

Efficacy of Silver Diamine Fluoride in Arresting Dental Caries in Primary Teeth in Patient Visiting Tertiary Hospital of Kathmandu

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ABSTRACT

Introduction

Cariou lesions can both be prevented and arrested using fluoride-based materials. This study was done to evaluate and compare the efficacy of silver diamine fluoride in arresting dental caries at different frequencies of applications.

Methods

This experimental study was conducted among ten preschool children of 3-5 years old with seventy- four active carious lesions taking teeth as a sample unit. Children were randomly allocated into two intervention groups: Group 1—application of 38% silver diamine fluoride solution at three consecutive weeks and Group 2— three applications of 38% silver diamine fluoride solution at monthly interval. The time taken of caries arrest was recorded. Data were collected and entered in Microsoft Excel sheet and analysis was done in Statistical Package for the Social Sciences (SPSS) version 16.

Results

The mean time taken for caries arrest for Group II (57.20 days) was found to be statistically longer than Group I (21.54 days) (p-value < 0.001). As the mean time taken for caries arrest for Group I was shorter, the weekly application was found to have higher efficacy than the monthly application.

Conclusions

Efficacy of Silver Diamine Fluoride was found to be more in Group I (weekly application) compared to Group II (monthly application).

Keywords: arrest of caries; dental caries; silver diamine fluoride.

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INTRODUCTION

Dental caries is a public health issue causing pain and infection in children.¹ It can be prevented and arrested using fluoride-based materials like Silver Diamine Fluoride (SDF) which is a non-invasive approach to halt the progression of carious lesion.^{2,3} SDF is a colorless alkaline liquid containing 255,000 ppm of silver and 44,800 ppm fluoride ion at pH 10. Its composition is 25% silver, 8% ammonia, 5% fluoride, and 62%v water. Each milliliter contains 380 mg (38 w/v%) of Ag (NH₃)₂F which is referred as 38% SDF. One drop of SDF contains 9.5 mg of it and can be used to treat five teeth. It is safe because doses used are 1/400th of the lethal dose.⁴ Various regimens of applications have been adopted like weekly,⁵ monthly,⁵ biannual⁶ or annual.⁵ Thus, this study was conducted to evaluate and compare the efficacy of SDF in arresting dental caries at different frequencies of applications.

METHODS

The experimental study was conducted among 10 preschool children from pre-primary school and age of 3-5 years old with 74 active carious lesions taking teeth as a sample unit. Before commencement of the study, an approval letter was obtained from Nepal Health Research Council (NHRC Ref no 424). The study was conducted from July 2019 to August 2020 in department of Pediatric and Preventive Dentistry of People's Dental College and Hospital in Kathmandu, Nepal. Non-probability sampling technique was used to select the children who met the inclusion criteria: school children of 3-5 years old with cavitated lesion in endodontically healthy deciduous teeth, medically fit, healthy and free of any systemic diseases. (American Society of Anesthesiologist-II)⁷ and cavitated lesions belonging to ICDAS II, Score 4, 5 and 6 were included in the study.^{8,9} Tooth with caries lesion extending into pulp or symptomatic teeth suggesting teeth as non-vital such as tooth discoloration, mobility and abscess, hereditary

developmental defects such as amelogenesis imperfecta and dentinogenesis imperfect, children whose parents refused to give consent and inability to cooperate for SDF treatment or return for recall visits at three months were not enrolled in the study.

