EFFECT OF FLUORIDE VARNISH ON CARIES PREVENTION OF PARTIALLY ERUPTED OF PERMANENT MOLAR IN HIGH CARIES RISK

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Abstract. The objective of this study was to measure the effectiveness of fluoride varnish as a public health intervention to prevent caries on partially erupted first and second permanent molars among 6-11 year old children at high risk for caries. In a six-month clinical trial, 105 children were randomly divided into a fluoride varnish (Duraphat®) group (117 molars) or a control group (117 molars). The chi-square test used to compare caries occurrence in each group with a 95% level of confidence ($p<0.05$) at the intervals of 3 months. Compared to control, fluoride varnish resulted in 79% and 77.5% caries reduction in partially erupted permanent molars at 3 and 6 months, respectively. There were statistically significant differences in caries progression between the groups at 3 and 6 months. Fluoride varnish significantly reduced carious lesions in partially erupted molars at six months among high caries risk children.

Keywords: caries prevention, fluoride varnish, high caries risk, partially erupted permanent molars

INTRODUCTION

Dental caries are one of the most common infectious diseases among children. Hargreaves and Chester (1973) found the occlusal surface of over 80% of permanent first molars had caries and Lewis and Hargreaves (1977) found 79% of second molars were carious within the first 2 years after eruption. Erupting teeth are more likely to develop dental caries due to the favorable condition of plaque accumulation. Therefore, preventive strategies to reduce occlusal dental caries in children should start as soon as possible after tooth eruption.

Preventive strategies for dental caries include oral hygiene instructions, fluoride application and pit and fissure sealant. Of these, pit and fissure sealant is the best method for protection of the occlusal surface. However pit and fissure sealant of partially erupted molar teeth is not practical due to uncontrolled moisture. It is important to find a better method of prevention.

Fluoride varnish to prevent dental caries was developed in the 1960s and is widely used in public health dental programs. Marinho *et al* (2002) found fluoride

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varnish substantially reduces tooth decay in both primary and permanent teeth of children and adolescents. Meta-analyses of controlled clinical trials of sealants (Llodra *et al*, 1993; Mejàre *et al*, 2003; Ahovuo-Saloranta *et al*, 2004) and fluoride varnish (Helfenstein and Steiner, 1994a,b; Strohmenger and Brambilla, 2001; Marinho *et al*, 2002, 2003) confirmed their effectiveness, but found significant heterogeneity suggesting the need for further studies.

The objective of the present study was to measure the effectiveness of fluoride varnish as a public health intervention to prevent caries in partially erupted first and second permanent molars among 6-11-year-old children at high risk for caries.

MATERIALS AND METHODS

This research protocol and informed consent form were approved by the Committee on Human Rights Related to Human Experimentation, Mahidol University, Bangkok, Thailand. Six of 26 primary schools in Bang Pakong District, Chachoengsao Province, Thailand were selected at random. Subjects invited to participate in this study were students in grades 1-6, aged 6-11 years, who were able to cooperate with the procedure. The procedure, possible discomfort, risk and benefits were explained fully to the parents and participants. Informed consent was obtained from the parents and participants prior to investigation. Of the 120 children enrolled in the study, none refused to continue in the study at follow-up; however, 5 moved to other schools and 10 receive resin-based sealant. The present analysis was based on the remaining 105 children who were followed for 6 months. This study used a spilt-mouth design: one tooth had the fluoride varnish, applied while the contralateral tooth was used for control. In the fluoride varnish group, the partially erupted first or second permanent molars was isolated with cotton rolls and cleaned with cotton swabs and one drop (0.1 ml) of fluoride varnish (Duraphat®; Colgate Oral Pharmaceuticals, Canton, MA) was then applied using a disposable brush. The fluoride varnish was left to dry for 30 seconds so that the solvent could evaporate. After 3 months the fluoride varnish was reapplied. The fluoride varnish was applied by a dentist.

Examination for caries-into-dentin was carried out according to Ekstrand's criteria (1997) (Table 1). Baseline dental examinations were carried out by a dentist who was blinded to the group assignment. The intra-examiner diagnostic concordant level was analyzed by repeating the examination in at least 10% of the children. Follow-up examinations were conducted at 3 and 6 months by a dentist.

The chi-square test used to compare caries occurrence between the groups with a 95% confidence interval ($p<0.05$) at 3 and 6 months.

RESULTS

A total of 105 participants were followed for 6 months; 15 participants were not included because they either received resin sealant according to the policies of the Ministry of Public Health or they moved to other schools. Two hundred thirty-four partially-erupted permanent molars were included in this study and were divided into 2 groups: 117 partially-erupted permanent molars were treated with fluoride varnish (study group) and the other 117 teeth had no fluoride varnish applied (control group).

At 3 months 97% of the teeth in the study group were sound (no caries)

Table 1
Criteria used for visual scoring system.

Score	Pit and fissure
0	No or slightly change in enamel after prolonged air-drying (10S).
1	Opacity or discoloration hardly visible on wet enamel, but distinctly visible after air-drying.
2	Opacity or discoloration hardly visible on wet enamel, but distinctly visible without air-drying.
3	Localized enamel breakdown in opaque or discolored enamel and/or grayish discoloration of the underlying dentine.
4	Cavitation in opaque or discolored enamel exposing dentine.

