

Parental Acceptance and Clinical Effectiveness of Silver Diamine Fluoride as a Caries-Arresting Agent in Preschool Children

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ABSTRACT

Early childhood caries affects nearly half of preschool children worldwide. 38% Silver Diamine Fluoride (SDF) is a non-invasive caries-arresting agent, but the black staining it causes may affect whether parents accept it. Thus the aim of my study was to compare parental acceptance and clinical caries-arresting effectiveness of 38% Silver Diamine Fluoride (SDF) with a conventional caries-arresting agent (5% Sodium Fluoride varnish) in preschool children among 100 children aged 3–6 years with active dentinal caries. They were divided into Group 1 (38% SDF, n = 50) and Group 2 (5% NaF varnish, n = 50), with applications repeated every 6 months. A calibrated examiner assessed caries arrest at 6 and 12 months. Parental acceptance was recorded with a 5-point Likert questionnaire. We have found that, Caries arrest was significantly higher in Group 1 than in Group 2 at 6 months (72% vs 48%, $p = 0.014$) and 12 months (82% vs 56%, $p = 0.005$). Both groups improved significantly over time ($p < 0.001$). Satisfaction, comfort and willingness to repeat the treatment did not differ significantly between the groups ($p > 0.05$). Acceptance scores were lower for SDF at first ($p = 0.001$) but were comparable to NaF by 12 months ($p = 0.142$). Thus, we have concluded that, 38% SDF arrested caries better than NaF varnish, and parents' acceptance of it improved over time.

Keywords: Silver Diamine Fluoride, Early Childhood Caries, Caries Arrest, Parental Acceptance, Sodium Fluoride Varnish.

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INTRODUCTION

Early childhood caries (ECC) is one of the most common chronic diseases of childhood. A global meta-analysis based on WHO diagnostic criteria found that it affects about 48% of preschool

children worldwide, and 52% in Asia.¹ The burden in India is similar, with a pooled prevalence of 46.9% and a mean dmft of 2.23 across 71 studies of 69,330 children.² Untreated ECC can cause pain, infection, difficulty eating and sleeping, early tooth

loss and a poorer quality of life. Treating it with conventional restorations is often difficult in very young children. They may not cooperate, they are often anxious, restorative care is expensive, and many families have limited access to dental services. As a result, many children need treatment under sedation or general anaesthesia. This has increased interest in simple, non-invasive and low-cost ways to manage the disease.³ Silver Diamine Fluoride (SDF) has become one of the most promising non-invasive caries-arresting agents for children. The 38% solution contains about 24.4–28.8% silver and 5.0–5.9% fluoride. The silver acts as an antimicrobial, the fluoride promotes remineralisation, and the ammonia keeps the solution stable. SDF kills cariogenic bacteria, mainly *Streptococcus mutans*, and prevents cariogenic biofilms from growing. It also increases the mineral content of enamel and dentine and protects the collagen matrix of dentine from breakdown. A systematic review found that 38% SDF arrested about 81% of active caries lesions in primary teeth. The American Academy of Pediatric Dentistry (AAPD) guideline recommends 38% SDF for arresting cavitated caries lesions in primary teeth. It reported arrest in 76% of lesions with SDF compared with 51% with control treatments.^{4,5}

5% Sodium Fluoride (NaF) varnish is the conventional topical fluoride agent. It is widely used to prevent and arrest caries in young children because it is safe, easy to apply and does not stain the teeth. Trials comparing the two agents have not agreed.⁶ Another study found that 38% SDF arrested dentine caries significantly better than NaF varnish.⁷ In contrast to this, a study found that, both the agents were comparable at 18 months. The main drawback of SDF is permanent black staining of the arrested lesions, and this can affect whether parents accept it. A study reported that only 29.7% of parents found staining on anterior teeth acceptable, compared with 67.5% for posterior teeth.³ A meta-analysis found that acceptance was lower for anterior teeth and increased after follow-up and parental education.⁸

Moreover, most of the evidence on SDF comes from studies in China, Thailand and Western countries. There is little clinical data from Indian preschool children, and Indian parents' perceptions of staining may differ because of cultural and socioeconomic factors. Much of the acceptance research is cross-sectional and based on photographs. Such studies may not reflect how parents feel once their own child has been treated and they can see the caries has stopped. Few clinical studies have measured caries arrest and parental acceptance together in the same children over time. Evidence of this kind is needed to decide whether SDF can be used routinely in paediatric practice and in community programmes. The

present study was therefore planned with the following aim: to compare parental acceptance and clinical caries-arresting effectiveness of 38% Silver Diamine Fluoride (SDF) with a conventional caries-arresting agent (5% Sodium Fluoride varnish) in preschool children.

