



Effect of Fluoride Varnish with ACP on Caries Progression of Partially Erupted First Permanent Molar in Grade 1 Student at Wat Nawong School

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Abstract

The objective of this study is to determine the effectiveness in the clinical use of 5% fluoride varnish with amorphous calcium phosphate (ACP) as an intervention to decrease dental caries progression on partially erupted first permanent molars among children with high caries risk. Forty-two 1st Grade students with partially erupted first permanent molars have participated in this 6-month clinical trials with split-mouth design. They were randomly divided into a fluoride varnish (Enamel Pro[®]) group and a control group (each group consisted of 42 partially erupted first molars). The Chi-square test was used for statistical analysis, with a 95% level of confidence ($p < 0.05$). Thirty-seven participants (88%) of the study group had no caries progression, while 5 participants (12%) had caries progression. In the control group, 21 participants (50%) had no caries progression, and 21 participants (50%) had caries progression. There was a significant difference in caries progression between the two groups. Fluoride varnish group also resulted in 76% caries reduction in partially erupted first permanent molars at six months. In conclusion, 5% Sodium fluoride varnish with ACP (Enamel Pro[®]) is effective in reducing caries progression in the study group. Fluoride varnish can be used as an alternative intervention for reducing caries progression in partially erupted first permanent molar among high caries risk children.

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

1. Introduction

Dental caries is a multifactorial disease affecting most people in the developing country all over the world. According to the 7th National oral health survey 2012, it is stated that caries incidence in 5-6 years Thai children were 78.5% (Dental health division, Public health department, Thailand, 2012). The first permanent molar is the most important unit of mastication and essential in the development of desirable occlusion. It plays a vital role in the formation of permanent dentition and a normal bite. Early loss of a first permanent molar in a child can lead to changes in occlusal mechanism (Angle, 1907). The first permanent molars are erupting at an age at which diet habits of the child predispose to caries, and oral hygiene practice is still not well developed, these surrounding conditions contribute to high susceptibility to caries. (Lakhani, Arora, Bhayya, Dogra, & Jain, 2016). Therefore, these particular teeth deserve much attention in dental preventive programs directed towards elementary school children which is the average erupting age (Fukada et al., 1982). However, a high percentage of caries incidence in the first permanent molars during or immediately after an eruption has been reported in many studies. One study reported 59.8% of lower first molars to suffer from caries immediately after eruption while another similar study showed that 40% of occlusal caries occur during eruption even if the crown is still covered by the gingiva. (Miyano, Kawagoe, & Osawa, 1974; Iwakura, Shimada, & Takagi, 1974). Erupting teeth are more susceptible to develop caries due to the favorable condition of plaque accumulation and immature enamel with high organic content structure (Burt, 1984; Carvalho, Ekstrand & Thylstrup, 1989). It takes less than one year for the first permanent molar to have full occlusion from the point they emerge; therefore, preventive strategies of occlusal caries in children should be initiated as soon as possible after the eruption (Carvalho, Ekstrand & Thylstrup, 1991).

It is known that the preventive dental programs to prevent and control occlusal carious lesions on primary and permanent teeth is pit and fissure sealant. However, it is difficult to do effective moisture control on partially erupted molar teeth; therefore, more practical preventive measure should be accomplished in this condition.



Fluoride varnish was first developed in 1960s and then widely used to prevent and control dental caries in public health dental programs (Marinho, Worthington, Walsh, & Clarkson, 2002). The high effectiveness of fluoride varnish to reduce dental caries in primary and permanent teeth has been reported in many studies (Bonetti & Clarkson, 2016; Azarpazhooh & Main, 2008). Mechanisms of action of fluoride is to inhibit demineralization and increase remineralization by forming calcium fluoride compound (CaF_2) (Li, Wang, Joiner, & Chang, 2014). Recently, addition of calcium and phosphate ions into fluoride varnish has been developed to supplement the amounts of these ions in saliva and enhance fluoride in remineralization (Cate, 1997). Ratanapongpisarn et al., (2016) compared the remineralizing effect of 5% sodium fluoride varnish with 5% fluoride varnish adding amorphous calcium phosphate (ACP) in terms of surface microhardness and found that fluoride varnish with ACP has a higher remineralizing effect.

2. Objectives

The objective of this study is to determine the effectiveness in the clinical use of 5% fluoride varnish with ACP as an intervention to prevent dental caries on partially erupted first permanent molars among high caries risk children.