Case history was taken by trained doctor. Dental caries was checked according to DMFT/dmft criteria described by Gruebbel AO in 1944.¹⁰ For all selected teeth, numbering was done from 1-74. Participants with odd number were selected for Group I and with even number were selected for Group II. Total number of teeth selected for Group I were 39 and for Group II were 35. A written informed consent was taken from parents of the participants. Children were recalled in the hospital for application of the SDF. In Group I, three applications of 38% SDF at weekly intervals and in subjects of Group II, three applications of 38% SDF at monthly intervals was done. A disposable micro brush was used to apply the agent on each carious lesion in maxillary and mandibular teeth of both groups and rubbed for 10 seconds. After application, the child was asked not to drink or eat for at least 30 minutes. Non-fluoridated toothpaste was distributed to the children during study period. Subjects of Group I was recalled for three consecutive weeks for application of agent and after then recalled weekly for evaluation. Evaluation was done by another trained doctor to assess whether the treated lesion have become arrested or not. Cavities with smooth and hard surface were classified as arrested caries. The cavity which got arrested was marked as A. Time interval for each lesion in maxillary and mandibular teeth to get arrested was then recorded. Time to arrest of caries was the outcome measure of effectiveness. Similarly, subjects of Group II were recalled in second month and in third month for second and third application. After third application, subjects of Group II were recalled weekly for evaluation of caries arrest. In each visit required time interval to get the caries to be arrested was

noted down. The evaluation was done until three months.

RESULTS

The study was carried out in total of ten school children of age group 3-5 years. Out of which six (60%) males and four (40%) females with 74 active carious lesions. Group I included 39 teeth in which six central incisors (15.4%), six lateral incisors (15.4%), six canines (15.4%), nine first molars (23.1%) and 12 second molars (30.7%) were involved. Group II included 35 teeth; central incisors six (17.1%), lateral incisors five (14.3%), canines four (11.4%), first molars 11 (31.5%) and second molars nine (25.7%). Total number of teeth included in the study were central incisors 12 (16.2%), lateral incisors 11 (14.9%), canines 10 (13.5%), first molars 20 (27%) and second molars 21 (28.4%). Total of 33 (44.6%) anteriors and 41 (55.4%) posteriors. Total teeth in maxillary arch were 26 and in mandibular arch were 13 for Group I and for Group II 21 in maxillary arch and 14 in the mandibular arch.



Figure 1. a) Active dentinal caries before application of SDF in Group I, b) Caries arrest after three consecutive weekly application in Group I.

Figure 3 shows the distribution of selected teeth surfaces with active carious lesions in the Group I. Of the six central incisors with active carious lesions, four (66.7%) had the lesions on labial surface and two (33.3%) had the lesions on mesial surface. Similarly, among four lateral incisors (66.7%) with active carious lesions two had lesion on labial surface and two on mesial surface (33.3%) respectively; six canines (100%) had active carious lesion on labial surface; nine (100%) first molars on occlusal surface; two second molars (16.7%) on buccal surface and 10 second molars (83.3%) on occlusal surfaces. In total, 16 (41%) teeth had the lesion on labial or buccal surface, four (10.3%) had the lesion on mesial surface and 19 (48.7%) had the lesion on occlusal surface.

Figure 4 shows the distribution of selected teeth surfaces with active carious lesions in Group II. Of the six central incisors with active carious lesions, two (33.3%) had the lesions on labial surface, two (33.3%) had the lesions on mesial surface and two (33.3%) had the lesions on distal surface. Of the five lateral incisors, two lateral incisors (40%) had active carious lesions

