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Review Article

A recent update on Silver Diamine Fluoride

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ABSTRACT:
Progression of dental caries in children can lead to pain, infection and loss of function. Managing caries by means of minimal invasions and low-cost methods is an imperative issue. This paper highlights the various beneficial effects of topical application of Silver Diammine Fluoride in both primary and permanent dentition. This review discuss in detail how SDF is a Magic material in dentistry.

Keywords: Caries arrest, Dental caries, Primary dentition, Silver Diammine Fluoride, Topical application.

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INTRODUCTION

Caries has affected human race since prehistoric times and still is one of the most prevalent oral diseases of modern times. Despites the advances in dental care, dental caries remains one of the most common disease affecting children. Traditional approaches of treating dental caries include surgical removal of the diseased dental tissue, followed by the placement of suitable restorative material.

Since this approaches are replaced by minimal invasive approaches to arrest the progression of caries . The concept of minimal intervention approach sometimes called “Preservative Dentistry” to treating dental caries entails a departure from the traditional surgical approach to the elimination of carious lesions is focused on the management of caries as an infectious disease.[1] This includes supporting the use of cariostatic agents to stop the progress of the disease as part of treatment, rather than limiting the focus of treatment to restorative options alone.[2] Minimal intervention dentistry (MID) as a concept within oral healthcare was once considered a peripheral and unconventional topic but has now moved to centre-stage of oral health care. MID embodies a patient-centred approach to care, is evidence-based and supports development of novel treatment options. In order to avoid this, various attempts have been made to prevent and arrest caries at its earliest so that children are not subjected to such time consuming procedures later on. Thus, there is an obvious need to find a suitable method/material that would provide conservative approach to the management of dentinal caries; would be more acceptable to patients, parents and paediatric dentist and would arrest the remaining caries and exhibit least post-operative complications

In the quest of finding one such material, many materials were explored for having fluoride releasing ability and at the same time could arrest caries, various dental restorative materials were developed and evaluated but only some could partially fulfill the needs. One

such material which showed promising results was Silver Diammine Fluoride (SDF). One of these is silver fuoride (SDF) as a cariostatic agent. SDF was first recorded as being used in Japan in 1969 but has recently had a renaissance.[2]

What is silver diamine fluoride

SDF is a colorless aqueous solution containing ammonia and silver fluoride (AgF). The ammonia ions combine with the silver to produce a complex ion called the diammine–silver ion, $[Ag(NH_3)_2]^+$. This formation of diammine-silver ions is reversible and very stable with an alkaline pH of 8-9. Although available in various concentrations, SDF is commonly used in 38% solution as a commercial preparation and traded by the brand name Saforide (J. Morita Corporation. Osaka, Japan), which contains 380 mg water-soluble silver diammine fluoride in 1 ml colorless solution, or about 44,800 ppm of fluoride ions.[3]

THE DAWN OF SILVER DIAMINE FLUORIDE:

Scientific paper titled '' Diammine Silver Fluoride and its Clinical Application'' 1972, was amongst some of the earliest papers on silver diammine fluoride.[4] The paper gave a summary of the properties, mode of action and clinical applications to various indications of silver diammine fluoride. There has been a continuous interest of researchers in the routine clinical applicability of this material since then. Various large scale studies have been done to assess the effect of SDF on various dental hard and soft tissues, efficacy in arresting caries has also been time tested and proved to be effective.

How SDF is thought to work : (fig 1.)

It has been reported that SDF ($Ag(NH_3)_2F$) reacts with the tooth mineral hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$) to release calcium fluoride (CaF_2) and silver phosphate (Ag_3PO_4), which are responsible for the prevention and hardening of dental caries. The CaF_2 formed provides a reservoir of fluoride for the formation of fluoroapatite ($Ca_{10}(PO_4)_6F_2$), which is more resistant to acid attack than hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$). The Ag_3PO_4 that precipitates on the tooth surface is insoluble. Its antibacterial properties arise from inhibition of the enzyme activities and dextran-induced agglutination of cariogenic strains of Streptococcus mutans.[5] In addition, bacteria killed by silver have a further role in the biofilm's disruption and caries protection of the whole mouth through the "Zombie effect" whereby living bacteria are killed on contact with silver-affected bacteria[6].

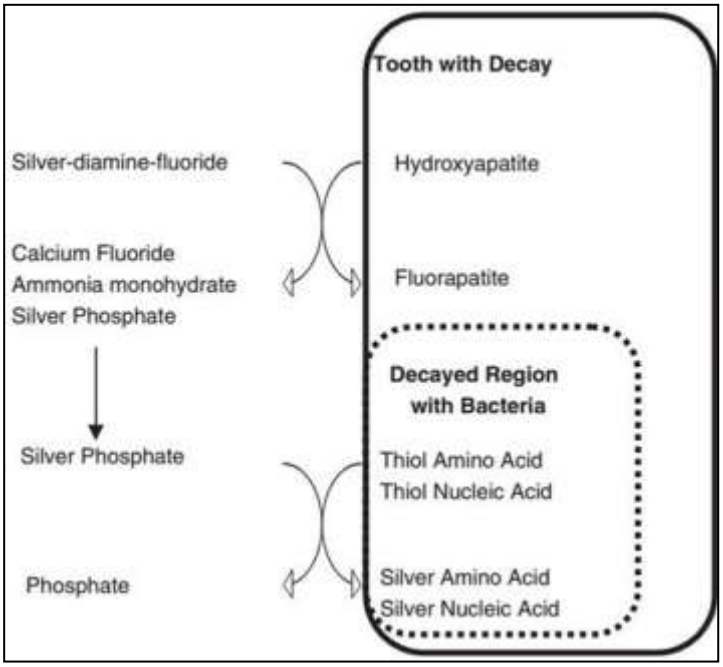

Fig 1: Diagrammatic representation summarising the actions of silver diamine flouride

