Our institution is passionate about high quality evidence based research and has excelled in various fields (Jayaseelan Vijayashree Priyadharsini 2019; Pc, Marimuthu, and Devadoss 2018; Ramesh et al. 2018; Ramadurai et al. 2019; Sridharan et al. 2019; Ezhilarasan, Apoorva, and Ashok Vardhan 2019; Mathew et al. 2020; Samuel 2021; R et al. 2020; Chandrasekar et al. 2020; J. Vijayashree Priyadharsini, Smiline Girija, and

Paramasivam 2018).In addition, SDF application can be an affordable way of managing dental decay in many children from low income families or living in areas where there is limited access to dental service providers.(Fernandez and Griffiths 2002; Shah et al. 2014; Buzalaf et al. 2011)

HISTORY

Japanese have used silver as tooth cosmetics to prevent dental caries for 1000 years.(de Olivera Carrilho 2017) In 1891, silver amalgam and nitric acid was used on carious teeth and had caries arresting properties. Silver nitrate was directly applied to carious cavities with analogous outcomes, and it was termed as Howe's solution, which was used for caries inhibition. In Western Australia, 40% silver fluoride (AgF) was applied as the treatment for deep dental caries in primary teeth at school dental care services. Until the late 1960s and 1970s, SDF was not much exposed to other parts of the world other than Japan.(Koch et al. 2017; Clemens, Gold, and Chaffin 2018)

Since the 1960's, it has been established as a therapeutic agent by the Central Pharmaceutical Council of the Ministry of Health and Welfare in Japan for dental treatment.(Juneja et al. 2019) For the past few decades, SDF has also been in use in Australia and China to prevent dental decay. SDF has been used in many community dental health programs in various concentrations in Argentina, Brazil and Spain; and additionally community health programmes were designed for subSaharan Africa and for other countries of Africa.(Doppalapudi 2020) Although an article in an American journal published in 1995 reported that there were health care providers in Southern California who applied SDF to seize caries progress in young children with early childhood caries.

However, SDF was not commonly available in some countries of Europe and the USA. In 2014, SDF was approved by the US Food and Drug Administration for management of tooth hypersensitivity.(Abdil-nafaa and Qasim 2020; Crystal 2019) Though its extensive use started in China in the start of the 21st century as a caries arresting agent in school going children. From 2005 to 2009 in Australia, a series of in vitro studies were conducted and proved the effect of SDF on *Streptococcus mutans* and dental biofilm as a caries arresting and antimicrobial agent respectively. Yee et al. in Nepal and 2009 Braga et al. in US used SDF as caries arresting agents.(Badger 2018)

In 2013, SDF was used to prevent root caries in elderly. Studies were conducted in India providing literature of successful use of SDF as a caries arresting agent. A study in 2018 found that SDF was successful in arresting active caries in primary teeth of young children in the USA and was also well received by their parents. Still, many studies are being conducted in various countries of the world to establish SDF as an aid for the dental public health community professionals to address dental caries in at risk populations.(Jain et al. 2019)

CARIES PREVENTION IN CHILDREN

The review undertaken by Rosenblatt et al.,(Rosenblatt, Stamford, and Niederman 2009) evaluated SDF's potential for prevention using data from 2 trials. The trial from Llodra et al.,(Llodra et al. 2005) included primary and permanent molars and found that new caries lesion development (as a marker of caries prevention) in permanent teeth was significantly lower in the SDF group (0.4 new lesions) than in the water control group (1.1 new lesions) over 36 months. In primary teeth, the SDF groups averaged 0.3 new lesions versus 1.4 in the water control group.

A trial conducted by Chu et al.,(Chu, Lo, and Lin 2002) using only maxillary anterior teeth in preschool children found the mean number of new lesions over a period of 30 months in the SDF group was 0.47 versus 0.7 new lesions per year with 4 yearly applications of FV, versus 1.58 new lesions in the water control group. The review concludes that the preventive fraction for SDF was 70.3% (>60% on permanent teeth and >70% on primary teeth). Only 2 other clinical trials have studied the preventive effect of SDF on permanent teeth. Liu et al.,(Liu et al. 2012) found that proportions of pit/fissure sites with increased dentin caries treated with sealant, VF, and SDF were not significantly different at 24 months and they were all more effective than water control.

Devji et al.,(Devji 2018) found that atraumatic treatment restoration sealants were more effective than a single application of SDF after 18 months. These 4 studies of permanent teeth have not been combined in a metaanalysis because they reported outcomes using different measures (number of teeth with new caries lesions or active lesions, in all surfaces vs only pit and fissure, and provide the data in different units of measurement. No solid conclusions can be reached with such a small number of studies on permanent teeth in children.(Duffin 2019)

In their recent systematic review and metaanalysis, Oliveira et al.,(Oliveira et al. 2019) evaluated caries prevention for primary teeth and concluded that, when compared with placebo at 24 months or more, SDF decreased the development of dentin caries lesions in treated and untreated primary teeth with a preventive fraction of 77.5%. Comparisons between SDF and FV concluded that SDF performed significantly better than FV at 18 and 30 months, and comparison between SDF and glass ionomer cements (GIC) showed that GIC was better than SDF at 12 months (not statistically significant). Both of these comparisons are weak because they are based on only 1 trial each.

Trial from Llodra included only primary posterior teeth and newly erupted first molars, non cavitated lesions in pit and fissures may have been difficult to code and, therefore, may have been missed. In contrast, the trial from Jiang et al.(Jiang et al. 2020) studied only maxillary anterior teeth, where detection of new lesions would have been easier. Another problem making statements about the preventive effect of SDF on the whole dentition is that the trials included have reported new caries in only the teeth studied and not the whole dentition.

Llodra and associates did not include any data on anterior teeth and the study by Chu and coworkers did not include any data on posterior teeth, even though they report that children had lesions and treatment in teeth not included in their study. Direct comparisons with the preventive effect of other modalities of fluoride applications are problematic, because those trials (on toothpaste of FV as an example) always report new caries in the whole dentition.

SIDE EFFECTS AND TOXICITY

None of the reviews or trials report any acute side effects of the SDF used in the conditions of the individual trials on either children or adults.(Castillo et al. 2011) Minor side effects have been described as transient gingival irritation and metallic taste in a small number of participants. Only 1 published study on adults had an as aim to study gingival erythema 24 hours and 7 days after SDF application and found that, even when there was a very small number of participants who presented mild gingival erythema at 24 hours, there was no difference from baseline at 7 days. (Yilmaz, Ocak, and Ökte 2020)

This finding suggests that minor gingival irritations heal within a couple of days. A recent report from a clinical trial on young children states that the prevalence of tooth and gum pain reported by parents was 6.6% 1 week after application, whereas gum swelling and gum bleaching were reported by 2.8% and 4.7%, respectively. SDF should not be used on lesions that are suspected of pulpal involvement because it will not prevent further progression of the infection into surrounding tissues.(Gotjamanos and Ma 2000; Vasquez et al. 2012)

CONCLUSION

Application of silver diamine fluoride biannually is better than all other minimally invasive treatment choices. However, it is unclear what will happen if treatment is stopped after 2-3 years and further research is required. SDF is more effective as a primary preventive material than other restorative materials which are available, except dental sealants which are 10 times more costly and need professional follow up. The use of SDF as a preventive or therapeutic modality can prevent or delay dental treatment for all age groups. It can easily replace fluoride varnish for the caries arrest in subjects that have active caries. It is a powerful public health tool in the fight against dental caries especially in low income countries.

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