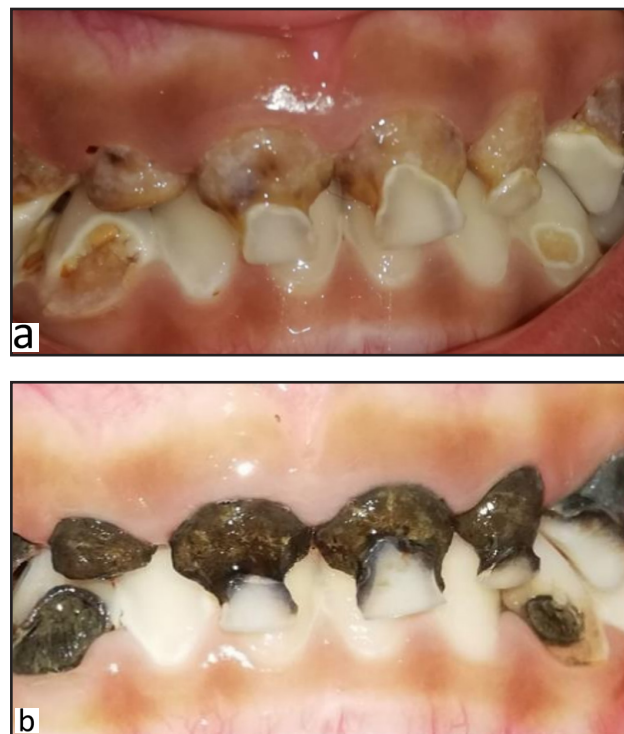


Figure 2. a) Active dentinal caries before application of SDF in Group II, b) Caries arrest after three consecutive monthly applications in Group II.

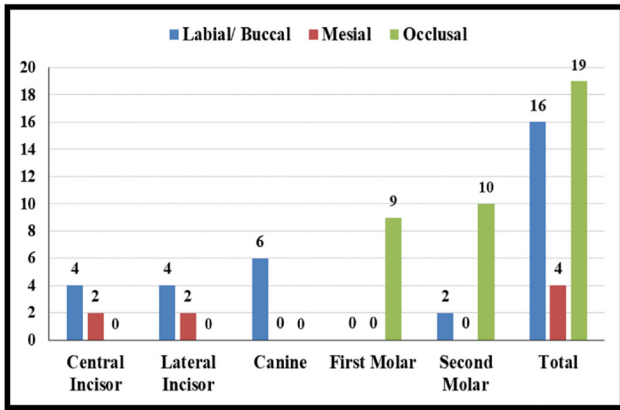


Figure 3. Distribution of selected teeth surfaces with active carious lesions in Group I.

on labial surface, two lateral incisors (40%) had active carious lesion on mesial surface and one lateral incisor (20%) had active carious lesion on distal surfaces respectively. Similarly, among four canines (100%) all had active carious lesion on labial surface. Among 11 first molars one (9.1%) had active carious lesion on buccal surface and remaining ten first molars (90.9%) had active caries lesion on occlusal surfaces, and in nine second molars (100%) had active carious lesion on occlusal surfaces. In total, nine (25.7%) teeth had the lesion on labial or buccal

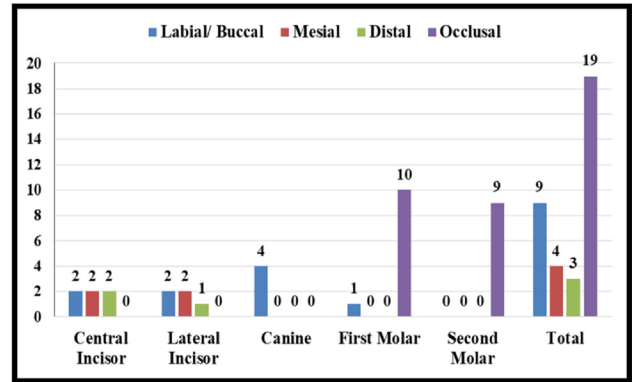


Figure 4. Distribution of selected teeth surfaces with active carious lesions in the Group II.

caries arrest was not seen in any teeth. Caries arrest was seen in 13 teeth during the second evaluation (after two weeks), in 10 teeth during the third evaluation (after three weeks) and in 16 teeth during the fourth evaluation (after four weeks) for the same group. In Group II, caries arrest was not seen in the first, second, third and fourth evaluation. Caries arrest was seen in nine teeth during the fifth evaluation (after five weeks), in 19 teeth during the ninth evaluation (after nine weeks) and in seven teeth during the tenth evaluation (after 10 weeks) in the same group (Table 1).

