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Preventive effect of adhesive tape supplemented with NaF on enamel erosion in vitro

조선대학교 대학원

치의학과

Le Huy Thuc My

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불소함유 접착테잎의 법랑질 침식 예방효과

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치 의 학 과

Le Huy Thuc My

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지도교수 이상호

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조선대학교 대학원

치의학과

Le Huy Thuc My

Le Huy Thuc My 의 석사학위 논문을 인준함

위원장 조선대학교 교 수 이난영 인

위원 조선대학교 교 수 장현선 인

위원 조선대학교 교 수 이상호 인

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조선대학교 대학원

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Abstract

Preventive effect of adhesive tape supplemented with NaF on enamel erosion in vitro

Le Huy Thuc My, D.D.S.
Advisor: Prof. Le Sang Ho, PhD
Department of Pediatric Dentistry
Graduate School of Chosun University

The effect of adhesive tape supplemented with sodium fluoride products in preventing dental erosion was studied. Sound bovine teeth samples were selected and randomly divided into 4 groups according to material treatments as follows: group 1: APF gel; group 2: fluoride varnish; group 3 and 4: fluoride tape supplemented with 5% NaF in methyl cellulose or poly vinyl alcohol carrier and then were soaked in artificial saliva for 24 hours. The following day, all specimens were submitted to alternate cycles of acid exposure in Cola beverage (pH 4.3) and artificial saliva 6 × 5 min/day for 5 days. Hardness values were recorded each day and lesion depth values were measured at the end of the 5^{th} day. Hardness values of experimental sides of group 2, 3 and 4 were significantly higher than those of their control sides and experimental side of group 1 during experiment ($p< 0.05$) except for the 5^{th} day. Regarding the erosion depth lesion, treatment group 2, 3 and 4 with fluoride varnish, fluoride tape increased the resistance of enamel surfaces from mineral loss significantly ($p<0.05$) compared to group 1 and their control sides. There were no statistically significant difference between group 2, 3 and 4. In conclusion, the present study showed that fluoride varnish and our fluoride adhesive tapes were effective in reducing erosion progression. Therefore, these products can be recommended clinically as prophylaxis for patients who are more susceptible to erosion.

국문초록

불소함유 접착테잎의 법랑질 침식 예방효과

레휘떡마이
지도교수: 이상호
소아치과
조선대학교 대학원

본 연구는 불소함유 접착테잎의 법랑질 침식 예방효과를 평가하였다. 건강한 소의 전치를 선정하여 아크릴 주형에 매몰하였다. 각 샘플은 정중선에 형성된 홈으로 대조군과 불소 제제를 도포할 실험군을 나눴다. 시편을 무작위로 18 개씩 4 군으로 나누였다. 1 군은 APF gel 를 도포하며, 2 군은 불소 바니쉬를 도포하며, 3 군과 4 군은 5% NaF 를 첨가된 methyl cellulose 나 poly vinyl alcohol 테잎을 부착하고 인공타액에 24 시간 보관한후 콜라에 5 분 증류수에 10 분씩 6 회 번갈아 처리하며 5 일 동안 반복하였다. 매일 미세경도계를 이용하여 표면미세경도를 측정했다. 5 일후 각 시편을 절단하고 침식병소의 깊이를 측정했다. 다음과 같은 결과를 얻었다.

1. 미세경도 값에대해 5 일만 제외하여 2 군, 3 군, 4 군의 실험군이 2 군, 3 군, 4 군의 대조군과 1 군의 실험군보다 더 컸다 ($p< 0.05$). 3 군과 4 군사이에는 유의성있는 차이가 없었다 ($p> 0.05$). 1 군의 실험군과 대조군은 유의차가 없었다 ($p> 0.05$).
2. 침식병소의 깊이에대해 2 군, 3 군, 4 군의 실험군이 2 군, 3 군, 4 군의 대조군과 1 군의 실험군보다 더 컸다 ($p< 0.05$). 2 군, 3 군, 4 군의 실험군 사이에는 유의차가 없었다 ($p> 0.05$).

