ORIGINAL ARTICLE

The Efficacy of Silver Diamine Fluoride in Arresting Carious Lesions in 6-9 Year Old Children From Peri Urban Islamabad

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ABSTRACT

Objective : The present study was done to assess the efficacy of silver diamine fluoride in arresting caries lesions in 6-9 year old school going children.

Study Design : Quasi-experimental.

Place and Duration of Study : The study was conducted from 15th February 2022 till 15th February 2023. The research was conducted by the community dentistry departments of Islamabad Medical & Dental College and Rawal Institute of Health Sciences in school going children from peri- urban Islamabad.

Materials and Methods : A sample size of 384 was calculated using Open Epi software which uses cochran's formula for sample size calculation. Active carious lesions extending to enamel and dentine in primary teeth and first permanent molars were identified using the International Caries Detection System. These teeth were then treated with 38% Silver Diamine Flouride using the standard application protocol. Data was recorded electronically on excel sheets (and later SPSS version 25 for analysis) at baseline and after 6 months to assess if the active carious lesion had been arrested. The data was discrete. Wilcoxon Signed Rank test was used to test the significance of the results.

Results: The participants included 64% males and 36% females. Average age of the study population was 7.7 years. More than half (66.4%) brushed their teeth once a day. The caries arrest in primary teeth and in first permanent molars was 77.5% and 87.7% respectively. Wilcoxon Signed Rank test was applied to check the significance of our results. In both the primary dentition and permanent molars, a single SDF application showed a statistically significant decrease in the mean number of carious lesions (p-value< 0.05).

Conclusion: The present study concluded that a single application of SDF with its ease of applicability can effectively halt the progression of active carious lesions in 6-9 year old children.

Key Words: *Carious lesions, efficacy, Peri-urban, school children SDF.*

Introduction

Oral health related problems in children revolve around dental caries globally.[1] The World Health Organization Global Oral Health Status Report 2022 estimates close to 3.5 billion people are affected by oral disease worldwide, with almost 75% living in middle-income countries.[2]

The prevalence of early childhood caries has been directly associated with limited finanacial resources and access to oral health care.[3] According to the Global Economy survey in Pakistan 62.27% of the population that lives in rural areas has an estimated dentist population ratio of 1: 200,000. Hence, access to oral health care is very limited in these areas.[4,5]

Traditionally, fluoride compounds have been used for stopping and preventing dental caries. In the 1960s Professor Reiichi Yamaga of Osaka University in Japan discovered Silver diamine Flouride (SDF) as an alternative to conventional restorative materials.[6] This material could be used for treating dental caries in young children, root caries in elderly patients, and for the prevention of pit and fissure caries.[7] It is a colourless liquid with a pH of 10, comprising of 62% water, 44,800 ppm fluoride ions, 25% silver, 8% ammonia, and 5% fluoride. SDF solution comes in concentrations ranging from 10% to 38%; the greater

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Received: May 16, 2024 ; Revised: June 03, 2024
Accepted: June 10, 2024

https://doi.org/10.57234/jiimc.june24.2080

concentration has been shown to be more beneficial.[8]

SDF works by uprooting the germs that cause dental cavities and causing calcium fluoride and silver phosphate to precipitate. This process remineralizes tooth structure and prevents dental caries.[9] In addition to this, it deters the matrix metallopeptidase increasing the microhardness of dentine and has an antibacterial effect on cariogenic biofilm, averting collagen degradation.[10] SDF does not cause any side effects when applied but causes a lasting black stain on the porous part of the tooth structure hence parental consent is essential. Although instant use of potassium iodide solution (KI) can potentially reduce the intensity of tooth staining. [9] Additionally, due to its easy application it has reduced dental chair anxiety, making treatment easy for both, the patient and the practitioner.[10]

The importance of managing dental caries cannot be overlooked as it is essential for better oral health outcomes in communities. Whatever the level of preventive method adopted, it is imperious that the technique should be tailored to the needs of the population. According to a recent meta-analysis conducted in Pakistan, the prevalence estimate of dental caries was 50.493% in the primary dentition, 61.183% in the mixed dentition, and 57.184% in the permanent dentition.[11]

In Pakistan, SDF is not widely utilized or discussed despite the aforementioned advantages. Only 25% of dental professionals surveyed in a recent Lahore research were aware of SDF, and only 10% had actually used it. This is a worrying discovery, especially considering Pakistan's high dental caries rate.[12] People in rural localities in comparison to urban ones face these constraints to a greater extent.[13.] The present research sets out to explore the efficacy of one such material in arresting dental caries in school going children from a peri-urban locality.