Table 2
Caries occurrence in the study and control groups at 3 and 6 months (n=117).

Time period	Study group			Control group		
	Sound tooth	Caries		Sound tooth	Caries	
		Enamel	Dentine		Enamel	Dentine
3 months	113	4	0	98	19	0
6 months	108	9	0	77	28	12

Table 3
Caries reduction in the study and control groups at 3 and 6 months.

	3 months			6 months		
	Caries	Sound	Caries reduction (%)	Caries	Sound	Caries reduction (%)
Study group	4	113	79	9	108	77.5
Control group	19	98		40	77	

(Table 2). Four teeth (3%) had enamel caries (100% with a score of 1). In the control group, 84% were sound teeth, 19 teeth (16%) had enamel caries (79% with a score of 1 and 21% with a score of 2). No dentinal caries was found in either group. There was a significant difference in the caries occurrence between the 2 groups.

By 6 months, 92% of the study group had sound teeth (Table 2). Nine teeth (8%) had enamel caries (100% with a score of 1). No dentinal caries were found. In the control group, 66% had sound teeth; 40 teeth (34%) had dental caries (28% had a score of 1 and 42% had a score of 2); ten teeth (25%) had dentinal caries with discolored

opaque enamel resulting underlying dentine and localized enamel breakdown (score of 3) and two teeth (5%) had cavitation with opaque or discolored enamel disposing dentine (score of 4). There was a significant difference in caries occurrence between the two groups.

Table 3 shows the caries in the study and control groups at 3 and 6 months. The incidence of caries in the study group at 3 and 6 months were 79% and 77.5%, respectively.

The Kappa coefficient for intra-examiner reliability was >0.70. This is considered highly satisfactory according to the Landis scale (Landis and Koch, 1977).

DISCUSSION

This study was carried out to determine the effectiveness of fluoride varnish as a public health intervention in schools. Participants were recruited from a high-risk caries population in Thailand: A 2001 survey reported caries prevalences of 87.4% among 6-year-old and 57.3% among 12-year-old Thai children (Department of Health, 2001).

The main purpose of this study was to measure the effectiveness of fluoride varnish as a public health intervention to prevent caries on partially erupted first and second permanent molars in a high caries risk group. Erupting permanent molars are susceptible to caries because of plaque accumulation. The operculum covering the distal half of the tooth during eruption allows for the retention of plaque and the erupting molar has immature enamel more permeable and more prone to caries due to its relatively high organic content (Burt, 1984). It is important to protect newly erupting tooth surfaces, especially in children with high caries risk (Antonson *et al*, 2006).

This study was conducted for 6 month. Carvalho *et al* (1991) and Helm and Seider (1974) found the time interval between emergence of the permanent first molar to full occlusion is less than 1 year. A time interval of 6-10 months was observed among Japanese children as well (Fukuda *et al*, 1982). The period when care is most needed for erupting molars is during the first year after eruption.

A widely accepted method for protecting newly erupting molars is the application of pit and fissure sealant (Simonsen, 2002). Sealant acts like a physical barrier that isolates the occlusal surfaces from the oral environment. It also prevents dental plaque accumulation, initiation and progression of caries in underlying pits and fissures (Yip and Smales, 2002). However, sealant is technique-sensitive, and application requires a non-contaminated environment to ensure a complete bond to the enamel. In the presence of saliva, sealant has been found to be ineffective. The bond strength of sealant applied to etched surfaces contaminated by saliva is less than non-contaminated etched enamel controls (Rirattanapong *et al*, 2011). The American National Institutes of Health has stated adequate isolation is essential for sealant retention; success of the sealant is positively associated with the eruption status of the teeth and the operator's ability to maintain a dry field (National Institutes of Health, 1984). Therefore, it is necessary to find other preventive techniques for partially erupted permanent molars.

Application of topical fluoride is widely used for the prevention of dental caries. Professionally applied topical fluorides come as varnishes or gels. The first commercially produced fluoride varnish was introduced by Schmidt in 1964 under the trademark Duraphat®. Due to ease of application and less need of patient

cooperation (Weinstein *et al*, 1994), fluoride varnishes have become one of the most common professional measures used in community dental health preventive programs in Europe (Ogaard *et al*, 1994).

Studies have found fluoride varnish to reduce dental caries by 18-77% in permanent teeth (Clark, 1982; Helfenstein and Steiner, 1994a; Zimmer *et al*, 1999). When comparing the effect of fluoride varnish with control in this study, the percentages of caries reduction at 3 and 6 months were 79% and 77.5%, respectively; a significant difference. Fluoride varnish can reduce dental caries on permanent molars because the varnish adheres to the fissures, allowing progressive release and mineral uptake of the outer surface of the enamel (Primosch, 1985). Holm *et al* (1984) applied fluoride varnish (Duraphat®) to fissures of newly erupted first molars every 6 months. They found a caries reduction of 50% after 2 years. Seppä and Pöllänen (1987) found a minimum of 2 applications of Duraphat® per year reduced caries by 37%.

In conclusion, fluoride varnish significantly reduced carious lesions on partially erupted molars at six months. In children with high caries risk, using fluoride varnish application every three months on newly erupted molars may be better than routinely sealing all fissures. Sealent treatment may then be postponed until the teeth are fully erupted.

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