

The Effectiveness of Silver Diamine Fluoride and Propolis Fluoride in Arresting Caries on Primary Teeth: A Study on Kindergarten Students in West Jakarta, Indonesia

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Abstract

The aim of this study was to compare the effectiveness of topical application of silver diamine fluoride (SDF) solution and topical application of propolis fluoride in arresting active dentine caries in primary teeth. A total of 224 children, aged 3-4 years, were randomly allocated to one of three groups for treatment of carious dentine cavities in their primary teeth: group 1 - application of SDF, group 2 – application of Propolis Fluoride, group 3 – control. Follow-up examinations were carried out 7 days, 1 month and 3 months to assess whether the treated caries lesions had become arrested. After 3 months follow up, 163 (72.8%) children remained in the study. The caries arrest rates were 88.68%, 55.78% and 2.13% for group 1, group 2 and group 3. Application of SDF solution or Propolis Fluoride solution can arrest active dentine caries. Topical application of SDF is more effective than Propolis Fluoride in inhibiting caries lesions progression, but Propolis Fluoride has the advantage that the arrested caries lesion will not turn black in colour like SDF.

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Introduction

Dental caries among schoolchildren remain a challenging problem. The prevalence of caries in preschool children in Jakarta is very high,^{1,2} and most are left untreated.³ The high cost, limited public access to dental care, and difficulty treating uncooperative children are reasons why dental treatment for children is still insufficient.⁴

Among the methods available, the topical application of silver diamine fluoride (SDF) is an easier, cheaper, and more effective method than conventional restorative treatments. It was proposed as a method to manage the epidemic of caries in children, especially in rural or less-developed areas, where resources and dental care services are limited.⁵

It has been reported that the application of SDF is an effective treatment to arrest active dentine caries, but blackening of lesions may not

be pleasing.⁶ Similarly, propolis fluoride provides an alternative treatment. It has been shown to reduce the virulence of *Streptococcus mutans* and have an increasing cariostatic effect.^{7,8} The natural ingredients contained in it, along with no discoloration of the arrested caries' lesions, make the application of propolis fluoride more interesting than that of SDF, especially for anterior teeth and for children.

The purpose of this study was to compare the effectiveness of the application of SDF and propolis fluoride in inhibiting the activity of caries in primary teeth in children.

Method

The study was conducted on kindergarten students in West Jakarta, Indonesia. The research protocol was approved by the Faculty of Dentistry, University of Indonesia's Ethical Committee (Approval No. 5/ Ethical Approval/ FKGUI/I/ 2016). Samples were children aged 4–5 years old, who were cooperative and willing to become the subject of research, signed informed consent, and had dentin carious lesions. At baseline, intraoral examination was performed by a single examiner, and the status of the dentine carious lesions was assessed by visual inspection and CPI probe. Five surfaces in each

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posterior tooth (occlusal, buccal, lingual, mesial, and distal) and four surfaces in each anterior tooth were assessed. Children who met the inclusion criteria were randomly allocated into three groups for the treatment of primary teeth dentin carious lesions: Group 1: application of SDF, Group 2: application of propolis fluoride, and Group 3: control.

Before application, teeth with caries were cleaned and isolated from saliva by using cotton rolls. Then, depending on the child's group allocation, either a 38% SDF solution (Saforide) or propolis fluoride was painted onto the cavity with a micro brush. Children were instructed not to eat or drink at least 30 minutes after application.

Follow-up examinations were performed after seven days, one month, and three months by the same examiner to assess the number of arrested carious surfaces. Collected data were analysed using SPSS (Windows).

Results

At baseline, 355 children were screened, and 224 children with a total of 776 active dentine caries surfaces meeting the criteria were included and randomly allocated into three treatment groups (Figure 1). There were 80, 79, and 65 children in Groups 1–3, respectively.

