



Use of Silver Diamine Fluoride for Caries Management

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Abstract: The most common chronic disease in children throughout the world is dental caries. It is a challenge for the clinician to excavate caries and restore teeth in un-cooperative children therefore a new management technique of untreated dental caries has been proposed using Silver Diamine Fluoride(SDF). Various In-Vitro studies by Knight *et al.* from 2005 to 2009 proved it has caries arresting effect and antimicrobial action. Chu *et al.* have recommended using three applications of 38% SDF weekly to arrest rampant caries. Due to its ease of use, cost effectiveness and minimal invasiveness it is one of the best alternative choice of caries control when the routine approaches are not available. Clinical evidence has proven that continued application 1-2 times per year has arrested caries, but if treatment is stopped for 2-3 years what will happen is still a question mark and research needs to be carried out further in this direction.

Key words: Silver Diamine Fluoride, Early childhood Caries, Arrest, Caries Control

Introduction: The most common chronic disease in children throughout the world is dental caries^[1] American Dental Association has recognized Early childhood caries as a prime public health issue in primary dentition of preschool children^[2] If left untreated, it can affect the child's general oral and overall health, body weight and growth and subsequently their performance in school^[3]. It is a challenge for the clinician to excavate caries and restore teeth in un-cooperative children therefore a new management technique of untreated dental caries has been proposed using Silver Diamine Fluoride(SDF). This has been known to have the ability to halt the caries progression as well as simultaneously prevent formation of new carious process^[4]. This hypothesized ability is derived from combined effects of Silver salts which stimulate the formation of sclerotic or calcified dentin, Silver nitrate having germicidal effect and the ability of fluoride to prevent dental caries^[5] Various In-Vitro studies by Knight *et al.* from 2005 to 2009 proved it has caries arresting effect and antimicrobial action^[6-8] Yee *et al.*^[9] in Nepal and Braga *Et al.*^[10] in US successfully used silver diamine fluoride as a caries arresting agent.

Clinical Applications:

- Caries Control – Silver Diamine fluoride (SDF) can be directly applied onto the sound tooth surface for caries prevention or on the decayed portion for arresting the carious process. It has been suggested to protect the gingival portion of the affected tooth with petroleum jelly to prevent gingival irritation. It has been noted that it takes longer for the arrest of carious lesion on application of SDF without removal of caries. The arrested caries appear coal black in appearance^[11] Yee *et al.* found out that 12% SDF was not effective in caries control among children^[12] Chu *et al.* have recommended using three applications of 38% SDF weekly to arrest rampant caries^[13]

Indications:

- Severe Early childhood caries
- Xerostomic Patients (Extreme risk of Caries)
- Medically compromised patients
- Behavioral Problems in children
- In carious lesions difficult to treat
- Carious lesions that cannot be treated in one visit
- In patients with no access to dental care^[14]

2. In Management of Dentin Hypersensitivity

SDF is known to have the ability to occlude the dentinal tubules thereby preventing pain initiated by tactile, chemical, thermal, evaporative or osmotic stimuli^[4,11]

3. Management of Infected root canals during Endodontic therapy

A study by Hiraishi *Et al.* (2010) concluded that 3.8% SDF can be used as an antimicrobial irrigant in root canals especially in areas where blackening or brownish discoloration of dentin by silver metallic ions is not a major concern. A 100% reduction in the microbe, *Enterococcus Faecalis* after a 60 minutes exposure to 3.8% SDF was demonstrated in a laboratory study^[15]

In 2012, Mathew *Et al.* stated that SDF can effectively remove the microbe present in the root canal and the circumpulpal dentin when used as an endodontic irrigant^[16]

4. Other uses -

- Recent studies have shown that the fluoride uptake by teeth is higher when treated with SDF on dentin after Er: YAG (2980nm) and CO₂ irradiation. This will thereby help in strengthening the dentin by changing the composition of recrystallized hydroxyapatite, reduced solubility and enhanced uptake of fluoride to form fluoroapatite crystals^[11]
- As an Indirect pulp capping agent – A study described by Yamaga *et al.* described the use of SDF on the residual softened carious dentin after cavity preparation in cases where the complete removal of the residual dentin may risk the exposure of pulp. This has been known to arrest caries progression and renders the residual dentin harmless^[17] Another study by Chu and Lo has shown the use of SDF to arrest caries as an Indirect pulp capping agent and in ART (Atraumatic Restorative Technique)^[18]