Materials and Methods

This one group pre post quasi expérimental study was conducted in 6-9 year old school children belonging to peri urban locations of Islamabad from 15th February, 2022 till 15th February, 2023. A sample size of 384 using cochran's formula was calculated taking caries prevalence at 50% among 6-9 year old children and 5% margin of error, with 95% confidence interval. A convenience sampling technique was used**.** After approval from the Ethics review Board from RIHS (Appl#Ref#Rawal/RDC/IRB/22/02) a list of schools in Islamabad's peri urban locality generated. The school administration was then contacted for consent to participate in the study. The children from the participating schools were given an information sheet and a consent form translated into Urdu regarding SDF application. Only those who consented and met the inclusion criteria were included in the study. Children aged 6-9 years with active carious lesions extending to enamel and dentine without any pain or infection were included in the study. According to the exclusion criteria children were not counted in the study if they reported to have silver allergy, or had any signs of irreversible pulpitis or peri apical periodontitis. Children likely to exfoliate teeth in the next six months or did not consent to participate were also not included in the study. Children with stomatitis or ulcerative gingival conditions and partially erupted teeth were also excluded from the study.

The age group of the study participants was between 6-9 years as children younger than that are generally non-compliant and would have made the application of SDF challenging. Secondly, a school setting was used for the purpose of convenience and easy follow up. A group of qualified and calibrated dentists were asked to screen the children for any active carious lesions and make sure that they had no signs of any acute oral infection or tooth ache. The extent of caries in primary teeth and first permanent molars was assessed using the International Caries Detection and Assessment System (ICDAS) and carious lesions in teeth with code three (localized enamel breakdown) and five (distinct cavity with visible dentin) was documented.[14]

In this paper, 'enamel caries' and 'dentine caries' refers to ICDAS code three and five respectively. The present research included only those children who had at least one carious lesion in accordance with the International Caries Detection and Assessment System II.[14]

Following the manufacturer's instructions, the teeth to be treated were first isolated using cotton rolls. Then, 38% SDF (Topamine, DentaLife, Australia) solution was dispensed in a plastic dish and applied directly to the lesion using a disposable microtip

https://doi.org/10.57234/jiimc.june24.2080

applicator, leaving it in place for 30 to 60 seconds. This procedure was performed by a dentist after recording the baseline scores of caries. Children were advised to avoid eating or drinking for around 30-60 minutes post application.

LA follow-up examination was performed approximately six months later to check if caries had been arrested in the teeth treated with SDF by evaluating the colour and consistency of the lesions. Once more, the examiners noted if pain and infection were present or not. Dark, hard, and black lesions that were free of pain or infection were seen as positive outcomes when evaluating the effectiveness of SDF based on clinical outcomes. The outcomes were recorded on an excel sheet and subsequently, SPSS for Windows version 25.0 was used to statistically evaluate the non-parametric data. As the data was discrete, a test for normality was not used. Wilcoxon signed rank test was used to check the significance of our results and a p value < 0.05 was considered significant.

Results

From the total sample size of 384 only 200 continued to participate in the study for follow up. Out of these 128 (64%) were male and 72 (36%) were female. The mean age of our study participants was 7.7 years.

Brushing frequency data was recorded (Figure 1). Data regarding the use of toothbrush and toothpaste was missing for nine and eight participants respectively. Among those who brushed their teeth, 174 (87%) confirmed using a toothbrush to do so and 170(85%) said they used toothpaste as well. None of the 200 (100%) participants had any acute oral infection.

The number of teeth with arrested caries in primary teeth and first permanent molars was 341 (77.5%) and 64 (87.7%) respectively (Table 1). As the data was discrete no test for normality was required and Wilcoxon Signed Rank test was applied to check the significance of our results. In the primary dentition, the mean number of enamel and dentin caries both showed a statistically significant decrease (p-value< 0.05). In the permanent molars, SDF application led to a statistically significant decrease in both enamel and dentin caries (p-value < 0.05).

Discussion

The results of the present study established that the efficacy of SDF in halting caries in primary and permanent dentition was 77.5% and 87.5% respectively. With more than half of the study participants 67.4% brushing their teeth at least once daily.

Table I : Number of Teeth with Active and Arrested Caries, at Baseline and Six Months

Variables	Number of primary teeth			Number of 1st permanent molars		
	Enamel	Dentine	Total	Enamel	Dentine	Total
Baseline: active caries	236	204	440	60	13	73
6 months: Active caries	29	70	99	8	1	9
Arrested caries (%)	207 (87.7)	134 (65.7)	341 (77.5)	52 (86.7)	12 (92.3)	64 (87.7)
P-value	0.000	0.00	0.00	0.00	0.013	0.013

