

Comparing Silver Diamine Fluoride Effectiveness on Primary and Permanent Dentition



So Hyeon Park DDS, Wai-Yin Chan MS, DMD, MPH

NYU Langone Dental Medicine, Advanced Education in Pediatric Dentistry Residency, San Diego, CA

NYU Langone Dental Postdoctoral
Residency Programs

INTRODUCTION

- According to the Centers of Disease Control and Prevention (CDC), approximately 23% of children aged two to five years had dental caries in primary teeth and about 60% of adolescents aged 12–19 have experienced dental caries in permanent teeth.¹
- In the pediatric dentistry field, due to the unique population of patients being served, traditional surgical removal of caries is not always a feasible option. Patients with behavioral challenges either due to their age or medical condition can benefit from caries management options which avoid traditional operative and restorative dentistry.²
- Silver Diamine Fluoride (SDF) is used as an antimicrobial and remineralization agent to arrest the progression of caries lesions. One of the hypothesized mechanisms of action of SDF in arresting caries is hampering degradation of the dentine collagen by inhibiting the activity of collagenase.³⁻⁵
- Pediatric patients are unique in that they have both primary and permanent dentition. Primary teeth and permanent teeth differ in enamel thickness, where primary teeth enamel is significantly thinner than permanent teeth enamel.⁸ This is theorized to contribute to the difference in efficacy of SDF application on primary dentition compared to permanent.

PURPOSE

- The objective of this retrospective chart review study is to evaluate differences in outcomes on primary compared to permanent dentition following Silver Diamine Fluoride (SDF) treatment.
- Hypothesize: There is a difference in outcomes following SDF treatment for primary compared to permanent dentition and tooth surface type

METHOD

- Participants**
 - Pediatric patients of a community health center in San Diego ages 3 to 14 years who received SDF treatment on posterior dentition between January 1, 2016 and December 31, 2019.
- Procedure**
 - This was a retrospective chart review. Information collected included: primary/ permanent dentition status, tooth surface (interproximal or non-interproximal) and outcome [no treatment needed (i.e.: allowed for exfoliation, remained asymptomatic) or intervention required (i.e.: restoration, extraction)].
 - Subject demographics recorded include: gender, age, insurance type, Race/ethnicity, American Society of Anesthesiologists (ASA) classification and patient behavior.
 - Charts were extracted using the Dental procedure code D1354 (interim caries arresting medicament application). Out of 4390 extracted charts, every 10th subject was selected for review.
 - Excluded anterior teeth application.
 - Excluded patients who failed to return, and the patients who returned to the clinic before the 9 month follow up period, but failed to return afterwards.
 - Excluded patients who needed Full Mouth Dental Rehabilitation under IV general anesthesia or Hospital Operating Room settings.
- Statistical Analysis**
 - Data was collected in RedCap (NYU Langone Hospital in New York). A bivariate analysis was completed with significance level set p=0.05.

TABLE 1. Demographics (n=101)

	Category	Overall
Number of teeth per subject (mean (SD))		2.67 (2.00)
Duration of follow up [mean months (SD)]		35.89 (16.98)
Behavior Frankel Score (at the time of application)	1	12 (9.2)
	2	18 (13.7)
	3	27 (20.6)
	4	74 (56.5)
ASA (%)	1	104 (79.4)
	2	26 (19.8)
	3	1 (0.8)
Gender	Male	63 (48.1)
	Female	68 (51.9)
Race	White, non Hispanic	9 (6.9)
	Hispanic	7 (5.3)
	African American	1 (0.8)
	Asian	3 (2.3)
	Multiracial	3 (2.3)
	No response	108 (82.4)
Ethnicity	Hispanic	48 (36.6)
	Non Hispanic	2 (1.5)
	Not defined	81 (61.8)
Insurance	Medi-Cal	128 (97.7)
	Other	2 (1.5)
	Self Pay	1 (0.8)
Age [mean years (SD)]		7.77 (3.68)

REFERENCES

1. Centers for Disease Control and Prevention. Dental Caries and Sealants Prevalence in Children and Adolescents in the United States, 2011-2012. <https://www.cdc.gov/nchs/data/databriefs/db191.pdf>

2. Crystal YO, Niederman Richard. Evidence-Based Dentistry Update on Silver Diamine Fluoride. Dent Clin North Am.2019 January; 63 (1): 45-68.