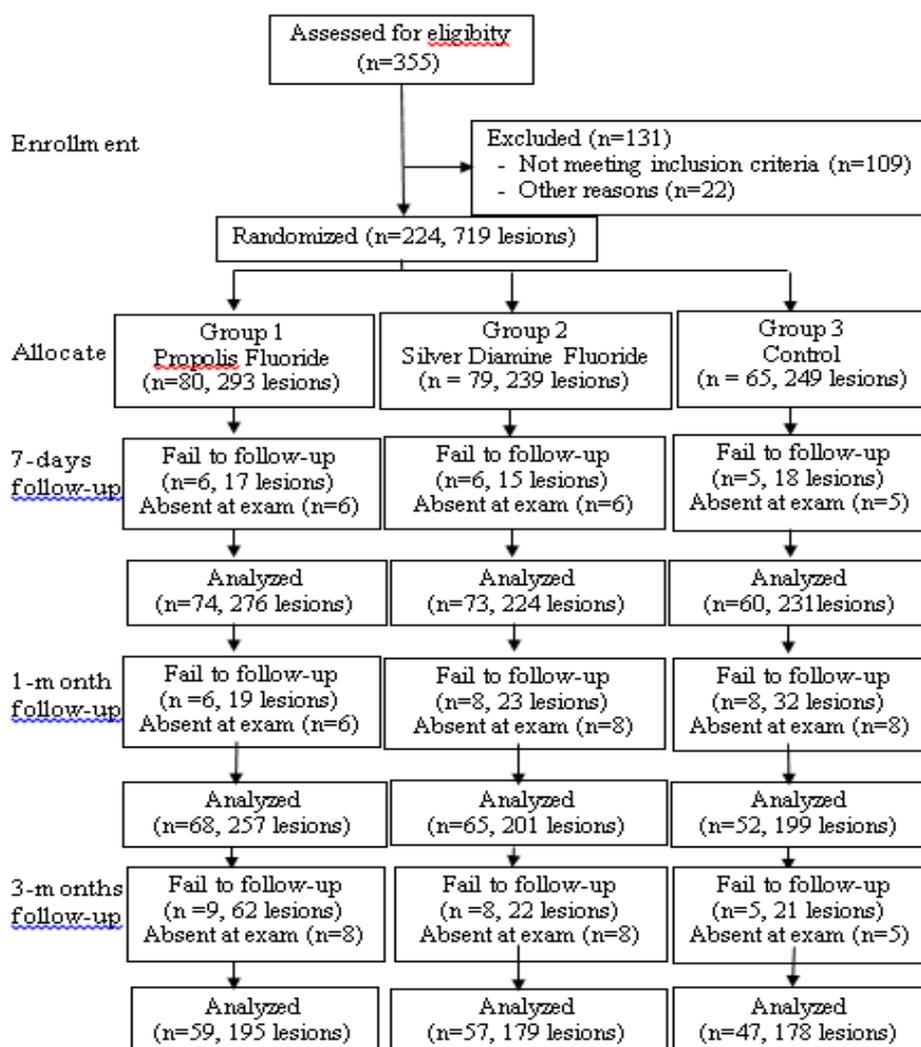


Figure 1 Randomly allocated three treatment groups.

The mean age of the children was 5.31 years, and the def-t score was 5.7 ± 2.65 . Around half of included teeth were upper anterior, and the most commonly involved surfaces were mesial, occlusal, and distal. No statistically significant differences were found among the three groups of children in these parameters (Table 1).

Table 1. Background information of the three study groups at baseline

	Group			p-Value
	Propolis Fluoride (n=80)	Silver Diamine Fluoride (n=79)	Control (n=65)	
Age (years)	5.28 + 0.53	5.40 + 0.48	5.23 + 0.57	0.143
Mean def-t score	5.49 ± 2.77	6.13 ± 2.50	5.44 ± 2.64	0.192
Tooth include (n=489)				
Upper anterior	51%	49%	53%	0.319
Lower anterior	5%	10%	9%	0.141
Upper posterior	9%	8%	14%	0.313
Lower posterior	36%	33%	24%	0.390
Tooth surface included (n=776)				
Occlusal	34%	30%	30%	0.506
Mesial	32%	42%	42%	0.678
Distal	21%	18%	19%	0.490
Buccal	9%	8%	6%	0.290
Lingual	3%	2%	3%	0.306
Tooth brushing				
More than twice a day	6.3%	0	4.5%	0.811
Twice a day	56.3%	56.4%	65.2%	
Once a day	20%	16.7%	12.1%	
Occasionally	17.5%	26.9%	18.2%	
Fluoride toothpaste				
Yes	96.3%	97.4%	95.5%	0.811
No	3.8%	2.6%	4.5%	

After 3 months, 163 (72.8%) of children remained in the study—59, 57, and 47 children in Groups 1–3, respectively. Intra-examiner reliability was tested with a Kappa coefficient of 0.66 and Cronbach’s alpha value of 0.795. As shown in Figure 2, the differences observed at seven days decreased over three months. The number of arrested carious surfaces was significantly higher in the two groups treated with propolis fluoride or SDF than in the control group. In the propolis fluoride group, 108 out of 195 carious surfaces become arrested lesions; this figure was 159 out of 178 in the SDF group.

