Antibacterial, Antiplaque and Anticaries Effect of Silver Diamine Fluoride and Fluoride Varnish in Children

Saloni Verma¹, Suma Sogi², Shalija Chatterjee³, Priyanka Sharma⁴, Abhishek Dhindsa⁵, Roopam Kapoor⁶

¹MDS, (Ex - Pg), Department of Pediatric and Preventive Dentistry.
²MDS, Professor and HOD, Department of Pediatric and Preventive Dentistry, Maharishi Markandeshwar College of Dental Sciences and Research (M.M.C.D.S.R.), Mullana, Ambala (Haryana). E-mail: hpsumasogi@gmail.com
³MDS, Professor, Department of Oral and Maxillofacial Pathology, Yamuna Institute of Dental Sciences and Research (YIDSR), Gadholi, Yamunanagar (Haryana).
⁴MDS, Reader, Department of Pediatric and Preventive Dentistry, Maharishi Markandeshwar College of Dental Sciences and Research (M.M.C.D.S.R.), Mullana, Ambala (Haryana).
⁵MDS, Professor, Department of Pediatric and Preventive Dentistry, Swami Devi Dyal Dental College, Panchkula (Haryana).
⁶MDS, Lecturer, Department of Pediatric and Preventive Dentistry, Maharishi Markandeshwar College of Dental Sciences and Research (M.M.C.D.S.R.), Mullana, Ambala (Haryana).

Abstract

Aim: To compare the antibacterial, antiplaque and anticaries effect of silver diamine fluoride (SDF) and fluoride varnish in children.

Materials and Method: A total of 54 children, 12-14 years of age were included in the study. Children were divided into 3 Groups: - Group 1: SDF, Group 2: Fluoride Varnish, Group 3: Normal Saline. All the children were evaluated for S. mutans count and Plaque score after 72 hours, 3 and 6 months.

Result: In Group 1, statistically significant reduction in mean S. mutans count was seen after 3 days, 3 months and 6 months. However in group 2 and 3 significant reduction in mean S. mutans count was observed only after 3 days. A significant reduction in mean plaque score was seen after 3 days and 3 months in group 1, after 3 days in group 2 whereas after 3 days and 3 months in group 3. Intergroup comparison shows non -significant difference in mean S. mutans count and plaque score between group 1 and 2, while statistically significant difference in mean S. mutans count was found between group 1 and 3 and group 2 and 3 after 3 days, 3 and 6 months. Moreover, a significant difference was found in mean plaque score between group 1 and 3 and group 2 and 3 after 3 days, 3 and 6 months excluding a non-significant value after 3 months between group 2 and 3.

Conclusion: In vivo application of SDF and Fluoride varnish results in significant reduction in S. mutans count, plaque score and no carious lesion was detected after the follow-up time intervals.

Keywords: Silver Diamine Fluoride (SDF), Fluoride Varnish, Dental Caries.

DOI: 10.47750/pnr.2022.13.S03.245

INTRODUCTION

Dental caries is a well-recognized multifactorial disease. Streptococcus mutans (S. mutans) plays a significant role in the progression of dental caries. Several studies have already revealed high number of S. mutans in the saliva and plaque in children with active carious lesions as compared to caries free children. So, to reduce dental caries various studies have focused on the prevention of S. mutans colonization. [1,2]

Comprehensive management of dental caries include management of disease and the lesion as well. A more focus on preventive strategies as minimally non-invasive methods are given. [3] Earlier, Bibby in 1942 presented topical fluoride in the form of 0.1% Na F solution. [4] Several topical fluorides were introduced and were significantly proven as an important and effective agent against dental caries.

In 1964, Schmidt introduced Fluoride Varnish to dentistry. [5] Since then, it became the most widely used professionally applied topical fluoride agent in Europe. Fluoride Varnish applied professionally two to four times a year would substantially reduce tooth decay in children. However, more vigorous research is needed to show significant results in the treatment. [6]

Even though there are multiple topical fluoride agents, still none of them have proved satisfactory. A relatively new fluoridated agent SDF with its hypothesized ability to halt the carious process and simultaneously prevent the formation of new caries has been used in Japan since 1970’s. SDF proves to be safe, effective, competent and could become a vital component for comprehensive and
effective preventive programs that fulfill the WHO Millennium Goals.\textsuperscript{[7,8]} Topical application of SDF has received much attention in the past years and this could be due to its ease of application and low cost.\textsuperscript{[9]} Hence, this present study was conducted with an aim to evaluate antibacterial, antiplaque and anticaries effects of SDF and Fluoride varnish in Children.