결론적으로, 본 연구의 결과로 미루어 보아 불소 바니쉬와 새로 개발된 불소함유 접착테잎은 침식 예방효과가 부명하게 보였다. 그래서, 이런 제품은 짐식에 감수한 환자에게 임상적인 예방법으로서 활용할 수 있는 가능성이 높다

Ⅰ. Introduction

Dental erosion has gained more attention from the dental community. Despite still few population-based surveys have been published, erosive defects are not a rare condition. In 1991, Lussi and Schaffner[1] reported that 29.9% of the young adults (26- 30-year-olds) had at least one severely eroded occlusal surface in Switzerland population. Facial and lingual erosion prevalence was lesser at around 3.6% to 13.2%[1]. In 2000, according to the National Diet and Nutrition Survey in UK, it was showed that 58% of 4-6-year-olds and 42% of 11-14- year-olds were affected by dental erosion[2]. In Saudi Arabia, the erosion problem is reported to be 34% and 26% among children and adolescent respectively[3] and an overall of 47% were reported in Ireland[4]. The frequency of erosion lesion seems increasing in population and should gain more concern.

The etiology of dental erosion was known as the frequent contacts between acids and the tooth surface. These frequent processes result in loss of dental hard tissue that is chemically etched away from the tooth surface without bacterial involvement[5-7]. The acids may originate from extrinsic or intrinsic sources. Considering the dramatically increased consumption of acidic foods like soft drinks and beverages in children and adolescents, it is suggested that these products would be causation. A number of studies already confirmed this relationship[8-12]. The erosive potential of these foods is not only dependent on their pH value but also on their titratable acidity, their mineral composition and the calcium-chelation properties[13-18].

The beneficial effect of fluoride for the prevention of dental caries is well recognized. Similar to its anti-cariogenic properties, fluoride application is suggested as a treatment option in preventing erosion. However, the role of fluoride on the prevention of dental erosion is still controversially discussing[19-23]. Some in vitro studies[24-27] have shown a limited erosion-inhibiting effect from topical fluoride treatment. These studies[27-30] carried out on the agents that have been selected over the years for caries prevention such as fluoride varnish, fluoride gel, oral toothpaste.

Efforts to find out the fluoride products that are more effective to prevent dental erosion still continue[25, 29, 30]. Bio-adhesive polymer which was used in drug delivery systems would be a suitable choice. This material was assumed that it could deliver high concentration of fluoride to the target in controlled release [31] and thus, would promote the formation of firmer and more poorly permeable remineralized surface. Furthermore, it is colorless, odorless, and gives better taste when applied and hence, it is easy to use for children who are not cooperative. In this study, the fluoride tapes containing 5% sodium fluoride in methyl cellulose carrier and poly vinyl alcohol carrier were used.

This study was carry out to investigate whether our new products- fluoride tapes would protect enamel from erosion in compared with APF gel and fluoride varnish.

Ⅱ. Materials and Methods

1. Sample preparation

Sound bovine permanent incisors free of caries and hypo-calcification were selected for this study. After extraction, the teeth were mechanically cleaned and disinfected in 70% alcohol. Crowns were sectioned from the roots and then vertically and horizontally sectioned with a diamond disc to produce enamel specimens (7 × 7 mm) from each crown (Fig. 1). Totally, 97 specimens were produced.

All these specimens were embedded in acrylic resin in moulds with the outer enamel surface exposed. The enamel surfaces of specimens were ground flat with a water-cooled grinding machine (Metpol-1, R&B Inc, Korea) using progressively finer grades of CC-400, 800, 1200 Cw paper (silicon carbide waterproof abrasive paper).

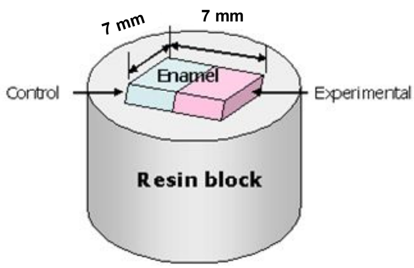

Fig.1. Schematic drawing of tooth section invested in resin block

Baseline surface micro-hardness analysis of the enamel blocks was recorded using a Shimadzu HMV-2 hardness tester with a Vickers diamond head under a 100-g load for 5 seconds. Three indentations spaced 100 µm for each other were made at the center of the enamel surface. Enamel blocks with baseline micro-hardness value between 230 and 300 VHN (Vickers's Hardness Number) were selected for this study.

