https://doi.org/10.36377/ET-0090

Silver diamine fluoride: A SMART solution for special care paediatric dentistry

Anagha Saseendran[1], Pallavi Urs[1], Nameeda K. Syeda[1], Fathimath N. Kandakkeel[2], Arul Selvan[1], Toufiq Noor[3] ✉, Abedelmalek K. Tabnjh[4, 5], Siddharthan Selvaraj[3, 6] ✉

[1] Krishnadevaraya College of Dental Sciences, Karnataka, India

[2] Lincoln University College, Petaling Jaya, Malaysia

[3] Dr. D.Y. Patil Dental College and Hospital, Dr. D.Y. Patil Vidyapeeth, Pune, India

[4] University of Gothenburg, Sweden

[5] University of Science and Technology, Jordan

[6] University of Puthisastra, Phnom Penh, Cambodia

✉ thisistoufiqnoor@gmail.com; sidzcristiano@gmail.com

Abstract

AIM. To compare and evaluate the clinical and antimicrobial efficacy of Silver Diamine Fluoride (SDF) and Silver Modified Atraumatic Restorative technique (SMART) in carious primary teeth in children with special needs.

MATERIALS AND METHODS. Sixty-six children aged 3–9 years with carious primary molars were randomly divided into two groups. Group I was assigned SDF treatment, and Silver Modified Atraumatic Restorative Treatment (SMART) in Group II. At the baseline and after six months, plaque samples were collected from the buccal and lingual aspect of tooth surface from both the groups using a disposable foam tipped applicators and was transferred into 1 ml of thyoglycolate broth and was incubated at 37°C in Mitis salivarius bacitracin agar plates and Streptococcoccus Colony forming units (CFU) were calculated. The participants were recalled after six-month intervals and were evaluated clinically to check the caries adjacent to the restoration by using visual and tactile evaluation and microbiologically to check the status of reduction of CFU in Streptococcus Mutans. SDF was reapplied in Group I and further follow up, re application of SDF in Group I and assessment is being carried out for both the groups. The behavioural assessment of the patient and the acceptance of SDF by the parents as well as the patients were assessed using Likert scale questionnaire.

RESULTS. Silver Diamine Fluoride was well accepted by the parents since it provided a minimally invasive treatment approach and caries arrest to the special children. In the present study, SMART's microbiological and clinical success rate was comparatively higher than SDF. After statistical analysis, with the significant p-value being 0.001 in Group II, it was found that the results obtained were statistically significant and was found that SMART as a better treatment modality.

CONCLUSIONS. SMART has gained significant traction due to its effectiveness in arresting the caries. The study promised both clinical and microbiological success rates of SMART when compared with SDF alone.

Keywords: silver diamine flouride, silver modified atraumatic restorative technique (SMART), Nyvad's criteria, special children

Article info: received – 14.02.2025; revised – 26.04.2025; accepted – 30.04.2025

Conflict of interest: The authors report no conflict of interest.

Acknowledgements: There are no funding and individual acknowledgments to declare.

For citation: Saseendran A., Urs P., Syeda N.K., Kandakkeel F.N., Selvan A., Noor T., Tabnjh A.K., Selvaraj S. Silver diamine fluoride: A SMART solution for special care paediatric dentistry. *Endodontics Today.* 2025;23(2):195–204. https://doi.org/10.36377/ET-0090

Серебряный диамин фторид: SMART-решение для стоматологии у детей с особыми потребностями

А. Сасиндран[1], П. Урс[1], Н.К. Сайеда[1], Ф.Н. Кандаккил[2], А. Селван[2], Т. Нур[3] ✉, А.К. Табндж[4, 5], С. Селварадж[3, 6] ✉

[1] Стоматологический колледж Кришнадеварая, Карнатака, Индия

[2] Университетский колледж Линкольна, Петалинг-Джая, Малайзия

[3] Стоматологический колледж и больница доктора Д.Й. Патила, Видьяпит, Пуна, Индия

[4] Гетеборгский университет, Швеция

[5] Университет науки и технологий, Иордания

[6] Университет Путисастра, Пномпень, Камбоджа

✉ thisistoufiqnoor@gmail.com; sidzcristiano@gmail.com

Резюме

ЦЕЛЬ. Провести сравнительный анализ клинической и антимикробной эффективности фторида серебра диамина (SDF) и модифицированной серебром атравматической реставрационной методики (SMART) при лечении кариозных временных моляров у детей с особыми потребностями.

МАТЕРИАЛЫ И МЕТОДЫ. В исследование включено 66 детей в возрасте от 3 до 9 лет, которые были рандомизированы на две группы: группе I проводилось лечение с использованием SDF, группе II – методом SMART. Образцы налета с вестибулярной и язычной поверхностей кариозных зубов собирались на исходном этапе и через 6 месяцев, инкубировались в агаре Mitis salivarius bacitracin, после чего подсчитывались колониеобразующие единицы Streptococcus mutans. Клиническая оценка проводилась визуально и тактильно, SDF повторно применялся в группе I. Дополнительно была проведена оценка поведения пациентов и принятия лечения с помощью анкеты по шкале Лайкерта.

РЕЗУЛЬТАТЫ. Методика SDF получила положительную оценку со стороны родителей как минимально инвазивный и приемлемый подход. Однако, по данным клинической и микробиологической оценки, эффективность SMART была достоверно выше (p = 0,001).

ВЫВОДЫ. Методика SMART продемонстрировала более высокую клиническую и антимикробную эффективность по сравнению с применением одного лишь фторида серебра диамина, и может рассматриваться как предпочтительный вариант лечения кариеса у детей с особыми потребностями.

Ключевые слова: серебряный диамин фторид, модифицированная атравматичная реставративная методика (SMART), критерии Нювад и дети с особыми потребностями

Информация о статье: поступила – 14.02.2025; исправлена – 26.04.2025; принята – 30.04.2025

Конфликт интересов: авторы сообщают об отсутствии конфликта интересов.

Благодарности: финансирование и индивидуальные благодарности для декларирования отсутствуют.