AIM

To compare parental acceptance and clinical caries-arresting effectiveness of 38% Silver Diamine Fluoride (SDF) with a conventional caries-arresting agent (5% Sodium Fluoride varnish) in preschool children.

MATERIAL AND METHODS

This prospective comparative clinical study was carried out on 100 preschool children aged 3–6 years who came to the outpatient department with active dentinal carious lesions in primary teeth. All 100 children had dental caries and met the eligibility criteria, so all were included. The children were divided into two groups of 50 each. Group 1 (n = 50) received 38% Silver Diamine Fluoride (SDF), and Group 2 (n = 50) received the conventional caries-arresting agent (5% Sodium Fluoride varnish). For both groups, the lesions were cleaned and isolated with cotton rolls, and petroleum jelly was applied to the adjacent soft tissues. In Group 1, 38% SDF was applied with a microbrush for 1 minute and excess was removed. In Group 2, 5% NaF varnish was applied as a thin layer. Parents were told not to let the child eat or drink for 30 minutes and not to brush for the rest of the day. Applications were repeated every 6 months. At baseline, 6 months and 12 months, a single calibrated examiner assessed caries arrest by visual-tactile examination with a blunt probe. A lesion was scored as arrested if it was hard on gentle probing, smooth and dark brown or black. The International Caries Detection and Assessment System (ICDAS) was also recorded. Parental acceptance was assessed with a pre-validated structured questionnaire using a 5-point Likert scale. It covered satisfaction with treatment, how parents viewed the black staining, and willingness to accept the treatment again, and it was given immediately after treatment and at each follow-up visit.

INCLUSION CRITERIA

1. Children aged 3–6 years who were healthy and cooperative (ASA I).
2. Children with at least one active cavitated carious lesion into dentin (ICDAS code 5 or 6) in a primary tooth.
3. Teeth with no clinical signs of pulpal involvement, such as spontaneous pain, swelling, abscess, sinus tract or pathological mobility.
4. Children whose parents or guardians gave written informed consent and agreed to follow-up visits.

EXCLUSION CRITERIA

Parental Acceptance and Clinical Effectiveness of Silver Diamine Fluoride as a Caries-Arresting Agent in Preschool Children

1. Children with a known allergy or sensitivity to silver or fluoride products.
2. Children with ulcerative gingivitis, stomatitis or other oral mucosal lesions.
3. Children with systemic disease, special healthcare needs or long-term medication use.
4. Teeth with irreversible pulpitis, a periapical pathology, or close to exfoliation.
5. Children who had fluoride varnish or SDF applied in the previous 6 months.
6. Uncooperative children and those whose parents did not give consent.

STATISTICAL ANALYSIS

The data was entered into Microsoft Excel and analysed with SPSS software (version 26.0, IBM Corp., Armonk, NY, USA). Categorical variables, including caries arrest status and parental acceptance responses, was shown as frequencies and percentages. Continuous variables was shown as mean $\pm$ standard deviation. The Shapiro–Wilk test was used to check whether the data are normally distributed. The Chi-square test (or Fisher's exact test where appropriate) was used to compare caries arrest rates and parental acceptance between the two groups. The Mann–Whitney U test was used to compare Likert-scale acceptance scores between the groups. Changes within each group over time (baseline, 6 months and 12 months) was analysed with Cochran's Q test or McNemar's test for categorical outcomes and the Friedman test for ordinal scores. A p-value below 0.05 was considered statistically significant.

RESULT

VARIABLE	GROUP 1	GROUP 2	P-VALUE
Age (Years), mean $\pm$ SD	4.42 $\pm$ 0.86	4.36 $\pm$ 0.91	0.734
Male, n(%)	27(54%)	26(52%)	0.841
Female, n(%)	23(46%)	24(48%)	

TABLE 1 : DEMOGRAPHIC CHARACTERISTICS

Table 1 showed that, the mean age was 4.42 $\pm$ 0.86 years in Group 1 (38% Silver Diamine Fluoride) and 4.36 $\pm$ 0.91 years in Group 2 (conventional caries-arresting agent). This difference was not statistically significant (p = 0.734). Group 1 had 27 males (54%) and 23 females (46%), and Group 2 had 26 males (52%) and 24 females (48%). The gender distribution also did not differ significantly between the groups (p = 0.841). Since age and gender were similar in both groups, differences in caries arrest and parental acceptance are unlikely to be due to these demographic factors.