2. Test materials

The specimens were treated with 2 new product fluoride tapes in comparison with commercially available anti-cariogenic products: fluoride gels- 60 seconds taste® (1,23% APF, Pascal Company Inc., USA) and fluoride varnish- Cavity Shield™ (5% sodium fluoride, Ominii Pharmaceuticals, USA) (Table 1).

Table 1. Fluoride products used in this study

Group	Product	Major composition	Manufacturer
1	60 seconds taste®	1,23% APF	Pascal company Inc., USA
2	Cavity Shield™	5% Sodium Fluoride	Ominii Pharmaceuticals, USA
3	Fluoride tape 1*	5% Sodium Fluoride	Test product
4	Fluoride tape 2**	5% Sodium Fluoride	Test product

* : fluoride tape supplemented with 5% NaF in methyl cellulose carrier

** : fluoride tape supplemented with 5% NaF in poly vinyl alcohol carrier

3. Erosive agent and artificial saliva

The erosive soft drink Coca-Cola® was used as a demineralizing solution. Five bottles of 1.5 L each were taken from the same package in supermarket. The pH of each was 2.43 at room temperature measured by pH meter (PMH 210, Radiometer analytical SAS, Cedex, France).

The artificial saliva used was similar to that described by McKnight-Hanes and Whitford[32], but it was modified by the exclusion of sorbitol and Methyl-p-hydroxybenzoate. It contained (in g/L): Sodium carboxymethyl cellulose sodium, 10.0; KCl, 0.625; $CaCl_2.2H_2O$, 0.166; $MgCl_2.6H_2O$, 0.059; K_2HPO_4, 0.804; KH_2PO_4, 0.326. The first component was used to simulate the protein and mucin contents of the natural saliva and increased the viscosity of this artificial saliva, while the other constituents provided the inorganic components at levels comparable with that of natural saliva. The pH was adjusted to 7 using NaOH.

4. Experiment procedure

Every selected block was divided into 2 sides- control and experimental side by a shallow groove in the center of enamel specimens using 1/4 round diamond bur (Fig. 1). With respect to the treatment products, these samples were randomly distributed into 4 groups with the experimental sides treated as following: (1) Group 1 (n = 18) was applied with fluoride gel by cotton pellet for 4 minutes without rubbing motion and washed with artificial saliva; (2) Group 2 (n = 18) was blasted and painted with a thin layer of fluoride varnish and allowed to dry for 1 minutes; (3) Group 3 (n = 18) was treated with fluoride tape made by methyl cellulose containing 5% NaF; and (4) Group 4 (n = 18) was treated with fluoride tape made by poly vinyl alcohol containing 5% NaF. fluoride tape was attached to enamel by wetting with artificial saliva and let it aside for 1 minute.