Для цитирования: Сасиндран А., Урс П., Сайеда Н.К., Кандаккил Ф.Н., Селван А., Нур Т., Табндж А.К., Селварадж С. Серебряный диамин фторид: SMART-решение для стоматологии у детей с особыми потребностями. *Эндодонтия Today.* 2025;23(2):195–204. https://doi.org/10.36377/ET-0090

INTRODUCTION

Early childhood caries affects millions of preschool children worldwide, and currently, it is one of the significant global health problems [1]. Children with Special Health Care Needs (SHCN) have poor oral hygiene due to the prevalence of gingival diseases, periodontal problems, and dental caries than the general population [2]. Due to limitations with health disabilities that can also contribute to dental issues, children with special health care requirements frequently miss out on receiving dental treatment at the proper time [3–6]. They have an increased prevalence of dental caries due to uncoordinated chewing in certain conditions, such as cerebral palsy, in which the patients may pouch the food in the mouth due to poor tongue or musculature coordination [7].

The minimally invasive restorative technique is essential in dentistry for such a group of children. Silver diamine fluoride (SDF) with a high fluoride ion concentration is used to promote remineralization of the decalcified tooth structure, which is constantly under acid challenge and the children with special health care needs finds difficult to maintain good oral hygiene due to the underlying health condition. SDF, being a minimal invasive treatment choice would be beneficial in those children to arrest the decay. SDF arrests and slows down the rate of caries progression by promoting caries arrest. Silver Diamine Fluoride has been used to deal with the high prevalence of caries by arresting or slowing down the rate of caries progression [8].

Several studies have proved the efficacy of SDF, and recent advances include the SMART (silver-modified atraumatic restorative treatment) [9–11]. This technique included sealing the decayed tooth with SDF and placing Glass ionomer cement over it on the same day, which cuts the nutrient source to any surviving bacteria,

further helping in the arrest of decay. The fluoride-releasing property of the GIC adds a beneficial effect to SDF, providing remineralization and a chemically tight seal [12]. The technique's benefits include effective placement of a chemically sealed and bonded GIC repair, partial or complete caries removal on deep caries lesions approaching a vital and asymptomatic pulp, and caries arrest caused by SDF's antimicrobial and demineralizing properties [12]. Chu and his colleagues concluded that the antimicrobial efficacy of SDF resulted in a significant reduction of Streptococcus mutans in carious lesions [13]. SDF had a strong antibacterial and antiplaque effect when compared to APF gel and had proven to reduce Streptococcus mutans count [14].

The study was formulated to compare the antimicrobial and clinical effectiveness of caries arrest after Silver Diamine Fluoride application and Silver Modified Atraumatic Restorative Technique in 3–9-year-old children with special needs with various disabilities. The research also focused on parents' acceptance of SDF.

MATERIALS AND METHODS

The study involved 66 kids between 3 and 9 years who attended special needs schools in Bangalore. Written consent was obtained from the parents/guardians of all the patients. Ethical approval from the ethical committee of Krishnadevaraya College of Dental Sciences was obtained (KCDS/165/2018-19). According to the inclusion and exclusion criteria, sixty-six subjects were selected using the Simple Random Sampling technique and were divided into two groups. The status of the caries was assessed by following Nyvad Criteria. Nyvad classification, which is a visual-tactile caries diagnostic system, focuses on the assessment of both activity status and the severity of caries lesions. Its emphases early detection and potential for non-invasive management. Surface texture, color and hardness of the lesion is observed and assessed for the diagnosis of the caries. Nyvad classification is considered as clinically proved efficient caries detection tool for under-standing caries as a dynamic process rather than a static condition [15].

Study participants

Inclusion and exclusion criteria: 3–9 years old Special children and participants with dental caries with Level 1 or 2 Nyvad criteria were included in our study. Patients with history of pain, teeth associated with irreversible pulpitis, teeth indicated for extraction or with physiological mobility, presence of any gingival or perioral ulcerations and known sensitivity to silver or heavy metal ions were excluded in our study.

Pre-treatment plaque sample 1 (s1) was collected from the buccal and lingual aspect of the tooth surface by a pre-sterilized foam-tipped applicator (Fig. 1), and it was transferred to 1 ml of thioglycolate broth, and microbiological evaluation [Streptococcus Mutans] was done.

Group I: (*n* = 32) Caries excavation was done following the Atraumatic Restorative Technique, and Vaseline application was carried out on the gingiva and mucosa to prevent staining of the mucosa. The cavity was appropriately isolated, and the lesion was saturated with silver diamine fluoride (Fagamine R) with a micro brush in a scrubbing motion for one minute (Fig. 2). Color changes were observed on the lesion after complete reaction of silver ions with carious dentin. Patients were instructed to follow post operative instructions and not to eat or drink for thirty minutes to one hour.

Group II: (*n* = 34) Caries excavation was done following the ART technique, and Vaseline was applied to the gingiva and mucosa to prevent staining of mucosa from SDF. The cavity was appropriately isolated, and the lesion was saturated with silver diamine fluoride for one minute. After the color change was observed, Glass ionomer cement (Ketac Molar TM) was placed immediately over the silver diamine fluoride (Silver Modified Atraumatic Restorative Technique, SMART), and Vaseline was applied (Fig. 3).

The University of California San Francisco's (UCSF) adaptation of the SDF application procedure involves isolating and drying the affected teeth prior to treatment, and the carious dentin is saturated for one to three minutes to improve absorption and any surplus or leftover material is re-moved with the cotton roll. According to the research, the application period may range between 3 to 5 minutes, and there is no evidence linking it to clinical outcomes [7].

