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研究題目：Effectiveness of silver diamine fluoride on arresting caries among Vietnamese preschool children

Introduction：

Early childhood caries（ECC）is a significant oral health problem of children world-wide. ECC not only has adverse effects on health and quality of life in children but also creates a huge financial burden for families. To improve children's oral health, appropriate treatment as well as preventive measures should be implemented. Silver diamine fluoride（SDF）is considered as a safe, inexpensive and effective medicament that can arrest caries progression. SDF has been used to arrest caries for children in Japan more than 50 years and recently many countries have started using it. In Vietnam, children's oral health receives little attention as many people believe primary teeth are not important because they are replaced by permanent teeth. However, children's caries prevalence is high and most caries are untreated. Moreover, SDF has not been used much and no research about SDF has been carried out. Therefore, this study was conducted to evaluate the effectiveness of SDF on the arrest of caries among Vietnamese children.

Methods：

A total of 295 children（152 boys and 143 girls）aged 2-3 years who had at least one active caries surface without pulpal involvement were selected in this study. Children were divided into three groups；group 1（G1）received annual SDF application（n＝90), group 2（G2）received biannual SDF application（n＝99), and group 3（G3）did not receive SDF application（n＝106).

A tooth surface level clinical oral examination was conducted by 2 calibrated dentists with knee-to-knee technique in the preschools. Four surfaces（buccal, lingual, mesial, and distal）of anterior teeth and 5 surfaces（buccal, lingual, mesial, distal, and occlusal）of posterior teeth were examined. Dental caries status was diagnosed by tactile detection using a WHO periodontal probe, in addition to using a dental mirror and a flash light. A decayed surface was classified as active caries if the cavity's floor and walls were soft when touched with the probe, and as arrested if hard when touched with the probe.

Saforide®, 38% aqueous solution of SDF（44,800ppmF）（Toyo Seiyaku Kasei Co. Ltd., Osaka, Japan), was used in this study. SDF was applied on the active enamel caries and mild

to moderate dentine caries surfaces. Fluoride gel, 2% sodium fluoride (9,000 ppmF) (Toyo Seiyaku Kasei Co. Ltd., Osaka, Japan) was also used in this study. After SDF application, fluoride gel was applied to the sound tooth surfaces in all three groups at baseline and after 6 months.

The study protocol was approved by the Ethics Committees of Hue University of Medicine and Pharmacy, Vietnam and Tokyo Medical and Dental University, Japan.

Results :

Mean dmfs were 14.92 in G1, 15.99 in G2, and 18.30 in G3 (Table 1). Mean ds was the main component of dmfs in all 3 groups at baseline : 14.92 in G1, 15.91 in G2, and 18.17 in G3. From baseline to 6 months or to 1 year, mean ds increased significantly in all children : 1.88 and 3.75 in G1, 2.22 and 3.44 in G2, and 5.20 and 8.91 in G3. There were no significant differences in mean ds or dmfs between the 3 groups at baseline. However, at 6 months, mean ds and dmfs were significantly higher in G3 than G1 ($p < 0.01$) or G2 ($p < 0.05$). At 1 year, there were significantly higher mean ds and dmfs in G3 than G1 ($p < 0.001$) or G2 ($p < 0.01$).

About 60% of active caries surfaces were applied SDF in both G1 (847/1,343 surfaces) and G2 (958/1,575 surfaces) at baseline. In G1, mean active caries surfaces with SDF application at baseline was 9.41 (Table 2). Mean and proportion of arrested caries surfaces decreased significantly from 6 months (5.82 and 61.8%) to 1 year (4.48 and 47.6%). Mean and proportion of fs were very small : 0.03 and 0.4% at 6 months, and 0.06 and 0.6% at 1 year. No ms was found during the study period.

For G2, mean active caries surface with SDF application was 9.68 at baseline. There were significant increase in mean and proportion of arrested caries surfaces from 6 months (5.59 and 57.7%) to 1 year (6.19 and 64.0%). Mean and proportion of fs were 0.03 and 0.3% at 6 months, and 0.13 and 1.4% at 1 year. Those of ms were 0.03 and 0.3 % at 6 months, and 0.08 and 0.8% at 1 year.