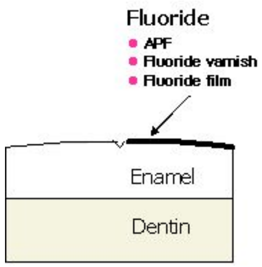

Fig.2. Cross-section of specimen

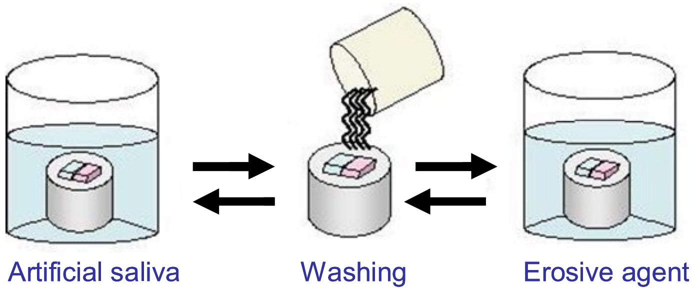

Fig.3. Experiment processing

After treating, all specimens were stored for 24 hours in artificial saliva solutions which were changed every day during experiment. The following day, cycling between artificial saliva and erosive agent challenge solutions began. The cycle comprised: (1) rinsed specimens in distilled water; (2) soaked in Coca-Cola® for 5 minutes, pH 2.43, room temperature; (3) washed in distilled water and (4) immersed in artificial saliva for 10 min to stimulate remineralizing (Fig. 3). The beverage was changed every 3 cycles. The containers were put on the lid and were kept under continuous agitation during experiment to simulate the movement of saliva under influence of tongue, lip, buccal. Teeth were cycled between artificial saliva and erosive agent exposure 6 times per day in consecutive 5 days. After the initial application of the fluoride, no further applications were used during experiment.

5. Measurement of microhardness

Micro-hardness tester (HMV-2, Shimadzu Co., Japan) with a Vickers diamond head under a load of 100 g force in 5 seconds was used to determine possible changes in surface micro-hardness during experiment. The measurements were made initially, after erosion exposures of every experimental day. Three well-formed indentations were measured to calculate the mean Vickers hardness number for each test and control surface. In the cases where remnants of varnish were observed in the optical microscope mounted on the hardness tester, care was taken not to make the indentations on such areas.

6. Measurement of erosion depth

At the conclusion of 5 days test period, specimens were sectioned to the thickness of 0.5 mm by low speed diamond blade (Model 650, South Bay Technology, USA). Every section included the experimental and control side. Then further reduction to the thickness of about 100 μm was accomplished by grinding machine (Metpol-1, R&B Inc, Korea) using progressively finer grades of CC- 800, 1200 silicon carbide abrasive paper. All these procedures were cooled properly by water.

Sections were washed with deionized water and oriented longitudinally on glass slides. The sections were imbibed with water (refractive index 1.33) for evaluation under polarized light microscopy (Zeiss, Germany). The lesion images were captured and examined using a Axioskop 2 plus program (Express, Media-cybernetics Co., USA). Lesion depth for each section (in µm) was taken as the average of three respective measurements from the imagined line connecting two intact points on the surface to the bottom of the lesion.

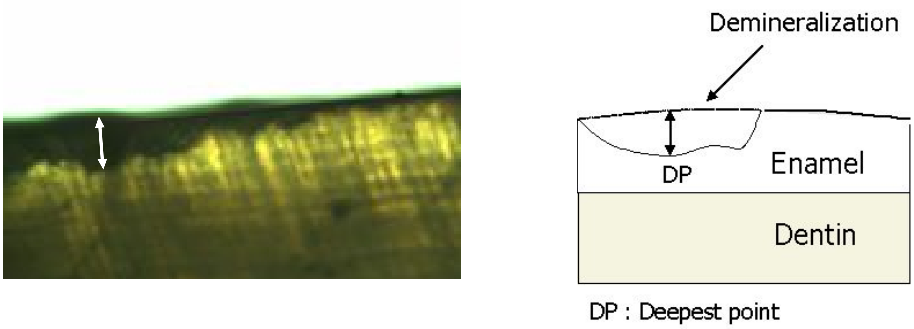

Fig.4. Measurement of lesion depth in cross-sectioned specimen

7. Statistical analysis

The statistical procedures were performed with the SPSS 12.0. The average erosion depth and Vickers hardness values observed on every specimen in four groups were analyzed for differences using analysis of variance (ANOVA). The comparisons among individual groups were performed using Turkey's post-hoc test. The level of significance was set at 0.05

Ⅲ. Results

1. Microhardness value

The mean surface hardness and standard deviation values at baseline (before fluoride treatment), and after every acid agent exposure day for each experimental group were summarized in Table 2. Statistical comparisons between control and its experimental groups and among the experimental groups in connection with the processing duration were displayed in Table 3.

With respect to its control side, group 2 was found having noticeable erosion-inhibiting ability even after the first experiment day ($p < 0.05$). Group 2, 3 and 4 revealed their considerable effect from the 2nd day and continuously until the 4th day ($p<0.05$). On day 5, there were no significant differences between experimental and control sides in all groups ($p > 0.05$). Group 1 had similar values to its control side in all 5 days ($p > 0.05$).