Fig. 1. Collection of plaque sample

Рис. 1. Сбор образца зубного налета

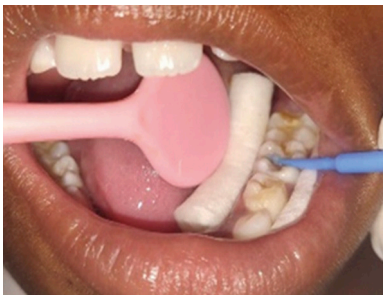


Fig. 2. Application of SDF

Рис. 2. Применение диамина фторида серебра (SDF)

Fig. 3. Placement of GIC over SDF treated tooth (SMART)

Рис. 3. Нанесение стеклоиономерного цемента (GIC) на зуб, обработанный диамином фторида серебра (SDF) (техника SMART)

Each subject's behaviour was observed and classified according to Frankl's classification with Wright's modification [16]. A Likert scale questionnaire was carried out to determine the parents' satisfaction and attitude regarding the acceptance of the procedure [17]. Patients were followed up at six months, post plaque sample 2 (s2) was collected, and the microbiological evaluation was carried out for Groups I and II. Secondary caries assessment was done by visual and tactile evaluation for Group I, and the presence of any surface decay was checked in Group II (SMART) [18; 19]. Reapplication of Silver diamine fluoride was done at six months for Group I, which further increased the caries arrest.

Statistical Analysis

SPSS version 22 was used to carry out statistical analysis. Comparison of pre- and post-microbial load among the two groups was analysed using paired and unpaired T-tests.

RESULTS

In our present study, parents were more concerned about caries arrest and the minimally invasive treatment approach than the staining of the primary teeth. Few parents expressed their aesthetic concerns about SDF, and many reported that their children were too young to care about the black staining after SDF application; instead, they were happy about when the sensitivity had stopped. The present study included 37.5% female and 62.5% male in Group I and 32.4% female and 67.4% male in Group II. Children with various disabilities including Autism, Hearing Impaired, Cerebral Palsy, Blind, Down Syndrome, Intellectually Impaired, Intellectual disability, and ADHD were included. In Group I, Autistic patients were 40.6%, and in Group II, the Intellectually impaired had the highest percentage of 40.7% (Table 1).

Nyvad I (34.4% in Group I and 2.9% in Group II), Nyvad II (65.6% in Group I and 97.1% in Group II) (Table 2). The mean pre-microbiological load was assessed and compared between Group I and Group II, and the p-value was 0.386 (Table 3). At baseline, the mean colony forming units (CFU) was found to be 98600000 CFU/ml and it reduced to 37000000 CFU/ml which showed 37% reduction of the Streptococcus mutans colonies. Frankl's behaviour assessment scale assessed patients during the treatment by the operator among the two groups, and it was statistically compared (Table 4). The microbial count of S. mutans is presented in Fig. 4.

Table 1. Percentage of patients with disabilities in Group I and II

Таблица 1. Процент пациентов с ограниченными возможностями в группе I и группе II

Disability	Group I (n = 32), %	Group II (n = 34), %
Autism	40.6	5.9
Blind	3.1	11.8
Cerebral Palsy	6.2	14.7
Hearing Impaired	18.8	17.6
Intellectually impaired	21.8	40.7
ADHD	6.1	–
Downs	3.1	8.8

Table 2. Percentage of Nyvad classification among study groups

Таблица 2. Процентное распределение классификации Нювад среди исследуемых групп

Classification			Group 1	Group 2	p-value
NYVAD	1.00	Count	11	1	0.001
		%	34.4	2.9	
	2.00	Count	21	33	
		%	65.6	97.1	

Note: p = 0.001 (between group 1 and group 2, there was a statistically significant variation in the proportion of different NYVAD scores)

Примечание: p = 0,001 (между группой 1 и группой 2 наблюдалась статистически значимая разница в распределении различных баллов по классификации NYVAD)

Table 3. Comparison of the mean Pre microbiological load in the study groups

Таблица 3. Сравнение среднего микробиологического фона до лечения в исследуемых группах

Group	N	Mean	Std. Deviation	p-value
1	32	219.000	329.258	0.386
2	34	157.235	241.428	

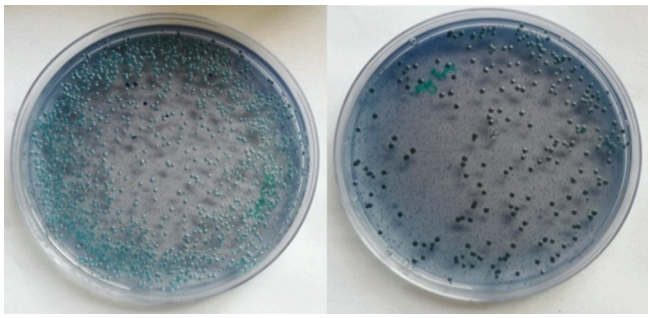
Note: p = 0.386 (there was no statistically significant difference between group 1 and group 2's mean premicro scores)

Примечание: p = 0,386 (статистически значимой разницы в средних показателях микробной нагрузки до лечения между группой 1 и группой 2 не выявлено)

Table 4. Frankl's child assessment between two groups

Таблица 4. Оценка поведения детей по шкале Франкла в двух группах

Classification			Group 1	Group 2	p-value
Frankl's	Definitely Negative	Count	2	0	0.144
		%	6.2	0.0	
	Negative	Count	5	1	
		%	15.6	2.9	
	Negative-Positive	Count	2	2	
		%	6.2	5.9	
	Positive	Count	9	13	
		%	28.1	38.2	
	Definitely Positive	Count	14	18	
		%	43.8	52.9	



A B

Fig. 4. Microbial count of Streptococcus mutans: *A* – pre microbial count; *B* – post microbial count

Рис. 4. Количество микроорганизмов *Streptococcus mutans*: *A* – до лечения; *B* – после лечения

The result showed that there was not statistically significant difference between the two groups and the p value was 0.144.

According to Frankl's criteria, 52.9% of the Group II population were positive, followed by 38.2% who were positive among the Group II. In our present study, 71.9% of the parents strongly agreed, and 21.1% agreed that the SDF application was straightforward. Only 3% of the parents reported difficulty in the application of SDF. 31% of the parents in Group I were not concerned about the discoloration caused by SDF, and they agreed to SDF because of the minimally invasive treatment approach of SDF. 28% of the total parent population among Group I reported neutral concern for the discoloration of SDF after treatment (Fig. 5). 67% of the parents from Group II agreed that GIC application over SDF application was pain-free for their child and had accepted SMART (Fig. 3) as it was the minimally invasive procedure (Fig. 6).

