

Effect of Silver Diamine Fluoride in Arresting Dental Caries

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Abstract: Low-cost and easily operated professionally applied fluoride therapy has been proposed as an alternative treatment option for children with dental caries. One of the professionally applied fluoride therapy is the application of silver diamine fluoride (SDF), which was approved by the US Food and Drug Administration (FDA) to be used as a desensitizing agent in 2014 and has been used off-label to arrest carious lesions. This literature review aims to analyze the benefits and limitations of SDF in arresting dental caries. The result shows the beneficial effect of SDF in arresting dental caries but has shown adverse effects of dark staining and reversible white spots on the oral mucosa. A fairly recent randomized clinical trial research paper on nanosilver fluoride (NSF) to overcome the adverse effects has been reviewed. The result shows that NSF demonstrates the effect of arresting dental caries without the adverse effects of SDF.

Introduction:

Despite advances in dental materials and an increase in people's oral hygiene awareness, dental caries is still one of the most prevalent chronic diseases in the population. The US Centers for Disease Control and Prevention (CDC) reports that 28% of all US toddlers and preschoolers are affected by caries and that almost half of US children experience caries before entering kindergarten. When analyzed, the number of children affected by dental caries is disproportionately affected for the children from low socioeconomic status families. The children from such families have limited access to conventional dental care because they are either financially unaffordable or simply unavailable due to the lack of dental manpower and sophisticated dental equipment and facilities. An alternative solution to this problem is professionally applied fluoride therapy, which is low-cost and readily executed. Professionally applied fluoride therapy can be delivered in community settings outside the dental facilities and is a non-invasive procedure, making it easier for children to tolerate. The literature review aims to analyze the effectiveness of professionally applied fluoride therapy, specifically silver diamine fluoride (SDF). SDF was approved by the US Food and Drug Administration (FDA) to be used as a desensitizing agent in 2014 and has been used off-label to arrest carious lesions. Two systemic reviews on the effect of SDF and a fairly recent randomized controlled clinical trial testing the effect of nanosilver fluoride (NSF), a similar agent that overcomes the adverse effect of SDF, have been reviewed.

Role of fluoride in SDF to prevent, remineralize, and arrest dental caries:

Silver diamine fluoride (SDF) is a colorless liquid that at pH 10 is approximately 25% silver and 5% fluoride in volume. Fluoride contained in SDF plays a crucial role in caries prevention, remineralization, and arrest. Enamel, the tooth's outermost surface, is composed of

hydroxyapatite, which is composed of phosphate and calcium ions. There is an equilibrium between hydroxyapatite and phosphate and calcium ions in normal circumstances. However, hydroxyapatite is dissolved when the pH drops below a critical threshold, causing demineralization. When fluoride is present in the mouth, fluoride ion replaces hydroxyl ion groups in the hydroxyapatite to form fluorapatite, which is a stronger tooth mineral. The formation of fluorapatite makes teeth more resistant to demineralization under acidic conditions, lowering the critical pH value of crystal dissolution from approximately 5.5 to 4.5. In addition to inhibiting demineralization, fluoride enhances enamel remineralization and arrests dental caries.

Literature Review:

In the research article "Caries remineralisation and arresting effect in children by professionally applied fluoride treatment—a systematic review" written by Sherry Shiqian Gao, Shinan Zhang, May Lei Mei, Edward Chin-Man Lo, and Chun-Hung Chu (Gao et al., 2016), a systematic search of publications from 1948 to 2014, a total of 2177 articles were found, of which, 17 studies were ultimately selected that met the criteria of the systematic review, which is the clinical trial on children with the outcome measurement evaluating remineralisation or arresting effect of caries by a professional fluoride treatment. Among the 17 studies selected, seven studies were investigating the use of SDF or NSF in children. The seven studies showed the beneficial effect of SDF at different concentrations and NSF in arresting dental caries. Five studies used SDF at 38% concentration with differing application frequencies among the seven studies. Three studies reported annual application of SDF and the mean proportion of arrested dental caries ranged from 65.2 to 79.2%. One study used SDF 38% semi-annually with the mean proportion of arrested caries of 84.8%. Another study used SDF 38% applied one-time with



the proportion of arrested dental caries of 31.2%. The overall proportion of arrested dental caries after SDF 38% application was 65.9%.