Arrested caries rates at the three-month examination were 88.68% for the SDF Group, 55.78% for the propolis fluoride group, and 2.13% for the control group. No adverse side effects on the treated teeth and soft tissues were found (Figure 2).

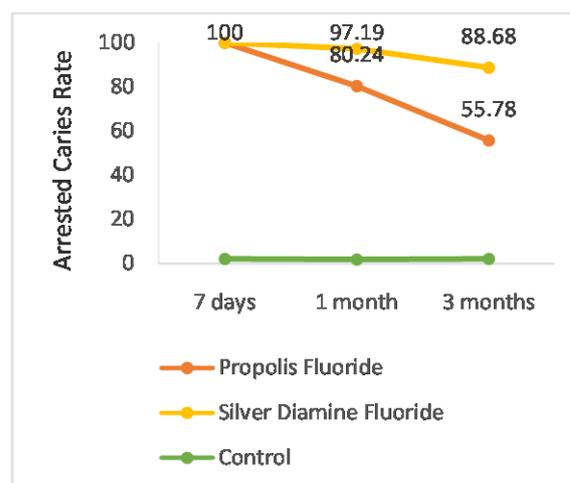


Figure 2: Arrested caries rate at the follow-up examinations in the three study groups effects on the treated teeth and soft tissues were found.

Discussion

This study is probably the first to compare the effectiveness of the application of propolis fluoride in arresting active dentine caries in primary teeth. It found that it could be as effective as applications of SDF solutions. The caries activity-inhibiting mechanisms of propolis fluoride and SDF are basically the same. Both materials have antibacterial properties and fluoride content.

The antibacterial properties of SDF are obtained from ion silver, while propolis fluoride's come from ethanol extract propolis (EEP). Antibacterial properties inhibit biofilm formation and interfere with the enzyme activity of glucosyl transferase (GTF), which causes decreased sugar synthesis, resulting in the reduction of plaque formation.^{9,10} While fluoride changes hydroxyapatite into fluorapatite ($\text{Ca}_{10}(\text{PO}_4)_6\text{F}_2$), which is more resistant to acidic environments, fluorapatite formation and limited cariogenic bacteria can cause demineralization replaced by remineralization, resulting in arrested caries.

Based on arrested caries rate, SDF has a greater ability than propolis fluoride to arrest caries. When propolis fluoride is applied, it caused blockade dentinal tubules and formed a stable layer resistant to irrigation on the dentin surface.¹¹ Whereas precipitated Ag_3PO_4 on SDF forms a protective layer over the tooth surface, it is not soluble, and it acts as phosphate ion reservoir to facilitate the formation of fluorapatite.⁹ In addition, the insoluble protective layer decreases the loss of calcium and phosphorus from carious lesions.

There was a decrease in collagen breakdown and increased dentin hardness after SDF application.^{12,13} Fluoride levels in SDF are greater than in propolis fluoride. According to Mei, 38% SDF contains about 44,800 ppm fluoride,¹² while propolis fluoride contains 21,000 ppm fluoride.

The arrested caries rate decreased as time passed. The results of follow up examination one month after SDF application compared with three months had an arrested caries rate decrease from 96.84% to 88.68%. This supports several studies that consider that the annual application of SDF can be good at preventing caries.

Increasing the frequency of SDF application to every six months can improve the quality of arrested dentin caries.⁶ While the

arrested caries rate after application of propolis fluoride was 81.78% at the one-month follow up examination and decreased to 55.77% at three months, it can be reapplied every three months to improve the effectiveness of arrested caries.