Observing the change in micro-hardness value among groups, group 2, 3, 4 remained at the much higher hardness numbers compared with group 1

Table 2. Vickers hardness number (VHN) of each group according to the processing duration.

Group	Baseline	After acid exposure				
		1st day	2nd day	3rd day	4th day	5th day
1	270.63 ± 15.71	137.91 ± 21.99	121.16 ± 15.85	107.80 ± 12.45	98.88 ± 10.68	90.78 ± 8.38
2	270.62 ± 18.80	190.44 ± 35.97	162.08 ± 20.63	136.47 ± 16.11	119.82 ± 15.24	96.41 ± 13.87
3	270.73 ± 17.49	151.62 ± 14.49	138.20 ± 12.78	121.93 ± 11.51	111.13 ± 9.43	100.64 ± 11.21
4	270.70 ± 19.66	149.93 ± 19.42	138.00 ± 15.54	121.38 ± 18.57	113.17 ± 18.89	98.02 ± 16.29
p value	1.000	0.000	0.000	0.000	0.000	0.135

Values represent the mean ± SD

(p<0.05) through out the first 4 days. Thereafter, on day 5, their hardness values were still higher than group 1 but no significant differences were observed (p> 0.05). Group 2, in comparison with group 3 and 4, showed its stronger effect in first 3 days (p< 0.05). Group 3 and 4 had similar hardness value during the experiment (p> 0.05). On the day 5, the hardness values were as following: group 3 > group 4 > group 2 > group 1, difference without statistical significance (p> 0.05).

Table 3. Comparison of Vickers hardness number (VHN) between groups at day 0/1/2/3/4/5.

	Control	Group 1	Group 2	Group 3	Group 4
Control		-/-/-/-/-/-	-/+/+/+/+/-	-/-/+/+/+/-	-/-/+/+/+/-
Group 1			-/+/+/+/+/-	-/+/+/+/+/-	-/+/+/+/+/-
Group 2				-/+/+/+/-/-	-/+/+/+/-/-
Group 3					-/-/-/-/-/-
Group 4					

* -: Not statistically significant (p> 0.05)

+ : Statistically significant (p< 0.05)

Day 0: before fluoride treatment.

1st, 2nd, 3rd, 4 th, 5th day: after every acid exposure day.

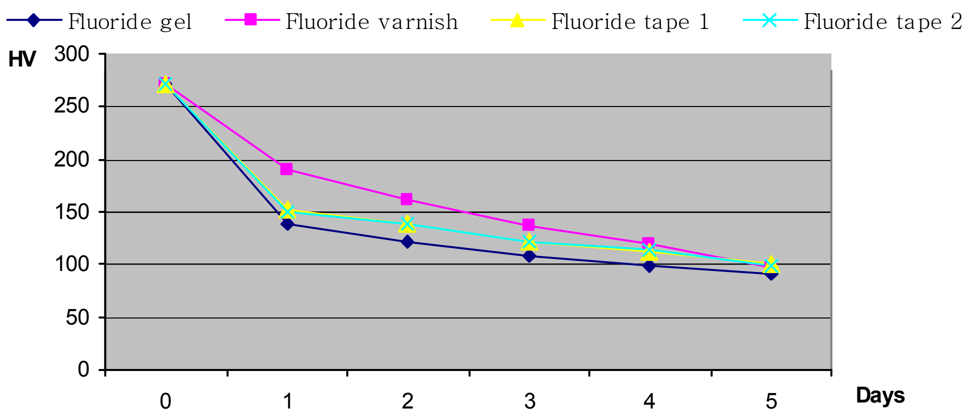

Fig.5. Comparison of micro-hardness number (VHN) in 4 groups

2. Erosion depth value

The erosion depth and standard deviation values were displayed in table 4.

Treatment group 2, 3 and 4 with fluoride varnish, fluoride tape increased the resistance of enamel surfaces from mineral loss considerably ($p<0.05$) compared to group 1 and their control sides. There were no statistically significant difference between group 2, 3 and 4 ($p> 0.05$). The lesion depth value in experimental side of group 1 was not much lesser than its control side ($p> 0.05$).