There were no significant mean or distributional differences in active caries surfaces, arrested caries surfaces, fs and ms between the 2 groups at baseline or 6 months. However, at 1 year, G2 had significantly higher mean and proportion of arrested caries surfaces or lower mean and proportion of active caries surfaces than G1 ($p < 0.001$).

Table 1. Changes of caries status by surface level in 3 groups［mean（SD）］

		Total	Annual SDF application G1（n＝90）	Biannual SDF application G2（n＝99）	No SDF application G3（n＝106）	p Value*
Baseline	ds	16.42（12.00）	14.92（9.83）^{a1}	15.91（10.85）^{a2}	18.17（14.36）^{a3}	0.147
	ms	0.03（0.46）	0.00（0.00）	0.08（0.80）	0.00（0.00）	0.373
	fs	0.05（0.51）	0.00（0.00）	0.00（0.00）	0.13（0.85）	0.105
	dmfs	16.49（12.07）	14.92（9.83）^{d1}	15.99（10.91）^{d2}	18.30（14.46）^{d3}	0.130
6 months	ds	19.61（13.72）	16.80（10.41）^{b1}	18.13（12.16）^{b2}	23.37（16.57）^{b3}	**＜ 0.001**
	ms	0.07（0.69）	0.00（0.00）	0.08（0.80）	0.11（0.86）	0.514
	fs	0.16（0.38）	0.06（0.38）	0.20（1.17）	0.21（1.23）	0.515
	dmfs	19.83（13.99）	16.86（10.46）^{e1}	18.41（12.63）^{e2}	23.69（16.78）^{e3}	**＜ 0.001**
1 year	ds	21.90（14.7）	18.67（10.72）^{c1}	19.38（12.45）^{c2}	27.08（17.96）^{c3}	**＜ 0.001**
	ms	0.10（0.77）	0.00（0.00）	0.18（0.99）	0.11（0.86）	0.270
	fs	0.26（1.43）	0.33（2.00）	0.30（1.36）	0.15（0.81）	0.629
	dmfs	22.29（14.96）	19.00（10.84）^{f1}	19.87（12.97）^{f2}	27.31（18.20）^{f3}	**＜ 0.001**

p Value*：comparison of ds, ms, fs, and dmfs between three groups

Comparison of ds and dmfs between baseline, 6 months and 1 year

a1 ＜ b1 ＜ c1；a2 ＜ b2 ＜ c2；a3 ＜ b3 ＜ c3

d1 ＜ e1 ＜ f1；d2 ＜ e2 ＜ f2；d3 ＜ e3 ＜ f3

all comparisons：p Value ＜ 0.001

Table 2. Changes of mean（SD）and proportion of SDF apllied caries surface in 2 groups

		Annual SDF application G1（n＝90）		Biannnual SDF application G1（n＝99）		p Value*
		mean（SD）	%	mean（SD）	%	
Baseline	SDF applied caries	9.41（5.70）	100.0	9.68（5.42）	100.0	
6 month	Active caries	3.56（2.84）^{a1}	37.8	4.03（3.24）^{a2}	41.6	0.129
	Arrested caries	5.82（3.49）^{c1}	61.8	5.59（3.12）^{c2}	57.7	
	Filled	0.03（0.32）	0.4	0.03（0.30）	0.3	
	Missing	0.00（0.00）	0.0	0.03（0.22）	0.3	
1 year	Active caries	4.88（3.54）^{b1}	51.8	3.27（2.94）^{b2}	33.8	**＜ 0.001**
	Arrested caries	4.48（2.70）^{d1}	47.6	6.19（3.51）^{d2}	64.0	
	Filled	0.06（0.38）	0.6	0.13（0.78）	1.4	
	Missing	0.00（0.00）	0.0	0.08（0.40）	0.8	