The application of SDF every six months as the recommended frequency of control visits is good for patients. Increasing the frequency to every three months for propolis fluoride applications is recommended in children with high risk of caries.⁶

Both of these materials can be an alternative dental caries treatment in children who are less cooperative and can be done at locations with limited dental health personnel numbers. SDF has better effectiveness than propolis fluoride, but the weakness of SDF is that it turns lesions black in colour.⁶

Propolis fluoride offers advantages such as not causing discoloration or an uncomfortable metallic taste in the child's mouth.

Conclusion

The topical application of SDF and propolis fluoride is effective in arresting active dentine caries. The topical application of SDF is more effective than that of propolis fluoride in inhibiting carious lesion progression, but propolis fluoride has the advantage that the arrested carious lesions will not turn black in colour like they would following SDF application.

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References

1. Darwita RR, Rahardjo A, Andreas P, Setiawati F, Adiatman M, Maharani DA. The Behavior Change on Brushing Teeth of Children by Mothers Using a Periodic Dental Health Evaluation Card. *J Int Dent Med Res.* 2016;9(3):65-71.
2. Melissa A, Yuvana AL, Nasia AA, Rahardjo A, Maharani DA, Zhang S. Dental and Periodontal Status of 5 and 12 years old children in Jakarta and It's Satellite Cities. *Journal of Dentistry Indonesia.* 2016;23(1):5-9.
3. Kementerian Kesehatan RI. 2014. Laporan Hasil Riset Kesehatan Dasar 2013. Available at: <http://www.depkes.go.id/resources/download/general/Hasil%20Risksdas%202013.pdf>.
4. Monse B, Benzian H, Araojo J, et al. A Silent Public Health Crisis: Untreated Caries and Dental Infections among 6- and 12-Year-Old Children in the Philippine National Oral Health Survey 2006. *Asia Pac J Public Health.* 2015;27(2):2316-25.
5. Liu BY, Lo EC, Chu CH, Lin HC. Randomized Trial on Fluorides and Sealants for Fissure Caries Prevention. *J Dent Res.* 2012;91(8):753-8.

6. Zhi QH, Lo EC, Lin HC. Randomized Clinical Trial on Effectiveness of Silver Diamine Fluoride and Glass Ionomer in Arresting Dentine Caries in Preschool Children. *J Dent.* 2012;40(11):962-7.
7. Razavian H, Khazaei S, Kazemi S, Seyedi SM. Propolis and its Effect on Oral Health. *Journal of Isfahan Dental School.* 2012;8(5):491-501.
8. M Shanthi, B.Vishnuvardhan Reddy, V. Venkataramana, S.Gowrisankar, B.V.Thimma Reddy, Sireesha Chennupati. Relationship Between Drinking Water Fluoride Levels, Dental Fluorosis, Dental Caries and Associated Risk Factors in 9-12 Years Old School Children of Nelakondapally Mandal of Khammam District, Andhra Pradesh, India: A Cross-sectional Survey. *J Int Oral Health.* 2014;6(3):106-10.
9. Fung HTM, Wong MCM, Lo ECM, Chu CH. Arresting Early Childhood Caries with Silver Diamine Fluoride-A Literature Review. *Oral HygHealth.* 2013;1(3):117.
10. Tulsani SG, Chikkanarasaiah N, Siddaiah SB, Krishnamurthy NH. The Effect of Propolis and Xylitol Chewing Gums on Salivary Streptococcus Mutans Count: A Clinical Trial. *Indian J Dent Res.* 2014;25(6):737-41.
11. Hongal S, Torwane NA, Goel P, Chandrashekar B. The Effect of 30% Ethanol Extract of Indian Propolis on Replica of Human Dentin Compared against Commercially Available Desensitizing Agent: A Methodological SEM Study in Vitro. *Pharmacognosy Res.* 2014;6(2):113-9.
12. Mei ML, Chu CH, Lo EC, Samaranayake LP. Fluoride and Silver Concentrations of Silver Diamine Fluoride Solutions for Dental Use. *Int J Paediatr Dent.* 2013;23(4):279-85.
13. Mei ML, Li QL, Chu CH, Yiu CK, Lo EC. The Inhibitory Effects of Silver Diamine Fluoride at Different Concentrations on Matrix Metalloproteinases. *Dental Mater.* 2012;28(8):903-8.