Table 4. Comparison of erosion depth value (μm) between control and experimental side of each sample among groups

Group	N	Control side	Experimental side	p- value
1	16	2.20 ± 0.63	1.82 ± 0.52[a]	0.068
2	14	2.33 ± 0.99	1.05 ± 0.42[b]	0.000
3	16	1.86 ± 0.74	0.99 ± 0.49[b]	0.000
4	17	1.91 ± 1.10	0.89 ± 0.26[b]	0.001

Different letters (a, b) indicate significant differences ($p<0.05$)

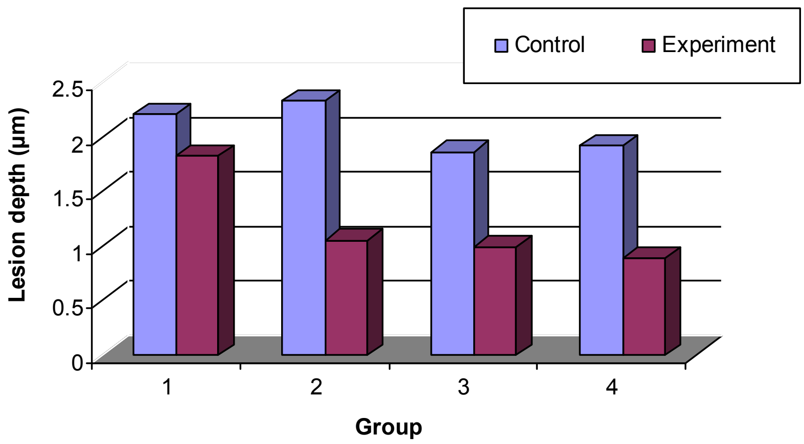

Fig.6. Comparison of erosion depth (μm) between control and experimental side of each sample among groups

IV. Discussion

Surface hardness measurements have been used in many studies to obtain information on enamel softening related to acid induced lesion[12, 24, 26-28, 30]. It is known as a useful method in assessing the initial stages of erosion when enamel softening starts. This study used hardness tester to observe the softening process during 5 days experiment. At the conclusion of day 5, erosion depth values were measured to get knowledge of tooth material loss after immersion periods.

Based on the experiment results, it is clearly revealed that topical fluoride treatment with concentrated sodium fluoride varnish and fluoride tapes inhibited enamel surface softening during the acid exposure and, thus, was able to protect enamel from erosion in initial stages of process. Therefore, these products can be recommended clinically as prophylaxis for erosion patients.

In mean terms for sample side pre-treated with acidulated gel at each time point, the Vickers hardness number was always lesser than its control side, but the differences were small ($p > 0.05$). Besides, its lesion depth results displayed a lesser depth of erosion lesion compared with its control side ($p > 0.05$). It can conclude that the acidulated gel can reduce erosion but the actual clinical benefit appears low. Huges[21] also reported the low benefit of acidulated gel.

Our results were in agreement with conclusions drawn by Sorvari et al.[24] that topical fluoride varnish treatment was able to protect enamel during the initial stages of the erosion process. The study by Kitchens and Owens[20], however, did not demonstrate a significant protective influence of fluoride treatment varnish on enamel surfaces. This was because the acid challenge was so severe- up to 350 hours (14 days) which was comparable to 14 years of normal beverage consumption and the sample size was small.

Topical fluoride treatment would maintain its effect for certain duration. Immersion of the fluoride pre-treated enamel surface into acidic beverage in

14 consecutive days could hardly manifest its effect[20]. Even in caries prevention, generally, fluoride application was recommended 2 intervals per year. Therefore, anticipating the effect of fluoride in such long term is unreasonable.

The study of Sorvari et al. [24] mentioned the time of effect as the enamel surfaces were exposed to cola beverage totally for 15 minutes. Until the end of the experiment (after 15 min), fluoride varnish and fluoride solution still protected the enamel surface from softening effectively. Even after shorter application of fluoride gel or toothpaste, a significant rehardening effect of fluoride has been shown[26-28, 33-34]. However, how long the effect does exist still a question. In the present study, fluoride varnish and fluoride tapes were shown to be able to limit erosion until the forth day of experiment equivalent to 120 min (2 hours) exposure to cola beverage.