After six months, the Group I and Group II patients were followed up, and a dropout of 2 patients was observed during the second visit. A microbiological plaque sample was collected, and a microbiological assessment was done. There was no statistically significant difference in mean post-micro scores in Groups I and II (Table 5).

Comparison of pre- and post-microbiological count in Group I and Group II was assessed, and the p-value was found to be 0.003 in Group I and 0.001 in Group II, which was statistically significant and implies that the mean microbial reduction was significant in Group II (SMART) when compared to Group I (SDF) (Table 6).

A chemically sealed restoration demonstrating SDF's remineralization and antibacterial action is achieved by placing GIC immediately over SDF. Nutrient supplies to any surviving bacteria will be cut off after placing GIC and with additional fluoride and caries, arresting the property of SDF, with its magic silver bullet release effect and "Zombie effect" [12] The deceased bacteria serve as a reservoir and encourage steady cation release, further helping to kill the remaining bacteria, which gives an additional anti-cariogenic property and carries arrest.

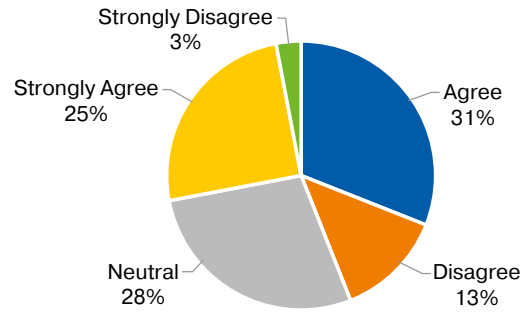


Fig. 5. Parent acceptance rate of group I

Рис. 5. Уровень принятия методики родителями в группе I

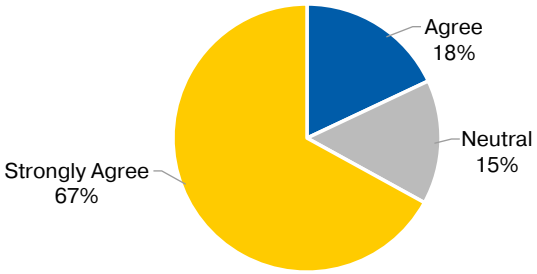


Fig. 6. Parent acceptance rate of group II

Рис. 6. Уровень принятия методики родителями в группе II

Table 5. Comparison of mean post Microbiological count among the study groups

Таблица 5. Сравнение среднего микробиологического показателя после лечения между исследуемыми группами

Group	*N*	Mean	Std. Deviation	*p*-value
1	31	343.516	148.709	0.605
2	33	205.181	326.730	

Note: p = 0.605 (There was no statistically significant difference in mean post micro score between Group 1 and Group 2)
Примечание: p = 0,386 (статистически значимой разницы в среднем показателе микрооценки после лечения между группой 1 и группой 2 не выявлено)

Table 6. Pre and post microbial count of group 1 and 2

Таблица 6. До- и послеоперационное количество микроорганизмов в группах 1 и 2

Group	Stage of treatment	Mean	Std. Deviation	*p*-value
1	Pre-Micro	226.806	333.570	0.003
	Post-Micro	343.516	432.245	
2	Pre-Micro	162.363	243.731	0.001
	Post-Micro	205.181	326.730	

Note: p value was 0.003 in group 1 and the p-value in group II was 0.001 which was statistically significant.
Примечание: Значение p в группе 1 составило 0,003, а в группе 2 – 0,001, что является статистически значимым.

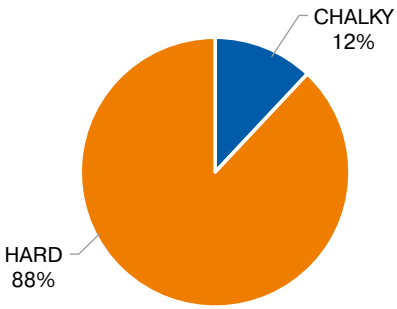


Fig. 7. Texture of secondary caries among group I
Рис. 7. Структура вторичного кариеса в группе I

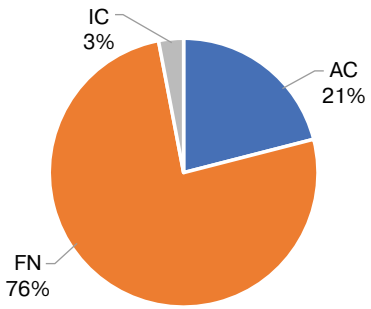


Fig. 8. Texture of secondary caries among group II
Рис. 8. Структура вторичного кариеса в группе II

After six-month interval, caries adjacent to restorations were evaluated in both groups by visual and tactile examination, and the color, consistency and the texture of cavity was assessed in group I and the presence of new caries, adjacent to the restorations were assessed in Group II. SDF was reapplied only in Group I during the follow up period which would ensure the caries arrest by the same. In Group I, 84% of the treated teeth were black and 87% hard in texture, clinically indicating arrested cavitated lesions among the Group I population. Only 12% of the patients in Group I had brown lesions, which were chalky in texture (Fig. 7).

Among the Group II population, it was observed that 76.4% of the total were Fine cavities with no decay, and 20.6 % were arrested cavitated lesions, which exhibited the effect and caries arresting property of SDF. 2.9% were observed with initial caries in Group II (Fig. 8).

DISCUSSION

The current clinical study was formulated to compare the antimicrobial and clinical effectiveness of caries arrest after Silver Diamine Fluoride (SDF) application and Silver Modified Atraumatic Restorative Technique (SMART) in 3–9-year-old children with special needs with various disabilities. The research also focused on the subjective feelings of the parents/guardians about the dis-coloration after the SDF's application, the SDF's taste, and the parents' acceptance of SDF. Since the study was aimed only at children with special needs, the non-invasive practical approach of SDF has added more beneficial effects to them. Dental caries is a discrete, post-eruptive pathological process of external origin that softens the hard tooth tissue and develops cavities (WHO). Enamel caries is a three-dimensional subsurface demineralization that spreads along the enamel prisms on both occlusal and proximal surfaces, and secondary caries is a lesion seen at the edge of a dental repair [20].