p Value*：for distributional difference between G1 and G2 at 6 months and 1 year

Comparison of active and arrested caries between 6 months and 1 year

a1 ＜ b1；c1 ＞ d1

a2 ＜ b2；c2 ＜ d2

all comparisons：p Value ＜ 0.001

Discussion：

From baseline to 1 year, caries had developed in all children, and there were significant differences in caries status at tooth surface level between the 3 groups. A fewer number of active caries surfaces were observed in children with annual or biannual SDF application than those without SDF application at 6 months and 1 year. The proportion of arrested caries surfaces was around 60% in both biannual and annual SDF application groups at 6 months. However, at 1 year, more than 60% of caries surfaces were arrested in the biannual SDF application group, while less than half of them in the annual SDF application group. These findings showed biannual application had a greater caries arresting effect than annual application.

The effect of SDF appeared to wear off over time according to current study. In high caries risk children like this study subject, the effect of SDF would not last long in particular. Moreover, there are tooth or surface related differences in SDF effectiveness. Caries of anterior teeth as well as buccal or lingual surfaces are more likely to be arrested. In contrast, caries of posterior teeth, especially mesial, distal, or occlusal surfaces are difficult to be arrested. Therefore, biannual SDF application was considered to increase the success rate of caries arrest by perfusing more SDF liquid to vulnerable tooth surfaces and minimizing the effect of SDF to wear off.

SDF has many advantages besides arresting caries. The procedure of SDF application is simple and requires no expensive equipment or infrastructure. It is flexible enough to implement in a community setting where facilities or manpower are limited. Appropriately trained dental auxiliaries could apply SDF to children in preschools or in health centers. SDF is also applicable to children who have uncooperative behavior. As caries could occur in very young age of children with high caries risk, SDF could be applied to such children to arrest caries at the initial stage. Furthermore, since cost of SDF application is low, even children from low-income families can afford to receive it.

SDF applied to caries lesions become black or brown, even though such discoloration is a good sign of caries arrest. However, no children's caregivers in this study complained about tooth staining. Gingival or pulpal response is another consideration for SDF application. No cases of severe gingival or pulpal problems after SDF application were reported in this study.

This study employed both SDF and NaF. The combined use of SDF and NaF could offer an additional caries preventive effect. In this study sample, overall dmft increased by 1.94（5.80 for dmfs）after 1 year, although the caries increase in children who received both SDF and NaF was smaller than in those who received only NaF. Both SDF and NaF have a caries preventive effect, but without a good oral health environment, the effect of SDF and NaF could not be maximized. It is therefore necessary to increase caregivers' awareness about the importance of oral health care and the promotion of good oral health behavior.

Conclusion：

Children's dental caries creates a huge financial burden in many developing countries like Vietnam. Proposing an effective and realizable method to manage caries of children is a big concern of health care professionals and related parties. Current one year study period may not be long enough to observe the long-term effect of SDF application on dental caries. Nonetheless, the findings in this study indicated the effectiveness of SDF in arresting dental caries among preschool children, especially by applying biannually. SDF application may be a promising candidate intervention to improve children's oral health.

Presentation：

1. Early childhood caries and related factors in Vietnam（oral presentation）
   Yen Hoang Thi Nguyen, Takashi Zaitsu, Masayuki Ueno, Yoko Kawaguchi
   The 65th general meeting of Japanese Society for Oral Health（JSOH）, Tokyo, May 27-29, 2016
2. Early childhood caries of children in Hue, Vietnam（poster presentation）
   Yen Hoang Thi Nguyen, Takashi Zaitsu, Masayuki Ueno, Yoko Kawaguchi
   The 23rd General Meeting of the Japanese Association for Dental Science, Fukuoka, Oct 21-23, 2016
3. Effectiveness of silver diamine fluoride on arresting dental caries（oral presentation）
   Yen Hoang Thi Nguyen, Takashi Zaitsu, Masayuki Ueno, Toai Nguyen, Yoko Kawaguchi
   The 2017 IADR/AADR/CADR General Session & Exhibition, San francisco, March 22-25, 2017