Effects of Silver Diamine Fluoride (SDF) Treatment on Oral Biofilm Composition in Pediatric Patients with Dental Caries on Primary Teeth

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INTRODUCTION

Dental caries is one of the most common oral diseases in children and remains a major challenge in pediatric dentistry[1]. Conventional restorative treatments do not fully address the progressive and multifactorial nature of caries in primary teeth[2]. Silver Diamine Fluoride (SDF) is an effective non-invasive option for arresting caries[3]. Although its antimicrobial effects have been studied[4,5], limited evidence exists on its impact on oral biofilm composition in children, particularly in primary dentition.

The purpose of this study is to evaluate the effects of Silver Diamine Fluoride (SDF) on oral biofilm composition in pediatric patients with caries affecting primary teeth. Specifically it aims to assess its impact on the abundance of cariogenic species, including *Streptococcus mutans* and *Streptococcus sobrinus*, as well as shifts toward health-associated bacteria such as *Rothia* and *Haemophilus*. Specifically it will investigate whether repeated SDF applications strengthen selective antimicrobial and remineralizing pressures, leading to sustained suppression of cariogenic taxa and stabilization of a health-associated, non-cariogenic microbial ecosystem over time.

METHODS & MATERIALS

Plaque samples were collected from carious and non-carious teeth at three time points surrounding two 38% SDF applications (baseline, ≥4 weeks after first application, and 3–6 months after second application). To date, four participants (P2, P3, P11, P12) with ≥4 untreated cavitated lesions and no prior restorative or preventive care have completed all visits. SDF was used as interim management due to uncooperative behavior, and no additional restorative treatment was provided during follow-up.

Genomic DNA was extracted by ethanol precipitation and analyzed using full-length 16S rRNA gene sequencing on the PacBio Sequel II (~30,000 CCS reads/sample) platform. After quality control and bioinformatic processing, sequences were taxonomically classified against eHOMD v4.1 to assess longitudinal microbial composition and diversity changes over time.

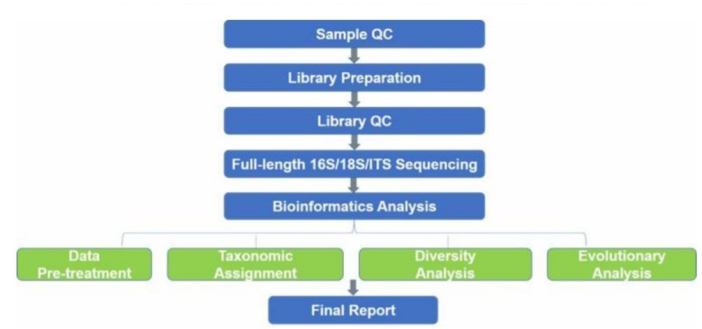


Figure 1. Genomic Analysis Workflow

RESULTS

Longitudinal Changes in Genus-Level Community Composition

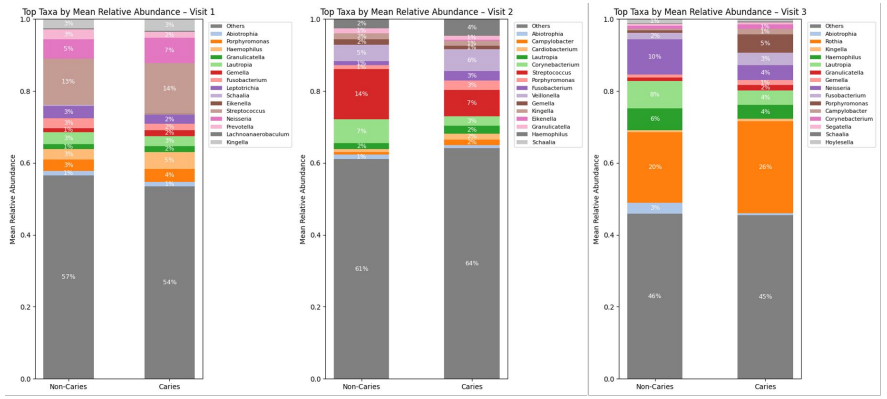
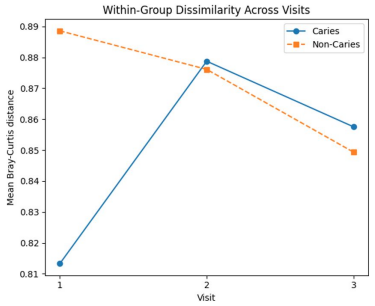


Figure 2. Microbial Composition of Plaque Samples in Control and Caries Sites (V1 - V3)

Dominant taxa (≥1% relative abundance in at least one group) demonstrated compositional shifts following repeated SDF treatment in both caries and non-caries sites. Longitudinal analysis across three visits showed a marked shift by Visit 3 toward increased *Rothia*, *Neisseria*, and *Haemophilus*, with reduced *Streptococcus*, consistent with biofilm restructuring over time. These findings suggest that SDF treatment is associated with community reorganization without progressive enrichment of cariogenic genera or loss of overall microbial diversity.

Genus	Non-Caries (Mean %)	Caries (Visit 1)	Caries (Visit 2)	Caries (Visit 3)
Streptococcus	9.3%	14%	7%	---
Porphyromonas	2.3%	4%	3%	5%
Veillonella		---	6%	---
Fusobacterium	2%	2%	3%	3%
Leptotrichia	1%	2%	---	---
Prevotella	1%	2%	---	---
Rothia	20%	---	---	26%
Lautropia	3.7%	3%	2%	4%
Haemophilus	3.7%	5%	4%	4%
Corynebacterium	2.3%	3%	1%	2%
Abiotrophia	1.7%	1%	1%	<1%
Kingella	6.7%	3%	1%	---
Others	54.7%	54%	64%	45%

Table 1. Relative Abundance of Selected Microbial Taxa in Control and Caries Samples



Mean Pairwise Bray-Curtis		
	Caries	Non-caries
Visit 1	0.813	0.889
Visit 2	0.879	0.876
Visit 3	0.858	0.849

Figure 3: Temporal Changes in Within-Group Microbial Community Dissimilarity (Bray–Curtis)

CONCLUSIONS

Based on longitudinal analysis of plaque samples collected before and after SDF application, we observed microbial community restructuring over time without significant loss of alpha diversity. Genus-level analyses indicated changes in the relative abundance of dominant taxa, including shifts involving Streptococcus and Rothia. Beta diversity analyses demonstrated compositional shifts and increased heterogeneity within caries communities, suggesting ecological reorganization rather than convergence toward a uniform dysbiotic state. Collectively, these findings suggest that repeated SDF application is associated with dynamic restructuring of the oral biofilm while maintaining overall community complexity. Larger longitudinal studies incorporating species-level and functional analyses are needed to clarify the long-term ecological impact of repeated SDF treatment.

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