According to von Fraunhofer and Roger[35], average daily consumption of soft drink in one person in US was 24 ounces (two 12 ounce cans) and a residence time in the mouth was about 20 seconds (before salivary clearance), This resulted in an annual exposure of enamel to soft drinks of approximately 25 hours per year. The period time of 120 min was comparable to 1 month of normal soft drink consumption in US. The fluoride varnish and our products, consequently, were able to inhibit the enamel surface from loss of mineral effectively in 1 month if the average daily consumption of soft drink in one person was 24 ounces (or 710 ml).

It must notice that this experiment was done on bovine teeth, which had morphology difference to that of human such as higher porosity[36, 37]. This would result in higher rates of lesion formation. If this issue was taken into account when interpreting the results, the actual protective time would be lengthened.

In this experiment, acidic challenges were performed 6 times × 5 min per day. This setting was not excessive compared to normal daily routine.

Meurman et al.[31] reported that the pH of the oral fluids usually returns to neutral conditions 1-3 min after one single sip of an acidic beverage. In some cases the pH of oral fluid recovers only to values around 4.0 within 10 min[39]. Millward[40] showed that after dietary acid intake, pH values were slowly recovered to pH 5.5 within 2 min at the incisor site and in 4-5 min at the molar site. In addition, if a person could intake 100 ml in his one sip, 6 times of consuming 710 ml beverage would be easily to reach. Together with the intake time of acidic foods, an experimental immersion time of 5 min 6 times daily seems to be close to normal condition.

The role of fluoride in preventing erosions still remains unclear. Under the erosion condition, the acidic challenge is much stronger so that enamel is lost layer by layer from the surface. This irreversible process differs fundamentally from that of a subsurface demineralization in dental caries[41, 42]. For that reason, fluoride application is assumed to perform for different purpose. According to Imfeld, the effect of fluoride is primarily to harden the enamel surface and thus, reduce its solubility under severe acidic condition. Low fluoride concentrations serve better for the purpose of remineralizing the deep subsurface in caries as it does not block enamel pores and facilitates the ion exchange activity to the deeper layer. Contrarily, in case of erosion, low fluoride concentration can not show its effect. It is believed that application of high fluoride concentration promotes the formation of a more poorly permeable remineralized surface but only a thin layer is involved[42]. In the presence of high fluoride concentration, brushite was formed instead of calcium fluoride (CaF_2)[43].

In present experiment, Cavity Shield® varnish and fluoride tapes contained higher concentration of fluoride than APF gel and displayed better protective effect. On the first 3 days, Cavity Shield® varnish performed its role best but then, its effect decreased to a similar level of fluoride tapes. Sorvari[24] suggested that fluoride varnish may have double action. The varnish layer itself was observed very sticky and very hard to remove from enamel[44, 45], and may act as a barrier against erosion. This explained the markedly well performance of varnish during first stages of experiment but then rapidly decreased in the day 4 and 5 due to the resin layer was completely dissolved.

Bio-adhesive polymer has been traditionally used in drug delivery systems. This material was reported to be able to deliver specific release rates of drug to its target[31)]. We suggested applying this special characteristic in dentistry. Fluoride tapes containing 5% sodium fluoride in methyl cellulose and poly vinyl acetate carrier were produced for this purpose. High concentration of fluoride was assumed to be delivered to the enamel surface in controlled release. We also expected more fluoride products would be permanently bound to dental enamel due to its controlled release rate ability favorable for deeper penetration of fluoride product. The results showed that these products performed rather well if taken into account for the whole experimental process. The last result numbers were better for these products even though no significant difference were found. In addition, these products are colorless, odorless and give better taste when applied. These advantages make them easier to indicate for children who are not cooperative.