3. Materials and Methods

Sixty Grade 1 students, aged 6-7 years, with partially erupted first permanent molars were recruited at Wat Nawong school in Meuang District, Pratum Thani Province, Thailand and then were selected to participate in this study. Forty-six subjects were selected according to inclusion criteria which were having a contralateral pair of partially erupted first permanent molars with a visible central pit, ICDAS code 0 to 2 according to the International Caries Detection and Assessment System (ICDAS) (Ismail et al., 2007) (Table 1), high caries risk according to American Academy of Pediatric Dentistry (AAPD) Caries risk assessment guidelines. The subjects had no previous application of fluoride within the last six months and no previous dental treatment, including sealant or filling on the study teeth. All participants were examined and evaluated the pre-treatment status, then re-evaluated after six months. They received oral hygiene instructions from the same dental staff team.

This research protocol and informed consent form were approved by the Human Ethics Review Committee of Rangsit University, Pathum Thani, Thailand. The procedure, possible discomfort, risk and benefits were explained to the parents and participants. The informed consents were obtained from the parents and participants before the study.

The fluoride varnish used in this study was 5% sodium fluoride with amorphous calcium phosphate (Enamel Pro[®] Varnish, Premiere Dental Products Company, USA). This study used a split-mouth design: one tooth was randomly applied by fluoride varnish, while the contralateral tooth was a control. The dmft score, plaque index, and eruption stage of the two partially erupted first permanent molars were recorded. Both teeth were cleaned with a toothbrush and remove excessive plaque with a blunt instrument. All pits and fissures on the occlusal surface were clearly visible. Then, the teeth were isolated with gauze and dried by using air blown from a rubber air blower. ICDAS score was recorded for each tooth by two calibrated pediatric dentists. In the fluoride varnish group, a small quantity (0.2–0.4 ml) of the Enamel Pro[®] varnish was applied on the occlusal surface using a micro-brush, special care was taken to cover all visible pit and fissures. Post-operative care instruction was given according to the manufacture's recommendation. Baseline dental examinations were carried out by two pediatric dentists who were blinded to the group assignment. The intra-examiner diagnostic concordant level was analyzed by repeating the examination in at least 10% of the subjects. Follow-up examinations were conducted at six months interval.

**Table 1** The ICDAS code used to determine the severity of carious lesions.

| Code | Criteria |
|------|---|
| 0 | Sound |
| 1 | The first visual change in enamel (seen only after prolonged air drying or restricted to within the confines of a pit or fissure) |
| 2 | The distinct visual change in enamel |
| 3 | Localized enamel breakdown (without clinical visual signs of dentinal involvement) |
| 4 | Underlying dark shadow from dentine |
| 5 | Distinct cavity with visible dentine |
| 6 | Extensive distinct cavity with visible dentine |

All data were processed with the IBM SPSS Statistics (version 20.0, Chicago, Ill., USA). The Chi-square test was applied to compare caries progression between the groups. Cohen's kappa value was calculated for intra-examiner reliability. A *p*-value of 0.05 was considered as statistically significant.

4. Results

A total of 42 participants were presented for six months follow up evaluation. Four participants were excluded because they either received resin sealant according to the policies of the Ministry of Public Health, or they were absent. Altogether 84 partially erupted first permanent molars were used in this study, 42 teeth in each group.

Thirty-seven teeth (88%) of the study group had no caries progression (Table 2). Five teeth (12%) had caries progression. In the control group, 21 teeth (50%) had no caries progression while 21 teeth (50%) had caries progression. There was a significant difference in caries progression between the two groups.

The caries progression at six months was 21 teeth in the control group and five teeth in the study group. The incidence of caries at six months was 76% reduction.

Table 2 Caries progression in the study and control groups at six months

| | Control group (n=42) | Study group (n=42) | Caries reduction (%) |
|------------------------------|----------------------|--------------------|----------------------|
| Caries progression | 21 (50%) | 5 (12%) | |
| No caries progression | 21 (50%) | 37 (88%) | 76% |
| Total | 42 | 42 | |

Table 3 Caries occurrence in participants at six months

| | Study group | | Total | |
|----------------------|------------------------------|-----------------------|------------|----------|
| | Caries progression | No caries progression | | |
| Control group | Carie progression | 5 (11.9%) | 16 (38.1%) | 21 (50%) |
| | No caries progression | 0 (0%) | 21(50%) | 21(50%) |
| Total | 5 (11.9%) | 37 (88.1%) | 42 (100%) | |

In terms of each participant, 11.9% of 42 participants were found to have caries progression in both control and study teeth (Table 3). While 38.1% had caries progression only in the control teeth but no progression in the study teeth. Half of the participants (50%) had no caries progression in both molars, and none had caries progression only in the study teeth. There was a significant difference in caries occurrence between the two groups.