3. American Academy of Pediatric Dentistry. Policy on the Use of Silver Diamine Fluoride for Pediatric Dental Patients 2018. https://www.aapd.org/media/Policies_Guidelines/P_SilverDiamine.pdf

4. Horst JA, Elleniotis H, Milgrom PL. UCSF Protocol for Caries Arrest Using Silver Diamine Fluoride: Rationale, Indications and Consent. J Calif Dent Assoc. 2016 Jan;44(1):16-28. PMID: 26897901; PMCID: PMC4778976.

5. Zhao IS, Gao SS, Hiraishi N, Burrow MF, Duangthip D, Mei ML, Lo EC, Chu CH. Mechanisms of silver diamine fluoride on arresting caries: a literature review. Int Dent J. 2018 Apr;68(2):67-76. English. doi: 10.1111/adj.12320. Epub 2017 May 21. PMID: 28542863; PMCID: PMC9378923.

6. Duangthip D, Jiang M, Chu CH, Lo EC. Non-surgical treatment of dentin caries in preschool children—systematic review. BMC Oral Health. 2015 Apr 3;15:44. doi: 10.1186/s12903-015-0033-7. PMID: 25888484; PMCID: PMC4403709.

7. Irene Shuping Zhao, Sherry Shiquian Gao, Noriko Hiraishi, Michael Francis Burrow, Duangpoom Duangthip, May Lei Mei, Edward Chin-Man Lo and Chun-Hung Chu. Mechanisms of silver diamine fluoride on arresting caries: a literature review. International Dental Journal 2018; 68:67-76

8. De Menezes Oliveira MA, Torres CP, Gomes-Silva JM, Chinelatti MA, De Menezes FC, Palma-Dibb RG, Borsatto MC. Microstructure and mineral composition of dental enamel of permanent and deciduous teeth. Microsc Res Tech. 2010 May;73(5):572-7. doi: 10.1002/jemt.20796. PMID: 19937744.

9. Scheffel DLS, Cury JA, Tenuta LMA, Scheffel RH, Perez C, Soares DG, Basso FG, Costa CAS, Pashley DH, Hebling J. Proteolytic activity, degradation, and dissolution of primary and permanent teeth. Int J Paediatr Dent. 2020 Sep;30(5):650-659. doi: 10.1111/ijpd.12632. Epub 2020 Mar 9. PMID: 32077547.

10. Fung M, Duangthip D, Wong M, Lo E, Chu C. Arresting dentine caries with different concentration and periodicity of silver diamine fluoride. JDR Clin Transl Res 2016;12(1):143-52.

11. American Academy of Pediatric Dentistry. Behavior Guidance for the Pediatric Dental Patient 2020. https://www.aapd.org/robiletses/media/policies_guidelines/tp_behavguide.pdf

12. Talari K, Goyal M. Retrospective studies - utility and caveats. J R Coll Physicians Edinb. 2020 Dec;50(4):398-402. doi: 10.4997/JRCP.2020.409. PMID: 33469615.

13. Roberts A, Bradley J, Merkle S, Pachal T, Gopal JV, Sharma D. Does potassium iodide application following silver diamine fluoride reduce staining of tooth? A systematic review. Aust Dent J. 2020 Jun;65(2):109-117. doi: 10.1111/adj.12743. Epub 2020 Feb 10. PMID: 31900927.