The non-invasive application method of SDF makes it beneficial to use in children with anxiety, fear and needle phobias, as it does not involve the process of drilling or the use of a syringe. It can also be beneficial to patients who cannot tolerate standard treatment due to severe cognitive and physical disabilities, patients with salivary gland dysfunction after radiation therapy, Sjogren syndrome, etc. [21]. When children are too young to have their carious teeth fixed using standard techniques, silver diamine fluoride can stop or slow the progression of caries. Also, the SDF ap-plication might be an affordable treatment method for several underprivileged youngsters or in regions with a severe lack of dental professionals [9; 22].

Yee and his colleagues concluded that single spot application of 38% SDF effectively arrested carious lesions.18 According to Jabin and his associates, repeated application of SDF at 6 and 12 months was effective for the arrest of caries [23]. A similar study was done by Sihra et al., who found that the caries was arrested after using SDF [24]. The biannual application of 38% SDF was effective, similar to our findings [25–29].

The current caries control strategies go well beyond just "drilling and filling" the teeth and focuses instead on a preventive and conservative approach to caries care. In a single appointment, the Silver Modified Atraumatic Restorative Technique (SMART) approach constitutes application of SDF for a minute to the damaged tooth before immediately covering it with GIC.

SDF alone cannot repair a tooth's structure and function, mainly when significant carious lesions are too large and close to the pulp. GIC restorations over the lesion utilizing the silver-modified atraumatic restorative technique (SMART) or interim therapeutic procedures such as stainless-steel crowns should be considered to boost the efficacy of an SDF-treated lesion. A chemically sealed restoration demonstrating SDF's remineralization and antibacterial action is achieved by placing GIC immediately over SDF. Nutrient supplies to any surviving bacteria will be cut off after placing GIC and with additional fluoride release and caries arresting property of SDF, with its magic silver bullet release effect and "Zombie effect" marks the clinical efficacy of SMART [19]. The primary trait of biocidal metals, such as copper and silver, has their gradual release of poisonous cations over a lengthy period of time. Silver particles displayed a biocidal effect against living microorganisms when they destroyed bacteria. Metal ions do not deactivate after killing the bacterium; hence, they continue to kill the germs. The deceased bacteria serve as a reservoir and encourage steady cation release, further helping to kill the remaining bacteria, which gives an additional anti-

cariogenic property and carries arrest [12; 19]. According to Zhao and his colleagues, applying SDF first may be beneficial in some circumstances, followed by glass ionomer restorations. When Glass Ionomer Cement is placed over SDF, the complete nutrient source to the bacteria will be cut off, and the anaerobic zone leads to the lysis of the remaining bacteria with additional caries arrest with anti-cariogenic properties of GIC and Silver particles in the SDF [30; 31].

The children were grouped into two groups (SDF and SMART) based on the Nyvad criteria for Caries Lesion Activity and Severity Assessment and the extent of caries. The reliability of the Nyvad criteria for Caries Lesion Activity and Severity Assessment for dental was excellent when used by trained professionals. After selecting the tooth according to Nyvad's Criteria, the child's challenging behaviour questionnaire was answered by the parents/guardian before the treatment to know the child's basic behaviour nature, which would help the pedodontist to carry out apt behaviour management techniques during the clinical procedure for each child. It was essential to understand and know the child better before the initiation of treatment because the special child lacks cooperative ability, and each child behaves and responds differently depending upon their cognition level and disability [32].

Our study selected around 38% SDF (FagaminR) as a treatment option because of the high fluoride content (44,800ppm), remineralization, and antibacterial and anti-cariogenic properties. Silver and fluoride ions released from the SDF helped to inhibit the cariogenic plaque biofilm and reported that it helps in the prevention of secondary caries [29; 30].

Plaque sample was collected from the buccal and lingual aspect of the primary upper and lower posterior teeth from both groups. The mean pre-microbiological load was assessed and com-pared between Group I and Group II, and the p-value was found to be 0.386, which was not statistically significant. 38% SDF was saturated for one minute for the cavitated lesions in Group I, and GIC was applied in Group II after the SDF application. The operator used Frankl's Behaviour Rating Scale and graded the patient's behaviour assessment in the categories of I, II, III, IV, and V. A Likert scale questionnaire was carried out to know about the acceptability of SDF and SMART by the parent\guardian. In our present study, parents were more concerned about caries arrest and the minimally invasive treatment approach than the staining of the primary teeth. Since children with special needs lack coordination and cooperation, the parents were happier about the non-invasive treatment approach with SDF in our current study. Most parents accepted it because of its less invasive nature. Few parents expressed their aesthetic concerns about SDF, and many reported that their children were too young to care about the black staining after SDF application; instead, they were happy when the sensitivity had stopped. In a similar study, Miller et al. [33] found that most parents accepted SDF as a nonsurgical treatment to arrest caries and minimize dentinal sensitivity secondary to caries. A similar report was given by Alshammari et al. [34].

Patel and his colleagues reported no difference in the staining intensity between SDF and SDF+KI [35], while few other authors found a statistically significant decrease in staining intensity [36; 37]. Patients were followed up at six months, and a plaque sample was collected from both groups. There was a dropout of two patients from the groups. Comparison of pre-and post-microbiological count in Group I (SDF)and Group II (SMART) was assessed, and the p-value was found to be 0.003 and 0.001, which was statistically significant and implies that the mean microbial reduction was significant in Group II (SMART) when compared to Group I (SDF). Secondary caries was evaluated by visual and tactile examination in Groups I and II, and SDF was reapplied in Group I, according to Zhi et al. [24]. The reapplication of SDF at six-month intervals added extra beneficial caries arresting effects to the study population as it is difficult for the special children to maintain oral hygiene properly due to lack of dexterity [38–40]. Our study found that SDF has given promising clinical results in the research sample. The Limitations of the study includes, the difficulty to isolate during the clinical procedures and lack of following of the post operative instructions by the patients due to the disabilities.