**Materials and Method**

The present prospective randomized controlled study was conducted in the Department of Pediatric and Preventive Dentistry, M.M.C.D.S.R, Mullana. Total 144 children (both male and females) were screened from primary and secondary government funded schools in Ludhiana and Yamuna Nagar district, Haryana. Out of them, 54 children with an age group of 12-14 yrs and decayed missing filled teeth score >2 and <5 were included in the study. Children with special health care needs, ulcerative gingivitis/stomatitis, with known silver allergy and whose parents were not willing to participate were excluded from the study. Informed written consent was taken from parents of all the participants and patient record form was filled. Ethical approval for study design and protocol was taken from Institutional Ethical Committee of MMCDSR, MMDU, Mullana.*

Children were divided into 3 groups on a random basis:

- **Group 1** - Study Group: SDF (38\%w/v)
- **Group 2** - Control group: Fluoride varnish FV (6\% NaF, 6\% CaF\textsubscript{2})
- **Group 3** - Placebo group: Normal saline was applied in the study group. (Fig 3,4,5)

**Method of Saliva Collection**

Baseline saliva samples were collected for study/control group. The resting whole saliva sample of the patient was collected using a sterile cotton swab, from all surfaces of the teeth and immediately transferred to a screw capped plastic tube containing Todd-Hewitt transport media. All tubes were immediately sealed. It was then transferred in bacteriological laboratory for culture. S.mutans growth was studied on Mitis Salvarius agar culture plates.\textsuperscript{[10]}

Following appropriate dental treatment for the decayed teeth, patients were evaluated for plaque score and S. mutans counts for all the three groups at baseline, 72 hrs, 3 months and 6 months time interval. Plaque index (Silness and Löe) and Mitis Salivarius agar media was used for
determining plaque score and S. mutans count respectively. After 6 months time interval, any broken restoration and new carious lesion was verified.

**Clinical Procedure**

Fluoride varnish was applied on the teeth with a thin brush. After Fluoride varnish has set, children were allowed to rinse with water. For SDF application, whole mucosal surface was covered with the vaseline, to protect it from mild burning sensation due to SDF. Isolation of the teeth was done with the help of cotton rolls & low volume suction. Application of SDF was done with small cotton pellet held with tweezer and applied for 3-4 minutes on all tooth surfaces in single quadrant at one time. The application was done in lower arch first (as saliva accumulates rapidly) starting from the most distal to mesial tooth followed by the upper arch This procedure was repeated on all quadrants in a similar manner. As per manufacturer’s instructions, after 4-5 minutes of application patient was allowed to rinse his/her mouth by gargling with normal saline. For Normal saline group, following the treatment, patient was allowed to rinse his/her mouth by gargling with normal saline.

**Microbiological Procedure**

The isolation of S. mutans was done in the Department of Oral and Maxillofacial Pathology, MMCDSR, Mullana. Mitis Salivarius agar media was prepared and autoclaved. 0.5% potassium tellurite was added in media and was poured into petri dishes. Samples were streaked onto the agar plates which were inoculated at 37°C for 72 hours in an incubator. The colonies were identified by the morphological characteristics i.e., round, elevated, blue in colour ranging from pin-point to pin-head size with glossy surface and can be detached from the agar surface. (Fig 1) The S. mutans counts for all the three groups in CFU/ml were counted using the magnifying glass.

**RESULTS**

The present study included 54 children (32 were males and 22 females) age group of 12-14 years with the mean age of 13.5 years.

In group 1 (SDF), statistically significant difference was observed between the mean value of baseline S. mutans count and count after 3 days, 3 months and 6 months with p value (<0.001) and also between the mean value of baseline plaque score and score after 3 days, 3 months with p value (<0.001). However, no statistically significant difference was seen in mean plaque score after 6 months of SDF application with the p value of 0.135.

In group 2 (fluoride varnish), for both S. mutans and plaque score, statistically significant difference was found between the mean value of baseline S. mutans count and counts after 3 days (0.016), however no significant difference was seen after 3 and 6 months.

