

Silver Diamine Fluoride in Arresting Caries

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Dental caries is a painful condition that could lead to nutritional problems which affects the overall health of the child, as well it is expensive to treat.

Keywords: children ; caries arrest ; primary teeth ; first permanent molars ; SDF

1. Introduction

Dental caries is a painful condition that could lead to nutritional problems which effect the general health of the child, as well it is costly to treat ^[1]. Early childhood caries has been presented by the World Health Organization (WHO) as a worldwide condition. It was reported that the prevalence of this disease is between 60% and 90% ^[2]. Moreover, the statistics issued by the European countries have showed that 61% of children (6–12) years old have at least one tooth affected with dental caries. As well, due to the widespread of dental caries, this disease may cause a financial load on the society besides its deteriorating results on the children's oral health ^[3]. In addition, the prevalence of dental caries and its severity in Saudi children was found to be almost 80% for the primary teeth with a mean dmft of 5.0 and almost 70% for the permanent teeth with a mean DMFT score of 3.5 ^[4].

Conservative management is the modern approach in managing dental caries. It includes: the early recognition of non-cavitated lesions, identifying the child's caries risk, identifying the activity of the disease, valid and reliable surveillance to select the appropriate conservative approaches and monitoring the signs of caries arrest or the progression of the carious lesions ^[5]. A systematic review by Gao et al. (2016) reported that the caries activity can be arrested by the application of topical fluoride without operative interventions ^[6].

Topically applied fluoride products, such as sodium fluoride (NaF) varnishes, are used for prevention due to their remineralization ability and their antimicrobial properties ^[7]. In 2014, the FDA has approved the use of sodium diamine fluoride (SDF) as a treatment for sensitive teeth, with an off-label use in arresting the carious process. However, it was recently approved (code D1354) to be used as an interim caries arrest product ^[8].

In addition to its cariostatic activity, 38% SDF causes an unfavorable environment for the activation of the dentin collagen enzyme ^[9]. Several studies have reported the effectiveness of SDF and NaF in arresting the caries process in primary and mixed dentition ^{[10][11][12][13]}. Chu et al. (2002) have studied the effectiveness of SDF and NaF in arresting dentin caries in 375 children (3–5) years old. The children were assigned into 5 groups. Children in the first and second groups have received a yearly administration of silver diamine fluoride solution (44,800 ppm F) after the soft carious dentin lesions have been excavated. Children in the third and fourth groups have received sodium fluoride varnish (22,600 ppm F) application every three months. Whereas the fifth group haven't received any treatment and was considered as the control group. All the 5 groups have been followed up for 30 months. It has been found that the children in the control group have developed more new lesions than the children in other groups who have received treatment using SDF and NaF varnish ^[10].

Furthermore, the systematic review by Trieu et al. (2019) regarding the abilities of SDF and NaF varnish in arresting the progression of dentin caries concluded that the effectiveness of SDF in arresting the caries progression manifested to be twice the effectiveness of NaF at 30 months period. Thus, SDF is more effective than NaF in controlling the progression of dentin caries ^[11].

Furthermore, in the current literature, studies have showed the effectiveness of different types of topical fluoride products and materials in arresting caries including SDF, NaF, silver nitrate (AgNO₃), novel nano-silver fluoride (NSSF) and glass ionomer cement (GIC) restorative material. However, the current available findings propose that SDF could be a successful product in arresting dental caries and an appropriate substitute of the widely used topical fluoride products and materials.

2. Silver Diamine Fluoride in Arresting Caries in Primary and Early Mixed Dentition

Dental caries is a global chronic bacterial disease that demineralizes the hard tissues of the dentition and remains a significant issue mostly in populations with low socioeconomic conditions ^[14]. Preventive management of dental caries should be taken in every community such as fluoridation of public water, using dentifrices with fluoride, good oral hygiene implementation and induce healthy dietary habits through the available community educational methods ^[15]. Zhi et al. (2012) and dos Santos et al. (2012) found that SDF is more effective in arresting caries than GIC used in ART when applied bi-annually which emphasizes on the importance of the follow up visits to achieve the desired cariostatic effect ^[16] ^[17]. In contrast, Monse et al. (2012) and Vollú et al. (2019) compared SDF and ART effect on carious lesions and found no significant difference in their cariostatic efficacy. However, the SDF had less chair-time than ART ^[14]^[18].