Our study concluded that the effectiveness of both the techniques (SDF and SMART) was equally beneficial to the target population. Since it was focused mainly on exceptional children, the non-invasive treatment approach offered easy, highly efficient caries arrest. However, it was statistically concluded that the mean microbial reduction was better in Group II (SMART) than in Group I (SDF), with a p-value of 0.001, which was statistically significant. Hence, the SMART procedure presented a deemed advantage in caries arrest and microbial reduction compared to clinically and microbiologically SDF. Only 2.9% of the occurrence of the new carious lesion was observed in Group II. In contrast, it was 12% in Group I, which signifies the clinical success of the SMART technique among children with special needs despite being a minimally invasive treatment approach.

CONCLUSION

Within the parameters of this study, it was concluded that, Silver Diamine Fluoride and SMART has given promising clinical results in the field of dentistry, which were equally beneficial in particular children. The mean microbial reduction was better in Group II(SMART) than in Group I(SDF), with a p-value of 0.001, which was statistically significant.

Hence, the SMART procedure presented a deemed advantage in caries arrest and microbial reduction compared to clinically and microbiologically SDF. In contrast, it was 15% in Group I, which signifies the SMART technique's clinical success among Special children despite being a minimally invasive treatment approach.

The advancement of the Silver Modified Atraumatic Restorative Technique (SMART) has proved a better clinical and microbial success when compared to Silver Diamine Fluoride alone in special children who would find difficulty in making multiple dental appointments due to the physical and mental health issues.

REFERENCES / СПИСОК ЛИТЕРАТУРЫ

1. Smales R.J., Yip H.K. The atraumatic restorative treatment (ART) approach for primary teeth: review of literature. *Pediatr Dent*. 2000;22(4):294–298.
2. Dharmani C.K.K. Management of children with special health care needs (SHCN) in the dental office. *J Med Soc.* 2018;32(1):1–6. https://doi.org/10.4103/jms.jms_115_16
3. Holder M., Waldman H.B., Hood H. Preparing health professionals to provide care to individuals with disabilities. *Int J Oral Sci*. 2009;1(2):66–71. https://doi.org/10.4248/ijos.09022
4. Selvaraj S., Naing N.N., Wan-Arfah N., Djearamane S., Wong L.S., Subramaniyan V. et al. Epidemiological factors of periodontal disease among South Indian adults. *J Multidiscip Healthc*. 2022;15:1547–1557. https://doi.org/10.2147/JMDH.S374480
5. Gerreth K., Borysewicz-Lewicka M. Access barriers to dental health care in children with disability. A questionnaire study of parents. *J Appl Res Intellect Disabil*. 2016;29(2):139–145. https://doi.org/10.1111/jar.12164
6. Selvaraj S., Naing N.N., Wan-Arfah N., Karobari M.I., Marya A., Prasadh S. Development and validation of oral health knowledge, attitude and behavior questionnaire among Indian Adults. *Medicina*. 2022;58(1):68. https://doi.org/10.3390/medicina58010068
7. Lewis C., Robertson A.S., Phelps S. Unmet dental care needs among children with special health care needs: implications for the medical home. *Pediatrics*. 2005;116(3):e426–e431. https://doi.org/10.1542/peds.2005-0390
8. Duangthip D., Chen K.J., Gao S.S., Lo E.C.M., Chu C.H. Managing early childhood caries with atraumatic restorative treatment and topical silver and fluoride agents. *Int J Environ Res Public Health*. 2017;14(10):1204. https://doi.org/10.3390/ijerph14101204
9. Chu C.H., Lo E.C. Promoting caries arrest in children with silver diamine fluoride: a review. *Oral Health Prev Dent*. 2008;6(4):315–321.
10. Willershausen I., Schulte D., Azaripour A., Weyer V., Briseño B., Willershausen B. Penetration potential of a silver diamine fluoride solution on dentin surfaces. An Ex Vivo Study. *Clin Lab*. 2015;61(11):1695–1701. https://doi.org/10.7754/clin.lab.2015.150401
11. Gao SS, Zhao I.S., Hiraishi N., Duangthip D., Mei M.L., Lo E.C.M., Chu C.H. Clinical trials of silver diamine fluoride in arresting caries among children: A systematic review. *JDR Clin Trans Res*. 2016;1(3):201–210. https://doi.org/10.1177/2380084416661474
12. Alvear Fa B., Jew J.A., Wong A., Young D. Silver modified atraumatic restorative technique (SMART): An alternative caries prevention tool. *Stoma Edu J.* 2016;3(3-4):243–249. https://doi.org/10.25241/stomaeduj.2016.3(3-4).art.15
13. Chu C.H., Mei L., Seneviratne C.J., Lo E.C. Effects of silver diamine fluoride on dentine carious lesions induced by Streptococcus mutans and Actinomyces naeslundii biofilms. *Int J Paediatr Dent*. 2012;22(1):2–10. https://doi.org/10.1111/j.1365-263X.2011.01149.x
14. Shah S., Bhaskar V., Venkataraghavan K., Choudhary P., Ganesh M., Trivedi K. Efficacy of silver diamine fluoride as an antibacterial as well as antiplaque agent compared to fluoride varnish and acidulated phosphate fluoride gel: an in vivo study. *Indian J Dent Res*. 2013;24(5):575–581. https://doi.org/10.4103/0970-9290.123374
15. Nyvad B., Machiulskiene V., Baelum V. Reliability of a new caries diagnostic system differentiating between active and inactive caries lesions. *Caries Res*. 1999;33(4):252–260. https://doi.org/10.1159/000016526
16. Kiran S., Bhatt R., Patel M., Shah N. Pattern and knowledge of wright's modification of frankl's behavior rating scale followed among postgraduate students of pediatric dentistry in ahmedabad city – A Survey. *Adv Hum Biol*. 2015;5(1):39–42. Available at: https://oaji.net/articles/2015/957-1433399154.pdf (accessed: 13.12.2024).
17. Clemens J., Gold J., Chaffin J. Effect and acceptance of silver diamine fluoride treatment on dental caries in primary teeth. *J Public Health Den*t. 2018;78(1):63–68. https://doi.org/10.1111/jphd.12241
18. Yee R., Holmgren C., Mulder J., Lama D., Walker D., van Palenstein Helderman W. Efficacy of silver diamine fluoride for Arresting Caries Treatment. *J Dent Res*. 2009;88(7):644–647. https://doi.org/10.1177/0022034509338671
19. Rosenblatt A., Stamford T.C., Niederman R. Silver diamine fluoride: a caries "silver-fluoride bullet". *J Dent Res*. 2009;88(2):116–125. https://doi.org/10.1177/0022034508329406
20. Yadav K., Prakash S. Dental caries: A review. *Asian J Biomed Pharm Sci*. 2016;6(53):01-07. Available at: https://www.abacademies.org/articles/dental-caries-a-review.pdf (accessed: 13.12.2024).
21. Policy on the use of silver diamine fluoride for pediatric dental patients. *Pediatr Dent*. 2018;40(6):51–54.
22. Mehta V., Tripathy S., Merchant Y., Mathur A., Negi S., Shamim M.A. et al. Oral health status of children with intellectual and developmental disabilities in India: a systematic review and meta-analysis. *BMC Pediatr*. 2024;24:748. https://doi.org/10.1186/s12887-024-05242-8
23. Jabin Z., Vishnupriya V., Agarwal N., Nasim I., Jain M., Sharma A. Effect of 38% silver diamine fluoride on control of dental caries in primary dentition: A Systematic review. *J Family Med Prim Care*. 2020;9(3):1302–1307. https://doi.org/10.4103/jfmpc.jfmpc_1017_19
24. Sihra R., Schroth R.J., Bertone M., Martin H., Patterson B., Mittermuller B.A. et al. The effectiveness of silver diamine fluoride and fluoride varnish in arresting caries in young children and associated oral health-related quality of life. *J Can Dent Assoc*. 2020;86:k9.
25. Zhi Q.H., Lo E.C., Lin H.C. Randomized clinical trial on effectiveness of silver diamine fluoride and glass ionomer in arresting dentine caries in preschool children. *J Dent*. 2012;40(11):962–967. https://doi.org/10.1016/j.jdent.2012.08.002
26. Deolikar S., Rathi N., Mehta V. Comparative evaluation of stress generation in primary teeth restored with zirconia and BioFlx crowns: A finite element analysis. *Dent J*. 2024;57(2):80–86. https://doi.org/10.20473/j.djmkg.v57.i2.p80-86
27. Fung M.H.T., Duangthip D., Wong M.C.M., Lo E.C.M., Chu C.H. Randomized clinical trial of 12% and 38% silver diamine fluoride treatment. *J Dent Res*. 2018;97(2):171–178. https://doi.org/10.1177/0022034517728496
28. Tolba Z.O., Hamza H.S., Moheb D.M., Hassanein H.E., El Sayed H.M. E Effectiveness of two concentrations 12% versus 38% of silver diamine fluoride in arresting