Indications for SDF:

(i) Used as an agent to promote the arrest and remineralization of active carious lesions.
(ii) Effective for active dentinal lesions, teeth with exposed root surfaces causing dentinal hypersensitivity and may also be useful for permanent molar teeth with molar incisor hypomineralization as blocking the dentinal tubules may reduce sensitivity.
(iii) Pre cooperative children, children and adults whose behavior/ medical conditions limit invasive restorative treatment.

(iv) Patients with high caries risk with medical or psychological conditions that limit other treatment approaches.

- Contra-indications OF SDF:
  - (i) Clinical signs or symptoms of irreversible pulpitis, or dental abcess.
  - (ii) Radiographic signs of pulpal involvement, or peri-radicular pathology.
  - (iii) Ongoing active lesions that are not arresting (only detectable over time)
  - (iv) Patient with ulceration, mucositis, stomatitis.

i. APPLICATION OF SDF

- Maximum 5 teeth can be treated with SDF in one dental visit.
- Application time - one minute
- Drying with gentle flow of compressed air is recommended.

a) Pre operative

b) After placement of SDF SDiammine Fluoride

C) Pre operative

d)After placement of SDF

Figure 2. Clinical photographs before and after application of SDF

POSTOPERATIVE INSTRUCTIONS

- No post operative limitations are listed by the manufacturer.
- Eating and drinking immediately after application is acceptable.
- Patients may brush with fluoridated tooth paste as per regular routine following SDF application.

SDF:- satisfies TRIPLE AIM OF CARE

DISCUSSION:

In developing countries like India, where more than 70% of population lives in rural areas with limited health services are available and the easy access to the dental treatment is not possible. Further, the high cost of restorative treatment for children of low-income families fails to attend to their dental needs, thus, resulting in untreated dental caries.

This situation becomes altogether more complex among paediatric restorative care as the dentists are conventionally stuck to the concept of drill and fill, while the anxiety about drill and fill also makes the children and parents shirk their dental treatment.

As fluoride application has an immense role in the prevention of dental caries, there is a need of a material which could be easily incorporated in community dental health programs and prevent caries.

One such agent, which provides caries arrest and has fluoride releasing ability, is Silver Diammine Fluoride, the specific interest in SDF centers around its 5 attributes[8]:

Control of pain and infection. SDF is effective in arresting caries progression that if left untreated will cause pain and infection

- Ease and simplicity of use (paint on),
- Affordability of material (highly economical *per* application),
- Minimal requirement of armamentarium and
- The treatment is non-invasive.

There has been extensive research on the effect of SDF in adjunct to various other preventive and restorative options like SDF treated dentin shows no decrease in bonding properties to GIC or other tooth coloured restorative materials. Additional benefits have been seen in caries arrest in teeth treated with SDF and laser irradiation.[9]

CH Chu et al. (2008)[1] in a review article described the caries arresting properties of SDF and reported that there was no adverse pulpal or soft tissue response to the its application and even if some mild discomfort was felt during SDF application, the symptoms subsided within 48 hours without any intervention.

Rosenblatt et al. (2009)[4] also reviewed the benefits of silver diammine fluoride in dentistry and coined the term "**SILVER-FLUORIDE BULLET**".

Apart from being a caries arresting agent for deciduous dentition, SDF has also shown to be an effective caries inhibitor in permanent dentition[5] besides being a dentine desensitizing agent[6] and root caries arresting agent.[7]

Although the use of SDF still warrants some precautions while its handling and application. The biggest disadvantage associated with the use of SDF as a routine caries arresting agent is the black staining of the tooth with carious lesion however, posterior region where deciduous teeth have least esthetic requirement and these are the teeth mostly affected, the caries preventive action of the silver diammine fluoride outweighs the discolouration issue. The parental acceptance to the application of SDF has been successfully demonstrated in a study by **Triches et al (2009)** which concluded that the esthetics is not a decisive factor over the cariostatic effect of SDF.[8]

What is the evidence for its use:

A recent umbrella review(a systematic review that, rather than review primary studies, puts together the evidence from systematic reviews) included 11 systematic reviews where SDF was used for carious lesion management in children and adults.[6] The umbrella review found that for prevention of carious lesions in adults and children, there was insufficient evidence to draw conclusion on the effectiveness of SDF. However all of the systematic reviews consistency supported the effectiveness of SDF for arresting coronal carious lesions in primary teeth.

CONCLUSION:

SDF can have a significant and substantial benefit in arresting and preventing caries.

- By implication, SDF could provide a new quantitative preventive benefit for individuals and populations.
- Thus, SDF appears to meet the criteria of both the WHO Millennium Goals, and the Institute of Medicine's criteria for 21st century medicine.

Even though being such a novel material, efforts are still needed to promote its usage and combat the ever increasing rate of dental caries.

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