TABLE 2 Outcomes based on dentition type (permanent vs primary)

	Overall n	Primary Dentition	Permanent Dentition	P-value
	481	203	147	
Intervention needed**	184 (52.6)	153 (75.4)	31 (21.1)	< 0.001
No further intervention needed**	166 (47.4)	50 (24.6)	116 (78.9)	

TABLE 2a Logistic regression for outcomes* based on dentition type (permanent and primary)

	Odds Ratio estimate	Upper Confidence Limit	Lower Confidence Limit	P-value
Permanent	Ref	Ref	Ref	Ref
Primary	11.45	19.047	6.88	<0.0001

TABLE 3 Outcomes based on surface treated (interproximal vs non-interproximal)

	Overall n	Interproximal	Non-interproximal	P-value
	481	207	143	
Intervention needed**	184 (52.6)	78 (37.7)	106 (74.1)	< 0.001
No further intervention needed**	166 (47.4)	129 (62.3)	37 (25.9)	

TABLE 3a Logistic regression for outcomes* based on surface treated (interproximal and non-interproximal surface)

	Odds Ratio estimate	Upper Confidence Limit	Lower Confidence Limit	P-value
Interproximal	Ref	Ref	Ref	Ref
Non-interproximal	4.738	7.566	2.967	<0.0001

* Chi-Square test was used

**Further intervention: direct or indirect restoration (ie: a filling, crown) or non-physiologic loss of tooth
No further invention needed: no carious removal and exfoliated naturally

RESULTS

- Out of 131 charts, 68 were girls and 63 were boys that received SDF application with a mean age 7.77 years (± 3.68 years). 97.7% of the children had Medi-Cal, 2% had other insurance and 1% were self-pay patients. The mean follow up period ranged from 9 months to 80 months (mean 35.89 ± 16.98 months). The number of teeth documented per subject ranged from 1 tooth to 8 teeth (mean 2.67 ± 2 teeth per subject) (Table 1).
- Primary dentition had 11.45 times higher odds of needing intervention compared to permanent (Table 2a).
 - 75% of primary dentition needed further intervention
 - 21% of permanent dentition needed further intervention
- Non-interproximal lesions had 4.7 times higher odds of needing intervention compared to interproximal (Table 3a).
 - 74.1% of the non-interproximal surface lesions required further intervention of treatment
 - 37.7% of the interproximal surface lesions required further treatment

CONCLUSIONS

- Strengths of this study:
 - Multiple variables studied
 - Primary vs Permanent
 - Interproximal vs Non interproximal
- Limitations and Weaknesses of this study:
 - Analysis of teeth with caries on non-interproximal surfaces
 - Non-interproximal surfaces (occlusal and buccal lesions) may not show radiographic evidence of success and the study relied on clinical exam and accurate documentation of those findings
 - Short Study follow up period
 - Exclusion of anterior teeth
 - Due to the unlikely nature of treating permanent anterior teeth with SDF
 - Retrospective chart review
 - The study utilized the data that was not originally designed for research, there might have been incomplete or missing documentation
 - The results should be interpreted with caution.
- Within the limitations, the results of this study suggest that there is a difference in outcomes following SDF treatment for primary compared to permanent dentition and tooth surface type.
- There was a significantly higher chance for further intervention needs following SDF application in primary teeth and teeth with non-interproximal surface caries.
- As a dental provider, it is important to discuss the likelihood of additional treatment needs based on the patient's risk for relapse. The patient's surface and dentition type being treated can be a point of discussion with regards to anticipated SDF treatment success. Furthermore, there should remain a continued emphasis on the importance of oral hygiene and regular recalls for all patients receiving SDF application.
- Some patients choose not to apply SDF for permanent dentition due to its staining property. However, SDF is shown to be even more effective for permanent detention when compared to primary dentition in this study. Thus, further studies are needed to determine whether agents like Potassium Iodide (KI) after SDF application can be used to mitigate SDF staining to increase its uptake among patients.¹³

ACKNOWLEDGEMENT

- Special thanks to Alberta Twi-Yeboah (NYU Langone Health Division of Biostatistics) for data analysis.
- Data collection was permitted by San Diego County community health center .