cavitated dentin caries among children: a systematic review. *Egypt Pediatric Association Gaz*. 2019;67:1. https://doi.org/10.1186/s43054-019-0001-y

29. Mei M.L., Ito L., Cao Y., Lo E.C., Li Q.L., Chu C.H. An ex vivo study of arrested primary teeth caries with silver diamine fluoride therapy. *J Dent*. 2014;42(4):395–402. https://doi.org/10.1016/j.jdent.2013.12.007
30. Zhao I.S., Chu S., Yu O.Y., Mei M.L., Chu C.H., Lo E.C.M. Effect of silver diamine fluoride and potassium iodide on shear bond strength of glass ionomer cements to caries-affected dentine. *Int Dent J*. 2019;69(5):341–347. https://doi.org/10.1111/idj.12478
31. Lath T., Rathi N., Mehta V., Mopagar V.P., Patil R.U., Hugar S. et al. Evaluation of stress generation in core build up-material of mutilated primary teeth: a comparative finite element analysis between BioFlx, stainless steel and zirconia crowns. *J Clin Pediatr Dent*. 2024;48(6):117–122. https://doi.org/10.22514/jocpd.2024.132
32. Kyoon-Achan G., Schroth R.J., Martin H., Bertone M., Mittermuller B.A., Sihra R. et al. Parents' views on silver diamine fluoride to manage early childhood caries. *JDR Clin Trans Res*. 2021;6(2):251–257. https://doi.org/10.1177/2380084420930690
33. Miller M.B., López L.A., Quock R.L. Silver diamine fluoride, potassium iodide, and esthetic perception: An in vitro pilot study. *Am J Dent*. 2016;29(5):248–250.
34. Alshammari A.F., Almuqrin A.A., Aldakhil A.M., Alshammari B.H., Lopez J.N.J. Parental perceptions and acceptance of silver diamine fluoride treatment in Kingdom of Saudi Arabia. *Int J Health Sci*. 2019;13(2):25–29.
35. Patel J., Anthonappa R.P., King N.M. Evaluation of the staining potential of silver diamine fluoride: in vitro. *Int J Paediatr Dent*. 2018;28(5):514–522. https://doi.org/10.1111/ipd.12401
36. Chadwick D., Chapman M., Davies G. Factors affecting access to daily oral and dental care among adults with intellectual disabilities. *J Appl Res Intellect Disabil*. 2018;31(3):379–394. https://doi.org/10.1111/jar.12415
37. Zhao I.S., Mei M.L., Burrow M.F., Lo E.C., Chu C.H. Effect of silver diamine fluoride and potassium iodide treatment on secondary caries prevention and tooth discolouration in cervical glass ionomer cement restoration. *Int J Mol Sci*. 2017;18(2):340. https://doi.org/10.3390/ijms18020340
38. Saloviita T., Pirttimaa R., Kontu E. Parental perceptions of the use of coercive measures on children with developmental disabilities. *J Appl Res Intellect Disabil*. 2016;29(1):11–20. https://doi.org/10.1111/jar.12154
39. Llodra J.C., Rodriguez A., Ferrer B., Menardia V., Ramos T., Morato M. Efficacy of silver diamine fluoride for caries reduction in primary teeth and first permanent molars of schoolchildren: 36-month clinical trial. *J Dent Res*. 2005;84(8):721–724. https://doi.org/10.1177/154405910508400807
40. Kharat P.B., Rajpurohit L., Mathur A., Mehta V., Kalpe S., Buddhikot C.S. et al. Survival of silver diamine fluoride varnish treated teeth among children with single/multiple applications: A split-mouth randomized clinical trial. *Int J Clin Pediatr Dent*. 2024;17(11):1211–1218. https://doi.org/10.5005/jp-journals-10005-2988