Step by step procedure for Application of SDF

1. Standard PPE(Personal Protective Equipment) for the clinician and patient.
2. 1 Drop of SDF in a plastic dappen dish.
3. Using suction, create a dry field free of saliva.
4. Using Cotton rolls or “2*2” Gauze piece isolate the tongue and gingiva from affected teeth.
5. If carious lesion is near the gingiva, consider application of petroleum jelly.
6. Dry the affected tooth surface using cotton.
7. Apply SDF directly on the tooth surface(s) using a microsponge.
8. Allow the SDF to be absorbed for 1min, the excess to be removed with gauze or cotton roll.
9. Rinse with water.
10. Used gloves, microbrush and cotton to be discarded appropriately^[14].

Drawbacks and Safety

- **Affected surface(s) will be stained black permanently.** Healthy tooth structure is not affected^[11] Parental concerns with esthetics when anterior teeth are affected and Complaints of social embarrassment in children due to visible discoloured teeth^[19] Knight *et al.* have suggested the use of KI (Potassium Iodide) after the application of SDF. It has been known that free silver ions form a precipitate of creamy white silver iodide crystals on reaction with Potassium Iodide. Therefore no silver ions are left to react with substances such as sulphur and other reducing reagents in the oral cavity to form black precipitates on the tooth surface. Further studies are required to be conducted to understand the exact efficacy of this mechanism^[4,6]
- **Staining of skin and clothes** - Although painless, may persist for a long time if not removed immediately. This can be removed under running water with soap or ammonia water. On clothing if it still persists, apply sodium hypochlorite or bleaching powder^[17]
- **Gingival Irritation** - This can be avoided by application of petroleum jelly on the gingiva or use of rubber dam to be on the safer side. If at all it occurs, the area affected turns white and is transient, heals in 1-2 days^[6]
- **Metallic taste** in the mouth, which goes away in sometime^[11]

SDF has shown long standing success over the years with no significant complication proven by literature. There has been no severe pulpal damage or severe irritation reported. A study by Llodra and co-workers reported gingival irritation which resolved in 2 days without the need for any treatment^[20] On the other hand, Gotjamanos has shown favorable pulpal response on application of SDF. It has been said to induce abundant reparative dentin and a wide odontoblast layer^[21]

Contraindications

Absolute Contraindication – Patients allergic to silver (Amalgam restorations)

Relative Contraindications – Ulcerative Gingivitis, Stomatitis^[11]

Discussion

The main idea behind the use of SDF is to arrest the carious process from further involving the tooth structure and invading the pulp^[14,22] Due to its ease of use, cost effectiveness and minimal invasiveness it is one of the best alternative choice of caries control when the routine approaches are not available. Mostly of good use for community service and the underprivileged who cannot afford routine dental care. Best used in un-cooperative children when all other measures of child management fail^[23,24] A study by Zhi *et al.* recommended the application of SDF biannually as compared to annual application^[25] Another research done by Llodra *et al.* observed significant caries arrest on biannual application of SDF^[20] As compared to dental sealants, SDF application is 10 times less expensive and does not require constant monitoring. It is a safe and effective caries control measure among all ages. One of the major drawbacks of esthetic concerns can be overcome with the simultaneous use of Saturated solution of Potassium Iodide(SSKI), which helps reduce colour changes. It is placed by air drying the tooth surface after the application of SDF solution. It must be avoided in pregnant patients^[14]

Conclusion

Silver Diamine Fluoride (SDF) has been a boon in the field of cariology providing timely care to patients in dire need of it. Although it has certain drawbacks, the benefits seem to outweigh it. Clinical evidence has proven that continued application 1-2 times per year has arrested caries, but if treatment is stopped for 2-3 years what will happen is still a question mark and research needs to be carried out in this direction^[14] No significant adverse effects have been noted. Toxicity is still a concern and further studies are still required in overcoming it. Many practices still show concerns over the esthetic results of this treatment^[14] Successful research in overcoming these drawbacks can help in making SDF a material of choice during this 21st century^[4]

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