Group I (Weekly)			Group II (Monthly)		
After 2 weeks	After 3 weeks	After 4 weeks	After 5 weeks	After 9 weeks	After 10 weeks
n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
13 (33.4)	10 (25.6)	16 (41)	9 (25.7)	19 (54.3)	7 (20)

surface, 4(11.4%) had the lesion on mesial surface, three (8.6%) had the lesion on distal surface and 19 (54.3%) had the lesion on occlusal surface. In Group I during the first evaluation,

Mean time taken to arrest the caries for Group II (57.2 days) was found to be longer than Group I (21.54 days) which was found to be statistically significant (p-value < 0.001) (Table 2).

Group	Mean time (days) ± SD	t-value	95% Confidence Interval		p-value
			Lower Bound	Upper Bound	
Group I (Weekly)	21.54±6.09	-14.35	-40.67	-30.66	<0.001*
Group II (Monthly)	57.20±13.53				

Independent samples t-Test, p-value < 0.05 statistically significant

The minimum time taken for caries arrest in Group I was 14 days and in Group II was 35 days while the maximum time taken for Group I was 28 days and for Group II was 70 days. As the mean time taken for caries arrest for Group I was shorter, weekly application was found to have higher efficacy than monthly application.

DISCUSSION

SDF offers an easy and highly efficient non-surgical alternative treatment to traditional restorative dental treatment in young children and has great potential to aid the dental public health community to address dental caries in at risk populations. SDF have anti-bacterial properties and anti-caries properties. Anti-bacterial property inhibits biofilm formation and interferes with the enzyme activity of glucosyl transferase (GTF), which causes decreased sugar synthesis, resulting in the reduction of plaque formation.^{10,11} While fluoride changes hydroxyapatite into fluorapatite ($\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$), which is more resistant to acidic environments, it limits cariogenic bacteria and enhances remineralization of demineralized tooth structure, resulting in caries arrest. There are no published recommendations for the frequency of SDF applications. Some have used single application and recalled after three weeks and at three months⁶ whereas some study has three weekly application¹², monthly application, biannual¹⁰ and annual application.¹² The commonly adopted regimen for frequency of application of SDF is either once a year or every six months for arresting caries in primary teeth. In this study the efficacy of three consecutive weekly applications and three consecutive monthly applications were compared. This study demonstrated that three consecutive applications of SDF whether weekly and monthly was effective as all teeth were arrested which was similar to the studies conducted by Zhi et al.¹³ and Fung et al.¹¹ Similarly, Duangthip et al. in 2016¹⁴ conducted a study which reported that

caries rate in both annual or three consecutive weekly applications of SDF solution was equally effective. The present study also showed similar results as the number of caries arrested was similar in both Group I and Group II. In this study, caries arrest on labial/buccal surface of the teeth involved showed higher caries arrest in both groups. These findings were consistent with those from an earlier study by Zhi et al. in 2012¹³ which found that lesions in the anterior teeth or buccal/lingual surfaces had a higher chance to become arrested as these surfaces bathed more directly in saliva than others or that surfaces exposed to light resulted in more active silver precipitation. Zhi et al. in 2012 and Fung et al. in 2016 stated posterior teeth and large cavities had less chances of arrest with one-time application^{11,13} which was also seen in this study as the total time required to arrest carious lesion in anterior teeth was shorter in both Group I and II, as compared to the posterior teeth which had larger lesions. The reason behind this could be the increased accessibility of anterior lesions for cleaning. This is in line with the general recommendation that high-risk children should receive more frequent topical fluoride applications.^{15,16}

CONCLUSIONS

Caries arrest is seen in both weekly application and monthly application of SDF but time taken to arrest caries for weekly application is shorter thus it is concluded that three consecutive weekly application is more effective. With this result, this study could be a valuable contribution to formulate regimen of frequency of application especially in primary teeth where caries occurrence and rate of caries progression is fast.

Limitations

Further studies with larger sample size, additional use of radiographs determine if the lesion progresses or not and reevaluation for a

longer period of time would have added more value to the study.

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