Furthermore, the results of Duangthip et al. (2016) and its follow up article (2018) compared 30% SDF and 5% NaF varnish in controlling caries and found that 30% SDF is more effective than 5% NaF varnish ^[12]^[19]. In agreement, Mabangkhu et al. (2020) compared the effect of 38% SDF and 5% NaF varnish in arresting caries and concluded that the application of 38% SDF is more effective than 5% NaF varnish ^[20]. Moreover, Fung et al. (2018) who compared two different SDF concentrations reported that 38% SDF is more effective in arresting caries than 12% SDF, indicating that the SDF concentration has a significant role in the caries arrest process ^[21]. The results of Tirupathi et al. (2019) showed that using 38% SDF and 5% NSSF have the same efficacy in arresting caries which was explained by the synergism of NSSF components (Nano silver and sodium fluoride) ^[15]. In contrary, Gao et al. (2020) found the use of 38% SDF every six months was as effective as the use of 25% AgNO₃ followed by the application of 5% NaF every six months in arresting ECC, and this can be explained by the high fluoride concentration in SDF (44,880 ppm) ^[13]. In addition,, the limitations mentioned in the studies such as small sample size and conducting the studies in one site may not be representative of the population ^[16]^[17]^[22]. Additionally, because radiography was infeasible in the community, Mabangkhu et al. (2020) used the visual-tactile examination for detecting caries which was considered as a limitation in their study. As well, it was mentioned that the black staining of SDF may lead to a bias on detecting caries. More limitations were mentioned such as using a blinded trained examiner who was not involved in the treatment and the 12-month study period that was considered a short period for confirming the caries progression and activity ^[20].

Gao et al. (2020) mentioned that the limitations of their study included the follow up period (six months interval) between the examinations as they were not able to determine the time when the caries process was arrested. Also, the reported caries arrest effectiveness might be lower than the real number since they used LOCF (last observation carried forward method) to input missing data. In addition, conducting the trial in a place with compromised equipment was one of the limitations because the caries arrest rate would be higher if the study was conducted in clinical setting ^[13]. Thus, this systematic review has to be cautiously viewed since it encountered limiting factors such as the different caries detection techniques used in the studies and the difficulty to blind the operator and examiner from the treatment groups since the SDF has different texture and causes black staining of teeth unlike NaF and the other topical fluoride products and materials ^[13]^[20]. This may play a role in representing the results of the studies.

In summary, SDF shows more effectiveness in arresting caries than the available topical fluoride products and materials in primary and permanent dentitions. The application of SDF is simple, less time consuming, and doesn't require high operator's skill. It is considered inexpensive compared to other materials such as GIC, also it is easy applied in teeth with difficult accessibility. However, the main disadvantage of using SDF is the dark black staining color.

Many studies have reported different solutions to overcome this disadvantage and decreasing the staining of the treated teeth such as the application of potassium iodide following the application of SDF ^[23]^[24]^[25]^[26]. In terms of parental acceptance, several studies have reported that SDF black staining of teeth was accepted by parents in posterior compared to anterior teeth in addition to other reasons as the child's cooperation, socioeconomic status, and the need of using sedation or referral to general anesthesia to receive dental treatment ^[12]^[14]^[20].

3. Conclusions

The application of SDF is a practical and efficacious practice in arresting dentin carious lesions in primary dentition and first permanent molars in children. As well, SFD showed to be more effective in arresting caries in primary and early mixed dentition when compared to the known used topical fluoride products and materials. Nevertheless, these findings must be cautiously viewed since more research is required to support them.

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