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



5. Discussion

The purpose of this study was to measure the clinical use of 5% fluoride varnish with ACP as an intervention to prevent caries on partially erupted first permanent molars among Grade 1 students with high caries risk. The results show that the teeth that were exposed to fluoride varnish, or the study group, had a significantly lesser percentage of caries progression compared to the control group.

First permanent molars erupt at the age of 6-7 years old. At this age, the child tends to have diet habits (e.g. frequently sugar consumption) predispose to caries and also requires parental supervision in oral hygiene practice (Syukra, 2012). Most parents do not have awareness and do not supervise the appropriate oral hygiene practice for their children. Lakhani et al., (2016) found that only 28% of mothers had knowledge about the time of eruption and importance of first permanent molar and only 13.4% of parents were aware of the existence of this teeth in the oral cavity of their children. Apart from this, the position of the teeth is situated behind the primary second molars which makes them difficult to clean.

The operculum covering the distal half of the tooth during eruption allows the retention of plaque accumulation and the immature permeable enamel also contribute to more susceptible to caries (Burt, 1984). There is also a systematic review on caries risk assessment stated that post-eruptive stage can be used as a predictor for caries on permanent teeth. It showed that those who are at higher risk of occlusal caries within the first year after the eruption are the first permanent molars (Mejäre et al., 2014). Carvalho, Ekstrand, and Thylstrup (1991) found that time interval between emergence of the first permanent molar to its full occlusion is less than 1 year. Therefore, the period of this study was conducted for 6 months.

Pit and fissure sealant application is a widely acceptable method to protect newly erupting molars. It creates a physical barrier that isolate the occlusal surfaces from the oral environment and also prevent dental plaque accumulation, initiation and progression of underlying caries (Simonsen, 2002). However, sealant application is technique-sensitive and requires well-controlled isolation to ensure an effectively complete bond to the enamel. Rirattanapong, Vongsavan, and Surarit., (2011) found that the bond strength of sealant applied to etched surfaces contaminated by saliva is less than non-contaminated etched enamel. Therefore, resin sealant is appropriate for fully erupted permanent molars. While glass ionomer-based sealant can be used in the area whereas moisture isolation is not well controlled, fluoride varnish application is also a practical strategy for caries prevention due to less equipment needed and more straightforward application (Carvalho et al., 1991)

Fluoride varnish has become one of the most common professional measures used in community dental health preventive programs in many countries. Fluoride varnish promotes remineralization by combine fluoride with calcium ion to form CaF_2 that can be slowly release fluoride ions at the junction of plaque and tooth surface. It also can inhibit metabolism and growth of the oral microbial. CaF_2 deposit in the lesion pores is effective in inhibiting demineralization (Cury & Tenuta, 2009). Fluoride varnish used in this study is Enamel Pro[®] varnish which contain amorphous calcium phosphate (ACP). Addition of ACP to fluoride varnish can provide reservoir of calcium and phosphate ions which readily precipitate into apatite, increase retention of fluoride and calcium ions in the oral environment, and improve remineralization of early carious lesions (Bosky, 1997).

In this study, 5% fluoride varnish with ACP was applied to the partially erupted first permanent molar for 6 months period, the effectiveness of fluoride varnish comparing with the control group showed that the percentage of caries reduction at were 76%. Similar results regarding the effectiveness of fluoride varnish to reduce the incidence of caries were found in other studies (Zimmer, Robke & Roulet, 1999; Arruda et al., 2012). Fluoride varnish can adhere to the pit and fissures, allowing slowly progressive release and mineral uptake at the outer surface of enamel (Bonetti & Clarkson, 2016). Holm, Holst, and Mejäre. (1984) applied fluoride varnish to newly erupted first molars every six months and found that the caries reduction was 50% after two years. Even though, there were some factors added to the limitations of this study which are the diet, the brushing skill, the oral hygiene care supervised by the parents, individual salivary flow and pH. These aspects should be considered in further study.

6. Conclusion



Five percent fluoride varnish with ACP significantly reduced carious progression on partially erupted first permanent molars of high caries risk children at six months. Application of fluoride varnish on newly erupted molars as soon as accessible yield more benefit than waiting until the teeth are fully erupted then perform the pit and fissure sealant. Therefore, fluoride varnish application is an effective practical preventive measure for reducing caries progression on partially erupted first permanent molar in high caries risk children.

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8. References

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