FELLO W-UP	STAT US	GRO UP 1	GRO UP 2	X ²	P- VAL UE
6 Months	Caries Arrest ed	36(72 %)	24(48 %)	6.0 0	0.014

	Caries Not Arrest ed	14(28 %)	26(52 %)		
12 Months	Caries Arrest ed	41(82 %)	28(56 %)	7.9 0	0.005

TABLE 2 : COMPARISON BETWEEN GROUPS AT FOLLOW-UP

Table 2 showed that, at 6 months, caries was arrested in 36 children (72%) in Group 1 (38% Silver Diamine Fluoride) and in 24 children (48%) in Group 2 (conventional caries-arresting agent). This difference was statistically significant ($\chi^2 = 6.00$, p = 0.014). At 12 months, the arrest rate rose to 82% (41 children) in Group 1 and 56% (28 children) in Group 2. The difference between the groups was again significant ($\chi^2 = 7.90$, p = 0.005). So 38% SDF gave significantly better caries arrest than the conventional agent at both follow-ups, and the gap between the groups was larger at 12 months.

GR OU P	BAS ELI NE n (%)	6 MO NT H n (%)	12 MO NT H n (%)	COC HRA N's Q	P- VA LU E	6 Vs 12 MO NTH S (Mc Nem ar) P- Valu e
GR OU P 1	0 (0%)	36 (72 %)	41 (82 %)	73.22	<0. 001	0.06 3
GR OU P 2	0 (0%)	24 (48 %)	28 (56 %)	49.14	<0. 001	0.12 5

TABLE 3 : CHANGE IN CARIES WITHIN GROUPS OVER TIME

Table 3 showed that, in Group 1 (38% Silver Diamine Fluoride), the number of arrested lesions rose from 0% at baseline to 72% at 6 months and 82% at 12 months. This change over time was statistically significant (Cochran's Q = 73.22, p < 0.001). In Group 2 (conventional caries-arresting agent), caries arrest rose from 0% at baseline to 48% at 6 months and 56% at 12 months, which was also significant (Cochran's Q = 49.14, p < 0.001). When 6 months was compared with 12 months, the further increase was not significant in either Group 1 (p = 0.063) or Group 2 (p = 0.125). This shows that both agents were effective over time, most caries arrest happened within the first 6 months, and SDF reached higher arrest rates at every follow-up.

QUESTIONN AIRE ITEM	GRO UP 1	GRO UP 2	X ²	P- VAL UE
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Satisfied with the treatment	38 (76%)	44 (88%)	2.4 4	0.118
Treatment was quick & comfortable for child	45 (90%)	43 (86%)	0.3 8	0.538
Willing to accept the same treatment again	40 (80%)	45 (90%)	1.9 6	0.162
Would recommend the treatment to others	37 (74%)	42 (84%)	1.5 1	0.219

TABLE 4 : PARENTAL ACCEPTANCE RESPONSE

Table 4 showed that, in Group 1 (38% Silver Diamine Fluoride), 76% of parents were satisfied with the treatment, compared with 88% in Group 2 (conventional caries-arresting agent). This difference was not statistically significant ($\chi^2 = 2.44$, $p = 0.118$). Most parents in both groups said the treatment was quick and comfortable for their child (90% in Group 1 and 86% in Group 2), with no significant difference ($\chi^2 = 0.38$, $p = 0.538$). Willingness to accept the same treatment again was 80% in Group 1 and 90% in Group 2 ($\chi^2 = 1.96$, $p = 0.162$). The proportion who would recommend the treatment to others was 74% and 84%, respectively ($\chi^2 = 1.51$, $p = 0.219$). Group 2 scored slightly higher on most items, but no item differed significantly between the groups. This shows that parental acceptance of 38% SDF was comparable to that of the conventional agent.