INFORMATION ABOUT THE AUTHORS

Anagha Saseendran – Department of Pedodontics, Krishnadevaraya College of Dental Sciences, Karnataka, India; https://orcid.org/0009-0001-0540-4253

Pallavi Urs – Department of Pedodontics, Krishnadevaraya College of Dental Sciences, Karnataka, India; https://orcid.org/0009-0008-2545-1138

Nameeda K. Syeda – Department of Pedodontics, Krishnadevaraya College of Dental Sciences, Karnataka, India; https://orcid.org/0009-0000-4222-6559

Fathimath N. Kandakkeel – Department of Paediatric Dentistry, Faculty of Dentistry, Lincoln University College, Petaling Jaya, Malaysia; https://orcid.org/0009-0009-8500-1072

Arul Selvan – Department of Microbiology, Krishnadevaraya College of Dental Sciences, Karnataka, India; https://orcid.org/0009-0009-7726-3275

Toufiq Noor – Department of Dental Research Cell, Dr. D.Y. Patil Dental College and Hospital, Dr. D.Y. Patil Vidyapeeth, Pune 411018, India; https://orcid.org/0009-0006-7296-8952

Abedelmalek K. Tabnjh – Sahlgrenska Academy, Odontology School, Department of the Cariology, University of Gothenburg, Sweden. Department of Applied Dental Science, Faculty of Applied Medical Science, Jordan University of Science and Technology, Jordan; https://orcid.org/0009-0002-0739-1676

Siddharthan Selvaraj – Department of Dental Research Cell, Dr. D.Y. Patil Dental College and Hospital, Dr. D.Y. Patil Vidyapeeth, Pune 411018, India. Faculty of Dentistry, University of Puthisastra, Phnom Penh, Cambodia; https://orcid.org/0000-0002-7776-3335

ИНФОРМАЦИЯ ОБ АВТОРАХ

Ананья Сасиндран – кафедра детской стоматологии, Стоматологический колледж Кришнадеварая, Карнатака, Индия; https://orcid.org/0009-0001-0540-4253

Паллави Урс – кафедра детской стоматологии, Стоматологический колледж Кришнадеварая, Карнатака, Индия; https://orcid.org/0009-0008-2545-1138

Намида К. Сайеда – кафедра детской стоматологии, Стоматологический колледж Кришнадеварая, Карнатака, Индия; https://orcid.org/0009-0000-4222-6559

Фатимат Н. Кандаккил – кафедра детской стоматологии, Стоматологический факультет, Университетского колледжа Линкольна, Петалинг-Джая, Малайзия; https://orcid.org/0009-0009-8500-1072

Арул Селван – кафедра микробиологии, Стоматологический колледж Кришнадеварая, Карнатака, Индия; https://orcid.org/0009-0009-7726-3275

Тауфик Нур – исследовательский центр в области стоматологии, Стоматологический колледж и больница д-ра Д.Й. Патила, Университет д-ра Д.Й. Патила Видьяпит, Пуна 411018, Индия; https://orcid.org/0009-0006-7296-8952

Абдельмалек К. Табндж – Академия Сальгренска, Школа одонтологии, кафедра кариологии, Гетеборгский университет, Швеция; кафедра прикладной стоматологии, факультет прикладных медицинских наук, Университет науки и технологий Иордании, Иордания; https://orcid.org/0009-0002-0739-1676

Сиддхартхан Селварадж – исследовательский центр в области стоматологии, Стоматологический колледж и больница д-ра Д.Й. Патила, Университет д-ра Д.Й. Патила Видьяпит, Пуна 411018, Индия; факультет стоматологии, Университет Путисастра, Пномпень, Камбоджа; https://orcid.org/0000-0002-7776-3335

AUTHOR'S CONTRIBUTION

Anagha Saseendran – a substantial contribution to the concept or design of the article; drafted the article or revised it critically for important intellectual content.

Pallavi Urs – a substantial contribution to the concept or design of the article; drafted the article or revised it critically for important intellectual content.

Nameeda K. Syeda – a substantial contribution to the concept or design of the article; the acquisition, analysis, or interpretation of data for the article.

Fathimath N. Kandakkeel – drafted the article or revised it critically for important intellectual content; approved the version to be published.

Arul Selvan – the acquisition, analysis, or interpretation of data for the article; approved the version to be published.

Toufiq Noor – drafted the article or revised it critically for important intellectual content; approved the version to be published.

Abedelmalek K. Tabnjh – a substantial contribution to the concept or design of the article; drafted the article or revised it critically for important intellectual content.

Siddharthan Selvaraj – drafted the article or revised it critically for important intellectual content; approved the version to be published.

ВКЛАД АВТОРОВ

А. Сасиндран – значительный вклад в разработку концепции или дизайна исследования; написание статьи или критическое редактирование с акцентом на интеллектуальное содержание.

П. Урс – значительный вклад в разработку концепции или дизайна исследования; написание статьи или критическое редактирование с акцентом на интеллектуальное содержание.

Н.К. Сайеда – значительный вклад в разработку концепции или дизайна исследования; сбор, анализ или интерпретация данных для статьи.

Ф.Н. Кандаккил – написание статьи или критическое редактирование с акцентом на интеллектуальное содержание; утверждение окончательной версии к публикации.

А. Селван – сбор, анализ или интерпретация данных для статьи; утверждение окончательной версии к публикации.

Т. Нур – написание статьи или критическое редактирование с акцентом на интеллектуальное содержание; утверждение окончательной версии к публикации.

А.К. Табндж – значительный вклад в разработку концепции или дизайна исследования; написание статьи или критическое редактирование с акцентом на интеллектуальное содержание.

С. Селварадж – написание статьи или критическое редактирование с акцентом на интеллектуальное содержание; утверждение окончательной версии к публикации.