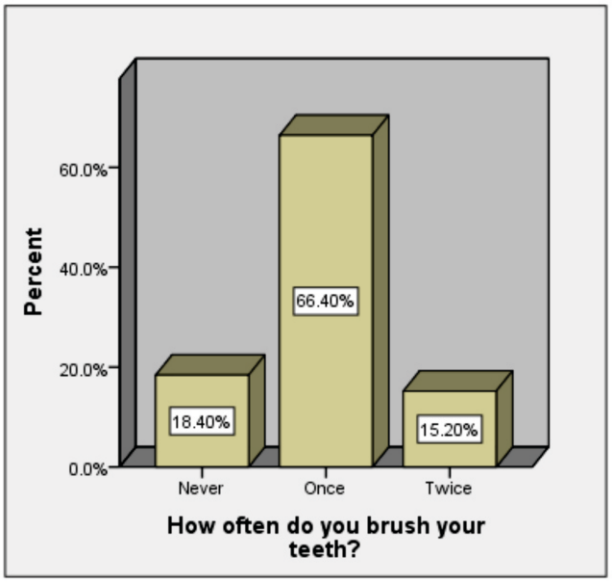

Figure 1: Brushing frequency

The World Health Organization (WHO) states that early childhood caries has an occurrence between 60 to 90% amongst the people in European countries, with 61% of children aged 6 to 12 years having at least one decayed tooth.[15] A recent meta analysis on the existing data in Pakistan showed that approximately 60% of the Pakistani population had dental caries showing it to be at high risk.[15] An alarming high frequency of damaged, untreated teeth in the primary dentition—66.1% of untreated caries in children aged six—was found in a research study carried out in the Rawalpindi district of Pakistan.[16] In the present study as well the participants all had at least one active carious lesion in either their permanent or primary tooth.

In Pakistan the dentist-to-population ratio is

1:10850.[16] The present study was conducted in a peri urban locality where this ratio is even more disproportionate.[4] A recent scopus review indicated that in low and middle income countries, policy makers should focus more on inequality determinants and incorporate practices for impartial dissemination and accessibility of dental facilities.[17] Rural areas of Pakistan have a dearth of dental care programs accompanied by low affordability of rural families, all contributing to the high prevalence of caries in these children.[15] Silver diamine fluoride has been in active use in many countries for arresting caries with an effectiveness ranging from 70-96% since 2009.[18]The present study aslo concluded that a single application of 38% SDF solution was quite effective in halting dental caries in deciduous teeth and permanent molars. Several studies have established its efficacy; a recent one by Chaurasiya and Gojanur with a 12 month follow up concluded that SDF can be utilized for halting caries in primary teeth.[7] As per Azuoru *et al.*, Rady *et al.*, and Chu et al., SDF works well to stop caries in kids.[19] Another study by Duangthip et al. Sihra et al established SDF application was more efficient than NaF varnish.[20]

The results of our study have serious implications in the context of dental caries experience for low socioeconomic status children having limited accessibility to oral health care. SDF with a single application can prove to be effective and efficient as a comprehensive evaluation conducted in 2019 revealed that a single annual application of SDF was significantly more effective in preventing caries than several applications of sodium fluoride varnish.[21] Another systematic review stated that the progression of caries can be stopped by SDF and was safe for children under 18 years of age.[22] About 60% of Pakistani people have dental caries[23], and risk factors for the condition include eating a diet high in cariogenic foods, not practicing good oral hygiene, and having a low socioeconomic status.[21] Apart from ingraining good oral hygiene practices healthy dietary habits SDF can help wrestle the problem at an early stage and prevent the progression of caries.

This research not only recognized the efficacy of SDF in treating enamel and dentinal caries after a single application but also helped us achieve this goal in a timely manner in low resource settings.

A study conducted in Hong Kong concluded that SDF should be incorperated into community dental outreach programs in order to improve access to oral health care and make it more equitable. This is especially important in low and middle-income countries where oral health care is often difficult to obtain.[24] In Pakistan community health workers can be utilized for dental outreach programs especially in rural areas and SDF can be used with its easy applicability. This can prove to be revolutionary in halting the progression of caries among children of our country.

Conclusion

In Pakistan there is grave concern with high prevalence of oral diseases and there is a dire need to devise an approach that is community-based, sustainable, effective and efficient. The present study concluded that a single application of SDF with its ease of applicability can effectively halt the progression of active carious lesions in 6-9 year old children.

Limitations

The present study focused on children only from peri urban locality the results of our study cannot be generalized as the sample size was not sufficient.

Acknowledgement

The authors would like to thank the Community Dentistry department at the Islamabad Medical and Dental College and Rawal Institute of Health Sciences in supporting the research project. In addition, the authors would like to acknowledge the support of Dentalife Australia for supplying SDF.

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CONFLICT OF INTEREST

Authors declared no conflicts of Interest.

GRANT SUPPORT AND FINANCIAL DISCLOSURE

Authors have declared no specific grant for this research from any funding agency in public, commercial or nonprofit sector.

DATA SHARING STATMENT

The data that support the findings of this study are available from the corresponding author upon request.