The second research article reviewed was "Effectiveness of silver diamine fluoride in caries prevention and arrest: a systematic literature review" written by Dr. Violeta Contreras, Dr. Milagros J. Toro, Dr. Augusto R. Elias-Boneta, and Ms. Angeliz Encarnacion-Burgos (Contreras et al., 2017). Similar to the first systematic review, database searches were performed, yielding 821 publications, of which 7 met the criteria of the systematic review. These included one study assessing the effect of SD at different concentrations, 3 studies comparing the SDF with other interventions, 2 studies assessing the effect of SD at different application frequencies, and lastly 1 study comparing the semiannual application of SD to the control group. The majority of the studies showed that SDF at 30% and 38% concentrations were effective for arresting dental caries compared to other interventions. Caries arrest rate was significantly higher for the semiannual 38% SDF application group (53%) compared to the annual 38% SDF (37%) or GIC (28.6%) application group. Also, 38% of SDF was shown to be more efficient in caries arrest compared to 12% of SDF and the control group. Another study showed that 30% SDF was 1.73 times more effective to arrest caries (66.9%) than an interim restorative technique (38.6%) after 6 and 12 months. One of the selected studies compared the effectiveness of 30% SDF applied 3 times at weekly intervals, 30% SDF applied annually, and 5% NaF fluoride varnish applied 3 times at weekly intervals. The 3 SDF applications group demonstrated higher caries arrest rates for the first year than the other groups. However, after 18 months, the annual SDF application group exhibited higher (40%) caries arrest rates than the 3 SDF applications group and NaF varnish application group (35% and 27%, respectively). In the last study investigated, 10% SDF was compared to other interventions, GIC and CTT. Again, 10% SDF showed significantly higher caries arrest rates than both GIC and CTT.

Both of these studies successfully demonstrated the effect of silver diamine fluoride in arresting dental caries. However, SDF exhibited adverse effects of forming dark staining of carious lesions and white spots on the oral mucosa. A randomized controlled clinical trial research article, "Nanosilver Fluoride—A Paradigm Shift for Arrest in Dental Caries in Primary Teeth of Schoolchildren: A Randomized Controlled Clinical Trial" written by Venugopal R Nagireddy, Daneswari Reddy, Saigeeta Kondamadugu, Niharika Puppala, Ajayreddy Mareddy, and Annie Chris (Nagireddy et al., 2019), investigated nanosilver fluoride which helps arrest dental caries and overcomes the disadvantage of SDF. The researchers randomly

selected a total of 100 deciduous maxillary and mandibular molars from 60 children of 4-9 years, which were then randomly divided into an NSF experimental group and a control group receiving saline. After the teeth were clinically diagnosed and treated by one masked examiner, they were followed up at 7 days, 5 months, and 12 months by a different calibrated examiner who was also blinded to the type of treatment the teeth received. The results showed that the NSF group had higher caries arrest rates compared to the saline control group at all time intervals. 78% of decayed teeth showed arrested caries at 7 days; 72.91% of decayed teeth in the NSF group showed arrest caries at 5 months, compared to 34% caries arrest rate in the saline group; NSF group showed 65.21% caries arrest rate after 12 months compared to the control group, which had 28.88% caries arrest rate. As previously mentioned, despite the benefits, SDF had the adverse effects of staining lesions black and forming white lesions on the oral mucosa. Unlike SDF, however, NSF investigated in this study did not exhibit any adverse effects.

Discussion:

Centers for Disease Control and Prevention (CDC) recommends water fluoridation on the basis that fluoride plays a key role in strengthening teeth and reducing dental decay. The therapeutic effect of silver diamine fluoride (SDF), a topical medication containing fluoride, was analyzed in the research articles, and all the results demonstrated the definitive effect of SDF on arresting dental decay. One notable disadvantage of SDF, however, is the black staining lesions on teeth and white lesions on the oral mucosa. Nanosilver fluoride (NSF) is an emerging anticaries material, which is similar to SDF but does not demonstrate the adverse effect of SDF. As shown in the clinical trial done by Nagireddy et al., NSF successfully arrests dental decay while overcoming the adverse effect of staining lesions black and forming white lesions on the oral mucosa.

Despite the benefits, it should be noted that SDF and NSF are not treatments for decay; rather, they simply arrest decay. A more definitive treatment for dental decay is the conventional treatment method, in which a dentist completely excavates dental decay utilizing rotary instruments and restores the prepared tooth with various restorative materials such as composite resin and amalgam. The purpose of such a method of treating dental decay is to restore the original function and esthetics of the tooth. Compared to the traditional method, SDF and NSF cannot restore function and esthetics.

However, it is not to say that SDF and NSF are not useful. In certain circumstances, instruments and materials necessary for the conventional dental decay treatment may not be available or the patients cannot

financially afford the treatment. In these cases, the utilization of SDF and NSF are crucial to arrest dental decay so that it does not progress to a bigger clinical problem down the road. Whether treating or arresting dental decay, the most important first step in preventing dental decay is to get a routine dental check-up, during which the presence of dental decay is discovered. Advance in a dental material is no use without an examination. The literature review hopes to raise people's awareness that dental decay can be arrested with affordable dental materials such as SDF and NSF and to encourage them to get routine dental check-ups.

Conclusion:

Research articles discussed and reviewed in this literature review have analyzed the clinical efficacy of SDF and NSF in arresting dental decay. NSF is a more recent dental material that overcomes the adverse effect of SDF, which stained teeth black and oral mucosa white. In the research articles reviewed, both SDF and NSF demonstrated clinical effectiveness in arresting

dental decay. In areas where access to dental care is limited, these materials can play a significant role in preserving community health by preventing dental decay from progressing to irreversible states in which patients would be in pain or teeth that could be saved would have to be extracted.

References:

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