In group 3 (normal saline), statistically significant difference was found between the mean baseline S. mutans count and count after 3 days and a significant difference was observed between mean baseline plaque score and score after 3 days and 3 months.

Intergroup comparison done by Posthoc Turkey test, fluoride varnish has the least mean value for S. mutans count after 3 days, 3 and 6 months, no significant difference was seen in mean S. mutans count between group 1 and group 2 (p value 0.68), while a statistically significant difference after 3 days, 3 months and 6 months in the mean S. mutans count was noted between group 1 and 3 (p value 0.002,0.021 and < 0.001) and group 2 and 3 (p value < 0.001,0.004 and < 0.001). (Table 1 and Graph 1) For plaque score, SDF has the least mean value after 3 days, 3 and 6 months, similarly no significant difference was seen in mean plaque score between group 1 and group 2 (0.855), while a significant difference was observed in between group 1 and 3 and between group 2 and 3 after 3 days, 3 months and 6 months excluding a non-significant value after 3 months between group 2 and 3 (p value 0.219). (Table 1 and Graph 2).

Graph 1: Intergroup Comparison - Posthoc Test for S. Mutans

**Anova Test for Plaque Score**

Graph 2: Intergroup Comparison - Posthoc Test for Plaque Score

**Table 1: Intergroup comparison - Posthoc Tukey Test**

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>(I) group</th>
<th>(J) group</th>
<th>Mean Difference (I-J)</th>
<th>Std. Error</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>S. mutans count Baseline</td>
<td>SDF</td>
<td>Fluoride Varnish</td>
<td>392.222*</td>
<td>91.195</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Saline</td>
<td>255.500*</td>
<td>91.195</td>
<td>0.019</td>
</tr>
<tr>
<td>S. mutans count after 3 days</td>
<td>SDF</td>
<td>Fluoride Varnish</td>
<td>57.333</td>
<td>69.262</td>
<td>0.688</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Saline</td>
<td>-235.000*</td>
<td>69.262</td>
<td>0.002</td>
</tr>
<tr>
<td>S. mutans count 3 Month</td>
<td>SDF</td>
<td>Fluoride Varnish</td>
<td>15.889</td>
<td>27.148</td>
<td>0.829</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Saline</td>
<td>-75.000*</td>
<td>27.148</td>
<td>0.021</td>
</tr>
<tr>
<td>S. mutans count 6 Month</td>
<td>SDF</td>
<td>Fluoride Varnish</td>
<td>-139.167*</td>
<td>29.899</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Saline</td>
<td>-144.444*</td>
<td>29.899</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Plaque score Baseline</td>
<td>SDF</td>
<td>Fluoride Varnish</td>
<td>0.083333</td>
<td>0.067269</td>
<td>0.436</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Saline</td>
<td>-0.08278</td>
<td>0.067269</td>
<td>0.441</td>
</tr>
<tr>
<td>Plaque Score 72 Hrs</td>
<td>SDF</td>
<td>Fluoride Varnish</td>
<td>-0.01389</td>
<td>0.025994</td>
<td>0.555</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Saline</td>
<td>-0.096111*</td>
<td>0.025994</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Plaque Score 3 Month</td>
<td>SDF</td>
<td>Fluoride Varnish</td>
<td>-0.05611</td>
<td>0.033555</td>
<td>0.226</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Saline</td>
<td>-1.127778*</td>
<td>0.033555</td>
<td>0.004</td>
</tr>
<tr>
<td>Plaque Score 6 Month</td>
<td>SDF</td>
<td>Fluoride Varnish</td>
<td>-0.00889</td>
<td>0.058885</td>
<td>0.988</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Normal Saline</td>
<td>-2.261111*</td>
<td>0.058885</td>
<td>0.001</td>
</tr>
</tbody>
</table>
**DISCUSSION**

Dental caries is still one of the most common chronic diseases affecting various age groups in all the countries and on their populations with varying degree of severity. One of the most powerful weapons that have been proved to control and prevent dental caries in last 50 years is Fluoride. Loesche & Marsh mentioned that dental caries is associated with increase in the proportions of bacteria in the plaque, especially S. mutans and lactobacilli, which are capable of demineralizing the enamel. [11-14]