TIME POINT	GROUP 1	GROUP 2	P-VALUE
Immediately after treatment	3.62±0.94/ 4 (3-4)	4.21±0.72/ 4 (4-5)	0.001
6 Month	3.80±0.90/ 4 (3-4)	4.20±0.74/ 4 (4-5)	0.018
12 Month	3.94±0.86/ 4 (3-5)	4.18±0.75/ 4 (4-5)	0.142
P-Value	0.021	0.882	

TABLE 5 : OVERALL PARENTAL ACCEPTANCE SCORES

Right after treatment, the mean acceptance score was 3.62 ± 0.94 in Group 1 (38% Silver Diamine Fluoride) and 4.21 ± 0.72 in Group 2 (conventional caries-arresting agent). This difference was statistically significant ($p = 0.001$). At 6 months, acceptance was still significantly lower in Group 1 (3.80 ± 0.90) than in Group 2 (4.20 ± 0.74) ($p = 0.018$). At 12 months, the difference was no longer significant (3.94 ± 0.86 vs 4.18 ± 0.75 , $p = 0.142$). Within Group 1, acceptance rose significantly over time ($p = 0.021$), while in Group 2 it stayed about the same ($p = 0.882$). This suggests that parents were less accepting of SDF at first, probably because of the black staining. Their acceptance

grew as they saw the caries arrested, and by 12 months it was comparable to the conventional agent.

DISCUSSION

In the present study, 38% Silver Diamine Fluoride (SDF) arrested caries significantly better than the conventional caries-arresting agent at both 6 months (72% vs 48%, $p = 0.014$) and 12 months (82% vs 56%, $p = 0.005$). The two groups had similar age and gender distributions, so these outcomes are unlikely to be explained by demographic differences. Our findings agree with the systematic review in which authors reported an overall arrest rate of 81% for 38% SDF in primary teeth. That is almost identical to our 12-month rate of 82%.⁹ Our results also match with another study which found, annual 38% SDF arrested significantly more carious surfaces than 5% NaF varnish applied every 3 months (2.82 vs 1.54 mean arrested surfaces, $p < 0.001$).⁷ Similarly, another study found a significantly higher 12-month arrest rate with semiannual 38% SDF than with 5% NaF varnish in young Thai children (35.7% vs 20.9%, $p < 0.001$; OR = 2.04).¹⁰ Their absolute arrest rates were lower than ours, probably because their children were younger (1–3 years) and at higher caries risk. Other studies do not show a consistent advantage for SDF.^{9,10,7}

In a 30-month trial, another study found that annual 30% SDF was superior to NaF varnish for cavitated dentine lesions (48% vs 34%, $p < 0.001$). However, the arrest rates did not differ significantly at 24 months (37% vs 33%, $p > 0.05$). For moderate lesions, NaF did not differ from either SDF protocol.¹¹ In an 18-month trial, a study found that 38% SDF was superior at 6 and 12 months, but by 18 months the two agents were comparable for enamel caries (59.1% vs 58.8%, $p = 0.873$). These differences are probably due to the lower SDF concentration, the application frequency, and the lesion depth; dentinal lesions respond better to SDF.¹² In our study, arrest rose significantly over time in both groups ($p < 0.001$). The increase from 6 to 12 months was not significant, which shows that most arrest happened in the first 6 months. Satisfaction, comfort, willingness to repeat the treatment and willingness to recommend it did not differ significantly between the two groups. In the SDF group, 76% of parents were satisfied and 80% were willing to accept it again. This agrees with another study found no significant difference in parental satisfaction with dental appearance between the SDF and NaF groups at 18 months (59.8% vs 60.7%, $p = 0.896$).¹² Similarly, another study reported that SDF had no negative effect on parental satisfaction. In contrast, cross-sectional surveys have reported more resistance.¹⁰ A study reported that 43.4% of Saudi parents found the staining strongly unacceptable.¹³ These surveys used photographs rather than actual treatment,

which may explain why they found lower acceptance than clinical studies such as ours. In the present study, overall acceptance scores were significantly lower in the SDF group immediately after treatment ($p = 0.001$) and at 6 months ($p = 0.018$). By 12 months, the difference was no longer significant ($p = 0.142$), and acceptance in the SDF group increased significantly over time ($p = 0.021$). This pattern is supported by the meta-analysis study, which reported that parental acceptance of SDF increased after follow-up visits and education.⁸

Hence, 38% SDF arrested caries significantly better than the conventional agent in preschool children, and parental acceptance, though lower at first because of the staining, became comparable by 12 months.

CONCLUSION

38% Silver Diamine Fluoride arrested caries significantly better than 5% Sodium Fluoride varnish in preschool children at both 6 and 12 months. Most of the arrest occurred within the first 6 months. Parents were satisfied with both treatments, found them comfortable for their child, and were willing to repeat them. Acceptance of SDF was lower at first, probably because of the black staining, but it improved over time and was comparable to NaF varnish by 12 months. SDF can therefore be recommended as an effective, non-invasive and parent-acceptable way to manage early childhood caries.

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