In conclusion, the present study has shown that fluoride varnish and our fluoride adhesive tapes are effective in reducing erosion progression on enamel surface. Therefore, these products can be recommended clinically as prophylaxis for erosion patients. Further research is needed to evaluate the effective application and appropriate time intervals that can gain best benefit to patients.

V. Conclusion

The effect of adhesive tape supplemented with sodium fluoride in preventing dental erosion was investigated. Study included 4 groups according to material treatments as following: group 1: APF gel; group 2: Cavity Shield® varnish; group 3 and 4: fluoride tape supplemented with 5% NaF in methyl cellulose or poly vinyl acetate carrier. Following results were obtained:

1. Hardness values of experimental sides of group 2, 3 and 4 were significantly higher than those of their control sides and experimental side of group 1 over experimental period ($p < 0.05$) except for the 5th day. Group 3 and 4 had similar hardness value during the experimental period ($p > 0.05$). Group 1 had similar values to its control side ($p > 0.05$).
2. With regard to erosion depth lesion, treatment group 2, 3 and 4 with fluoride varnish, fluoride tape increased the resistance of enamel surfaces from mineral loss significantly ($p<0.05$) compared to group I and their control sides. There were no statistically significant difference between group II, III and IV ($p < 0.05$).

In conclusion, the present study showed that fluoride varnish and our fluoride adhesive tapes were effective in reducing erosion progression. Therefore, these products can be recommended as clinically prophylaxis for erosion patients.

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저작물 이용 허락서

학 과	치의학과	학 번	20077787	과 정	석사
성 명	한글: 레휘떡마이 영문: LE HUY THUC MY				
주 소	501-759 광주광역시 동구 서석동 375 조선대학교 치과대학 소아치과				
연락처	E-MAIL: myhtlee @gmail.com				
논문제목	한글 : **불소함유 접착테잎의 법랑질 침식 예방효과** 영문: Preventive effect of adhesive tape supplemented with NaF on enamel erosion in vitro.				

본인이 저작한 위의 저작물에 대하여 다음과 같은 조건 아래 -조선대학교가 저작물을 이용할 수 있도록 허락하고 동의합니다.

- 다 음 -

1. 저작물의 DB 구축 및 인터넷을 포함한 정보통신망에의 공개를 위한 저작물의 복제, 기억장치에의 저장, 전송 등을 허락함

2. 위의 목적을 위하여 필요한 범위 내에서의 편집・형식상의 변경을 허락함.
다만, 저작물의 내용변경은 금지함.

3. 배포・전송된 저작물의 영리적 목적을 위한 복제, 저장, 전송 등은 금지함.

4. 저작물에 대한 이용기간은 5 년으로 하고, 기간종료 3 개월 이내에 별도의 의사표시가 없을 경우에는 저작물의 이용기간을 계속 연장함.

5. 해당 저작물의 저작권을 타인에게 양도하거나 또는 출판을 허락을 하였을 경우에는 1 개월 이내에 대학에 이를 통보함.

6. 조선대학교는 저작물의 이용허락 이후 해당 저작물로 인하여 발생하는 타인에 의한 권리 침해에 대하여 일체의 법적 책임을 지지 않음

7. 소속대학의 협정기관에 저작물의 제공 및 인터넷 등 정보통신망을 이용한 저작물의 전송・출력을 허락함.

2009 년 5 월

동의 여부: 동의 (0) 조건부 동의( ) 반대 ( )

저작자: LE HUY THUC MY (서명 또는 인)

조선대학교 총장 귀하

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Recent advances in technology have made great changes in dentistry. Disease relating to the variation of the environment and the alteration in human behavioral habit create more challenge to dentist. All force the dentist to continuously enrich themselves to be confident when facing such varied difficult cases. In that stream, I nurtured my wish to be a good dentist. I have worked for foreigner clinic in Vietnam and been contacted with modern equipments. However, experiences by cases and solving them appropriately were only achieved in big hospital. Thank you for relationship between my university and Chosun university that I got this good chance of coming here and spending such experience. Above all, I would like to express my sincere gratitude to professor Lee Sang Ho, my major advisor, who gave me permission to enter Chosun university and helped me to finish this thesis. He also supported finance for me and guided me during the time I studied here.

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