SDF is a cost-effective agent used for caries control and is available in 10%, 30%, 38% silver containing solution but 38% solution appears to be most effective. In vivo trials by Chu et al and Llodra et al, 38% SDF solution was commonly used to arrest dental caries. [9, 15]

SDF solution comprises silver, fluoride and ammonia. When SDF is applied to teeth, it penetrates into the enamel and dentin, 2 to 3 times more subsurface, fluoride is deposited in the teeth than with other fluoride solutions. The teeth then act as a fluoride reservoir and may increase its long-term efficiency. SDF reduces caries in 2 ways: Primarily it acts as an antimicrobial agent, as the silver ions react with thiol groups of amino and nucleic acids, disrupting metabolic and reproductive pathways of the bacteria resulting in cell death. At the same time, SDF react with hydroxyapatite forming fluorapatite, reducing or preventing further caries. SDF will turn soft carious dentin and enamel into dark brown harder or black sclerotic surface. [7, 16]

Fluoride Varnish is effectively used in young children, patient with gag reflex and physically or mentally disabled persons. Following Fluoride Varnish an application, the tooth surface is coated with a sticky film and thereby enhancing the penetration and absorption of fluoride ions into the tooth surface. [17]

In the present study, SDF and Fluoride Varnish were applied once after restorative treatment, according to manufacturer’s instruction. Chu et al found that annual application of 38% SDF was substantially more effective than 5% NaF varnish at 3 months interval in arresting and preventing dental caries in maxillary anterior teeth. [15]

In present study, in SDF group there was a significant difference observed between the mean value of baseline S. mutans counts and count after 3 days, and 6 months as well. Likewise, Llodra et al found 38% SDF as an effective anticariogenic agent for both primary and permanent teeth while Chu et al found it effective in primary anterior teeth. A significant difference was found between the mean values of baseline plaque score and score after 3 days, 3 months; however no significant difference was seen after 6 months of SDF application. After restorative treatment and SDF application, no new carious lesion was seen after 3 and 6 months follow-up in the present study which is in accordance with an in vitro study done by Suzuki et al. [10, 15, 18]

In Fluoride Varnish group, a significant difference was seen between the mean value of baseline S. mutans count and count after 3 days however no significant difference was seen after 3 months and 6 months. These findings were similar to the study done by Klimek et al. Correspondingly, a significant difference was found between the mean values of baseline plaque score and score after 3 days, however no significant difference was seen after 3 months and 6 months. Loesche et al and Klimek et al found reduction in plaque score after application of FV. [13, 19]

On intergroup comparisons in the present study, no significant difference was observed in the mean S. mutans count between SDF and Fluoride Varnish after 3 days, 3 and 6 months. However comparing SDF and Normal saline group and Fluoride varnish and Normal saline group, significant difference was seen after 3 days, 3months and even after 6 months. Shah S et al found significant reduction in the S. mutans counts in saliva by SDF as compared to Fluoride Varnish and APF gel in their study. [20]

A non-significant mean plaque values were seen after same time periods between SDF and Fluoride Varnish group. Whereas, a significant difference was observed in mean plaque value between SDF and Normal saline groups after same time intervals provided which was in agreement with the study done by Suzuki et al, where silver ions in combination with fluoride offer a possible antiplaque action of the agent. Likewise, a significant difference was found between Fluoride Varnish and Normal Saline groups after 3 days and after 6 months, but a non-significant difference was seen after 3 months which was in contrast to the study done by Klimek et al, where significant reduction in plaque score was found after application of fluoride varnish at all follow up time intervals. On the other hand, Shah S et al found decrease in Plaque score in all the subjects, but no significant difference was seen between SDF, Fluoride Varnish and APF gel group. [18-20]

**CONCLUSION**

In vivo application of SDF and Fluoride Varnish was efficient in reducing both S. mutans count and plaque score and no carious lesions were detected after follow-up time intervals as well. SDF and Fluoride Varnish can be efficaciously used as an antimicrobial, antiplaque and anticariogenic agent in young permanent teeth.

**LIMITATIONS OF THE STUDY**

The time period included in the study was not long enough to check the efficacy of SDF and Fluoride varnish for the reduction of caries susceptibility.

**REFERENCES**


